UEAA NEWSLETTER

2026, No. 1

Bucharest, January, 2026

LATEST NEWS

WoodInnovate – Innovative Uses of Bark Beetle-Damaged Wood

Across the Alpine–Adriatic region, forests are feeling the pressure of climate change. Warmer temperatures and longer dry periods have fueled bark beetle outbreaks, leaving large areas of damaged forest and creating serious challenges for forest managers and the wood-processing sector. What is often seen as a loss, however, also holds untapped potential.

The Interreg VI-A Italy–Slovenia project **WoodInnovate** (1. 6. 2025 – 31. 5. 2027) focuses on practical, science-based solutions to give bark beetle-damaged wood new value and to strengthen a resilient, circular forest–wood value chain across borders.

By bringing together research institutions and industry clusters from both countries, WoodInnovate aims to transform excess, low-value timber into innovative products, support sustainable forest management, and help the sector adapt to a changing climate.

Project partners

- University of Ljubljana, Biotechnical Faculty (SI) – Lead Partner
- Slovenian Forestry Institute (SI)
- Wood Industry Cluster Slovenia (SI)
- Legno Servizi Forestry Cluster FVG (IT)
- Wood Furniture Home Cluster FVG (IT)

Bark beetles (Figure 1) colonise spruce trees in symbiosis with ophiostomatoid fungi (Figure 1), which cause the characteristic blue to grey discolouration known as blue stain. Although blue staining significantly reduces the visual and commercial appeal of timber, detailed investigations show that its influence on material performance is selective rather than uniformly negative.

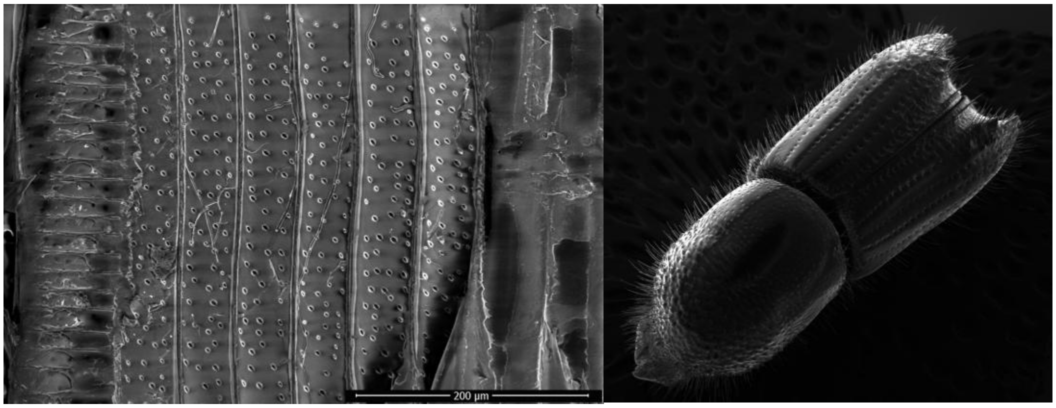

Figure 1: hyphae of symbiotic fungi growing in Norway spruce parenchyma cells (left) and bark beetle (right)

Experimental studies on Norway spruce demonstrate that the mechanical properties of blue-stained wood remain largely unaffected. Bending strength and compression strength are comparable to those of sound spruce wood, while only a moderate reduction in modulus of elasticity has been observed. This confirms that blue-stained timber can safely be used for many load-bearing and non-load-bearing applications from a structural point of view.

In contrast, the interaction with water is substantially altered. Blue-stained wood exhibits increased permeability, reduced contact angles, and significantly higher liquid water uptake during short-term and long-term immersion tests. These effects are attributed to fungal colonisation of pits and parenchyma cells, which opens new pathways for moisture transport. Importantly, vapour sorption behaviour remains comparable to non-stained wood, indicating that blue stain fungi do not fundamentally change the hygroscopic nature of the cell wall.

The increased wetting ability has direct consequences for durability. Blue-stained wood shows higher susceptibility to brown-rot fungi and a reduced resistance dose when evaluated using the Meyer–Veltrup service-life prediction model. As a result, the expected service life of untreated blue-stained spruce in above-ground outdoor applications can be approximately 30% shorter than that of reference spruce. However, the same increased permeability facilitates impregnation, hydrophobic treatments, and wood modification processes, offering clear opportunities for upgrading and protection.

WoodInnovate: Research-Based Valorization Strategies

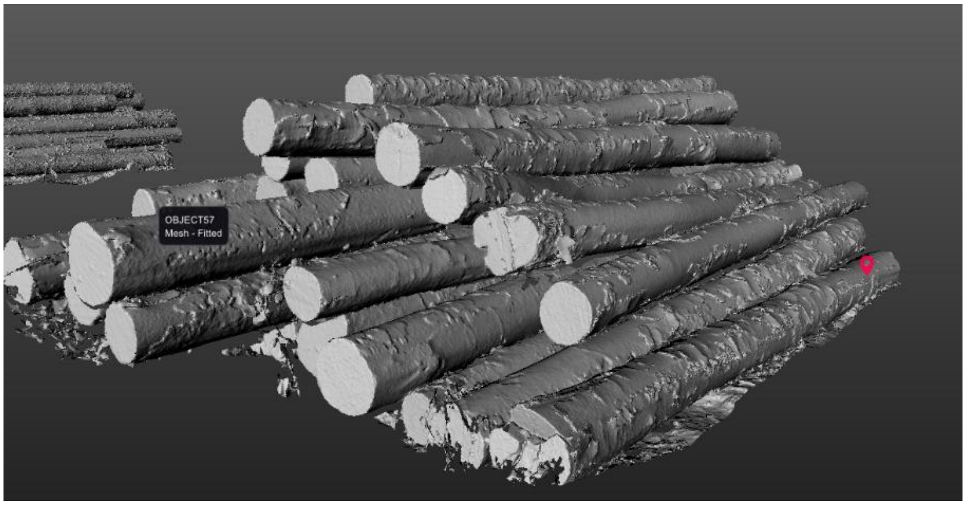

Figure 2. Experimental pile of logs

Building on this material understanding, WoodInnovate develops integrated solutions (Figure 2) that combine monitoring, processing, and design. Advanced non-destructive methods, such as moisture monitoring, acoustic measurements, resistance drilling, LiDAR scanning, and hyperspectral imaging, are used to rapidly assess the quality of bark beetle-damaged timber in storage yards and processing chains.

Figure 3. Cross sections of spruce logs and the visual appearance of the logs after nine months

The project emphasises the importance of harvesting time, storage conditions, and early moisture management. Results from recent field studies indicate that summer-felled and beetle-damaged logs are particularly vulnerable to fungal colonization (Figure 3) if moisture content remains above fibre saturation for extended periods. Consequently, WoodInnovate promotes early drying strategies, controlled storage, and real-time moisture monitoring as key measures to preserve wood quality.

Beyond assessment, the project demonstrates modification and processing techniques that enable the use of lower-grade timber for demanding applications, including urban furniture (Figure 4), façade elements, and semi-structural components. Pilot actions and demonstrators show how bark beetle-damaged wood can be transformed from a perceived liability into a resource that supports climate adaptation, resource efficiency, and regional innovation.

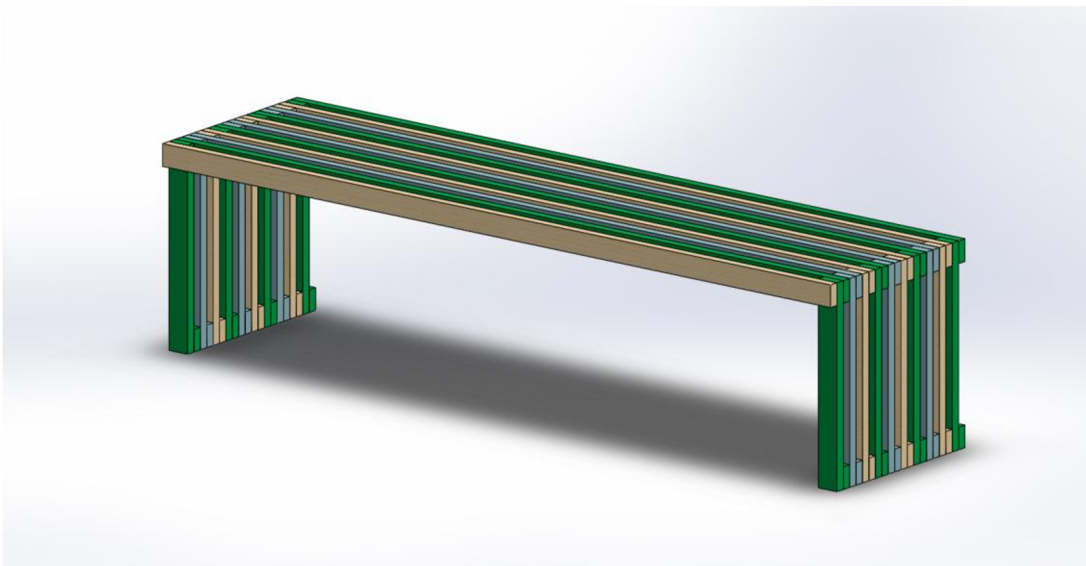

Figure 4. Design of the test-model bench used for demonstration of the application of bark-beetle-damaged wood in the urban environment in the future months

Through close cross-border cooperation among research institutions, industry clusters, and forestry stakeholders, WoodInnovate strengthens knowledge transfer, supports the uptake of innovation, and contributes to a more resilient and sustainable forest–wood sector in the Alpine–Adriatic region.

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