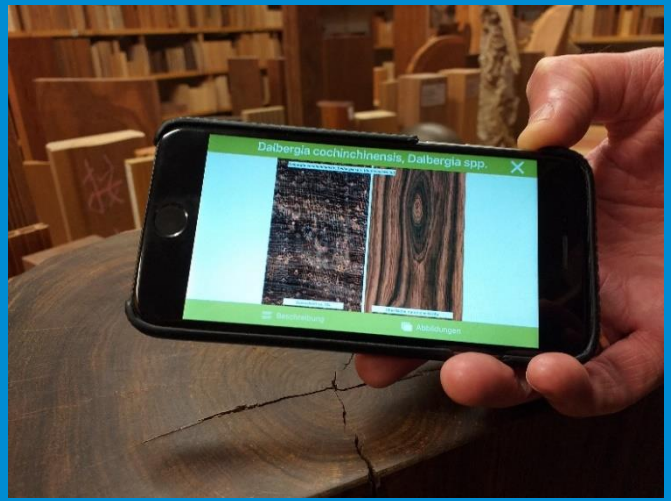
Thünen Institute of Wood Research
Research Unit: Quality of Wood and Wood Products

PD Dr. habil. Gerald Koch

Thuenen-Institute of Wood Research



Hamburg, 13.06.2023

Wood+_Summer School

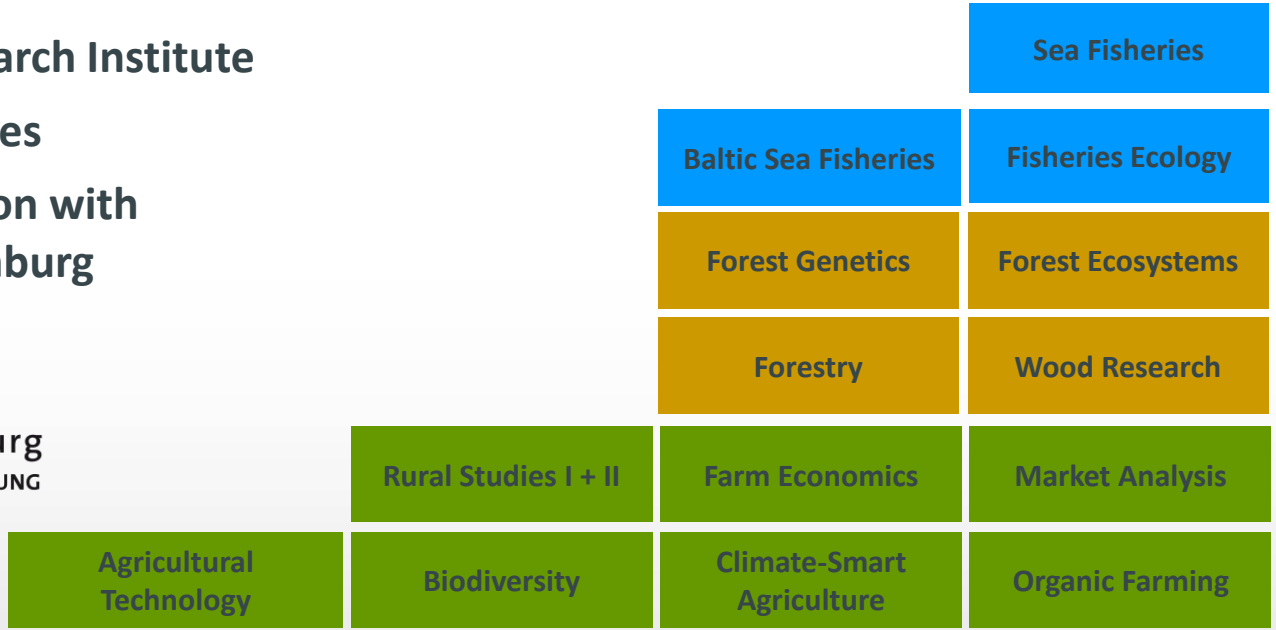
Thünen Institute - Federal Research Institute

THÜNEN

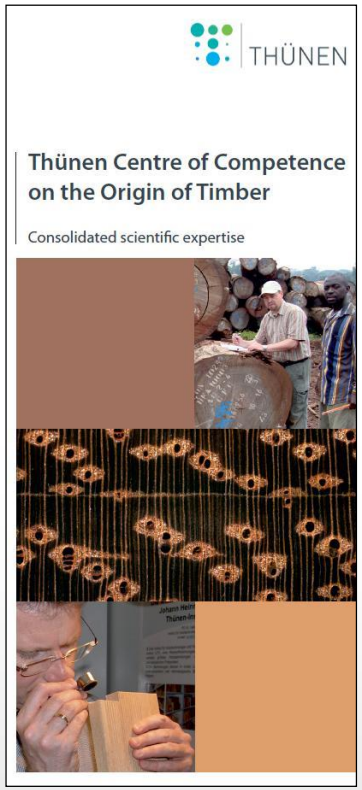
Federal Ministry of Food and Agriculture

- Federal German Research Institute
- 15 specialized Institutes
- Contracted cooperation with the University of Hamburg

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG



Thünen Centre of Competence on the Origin of Timber

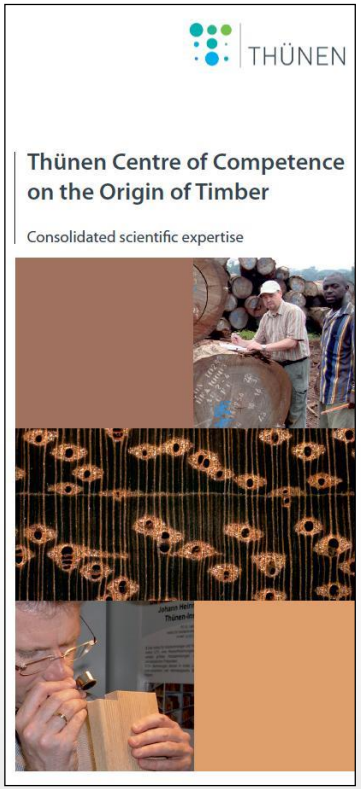


Participating institutes:

- Thünen Institute of Wood Research (TI-HF)
  - **- Macroscopic and microscopic wood identification**
- Thünen Institute of Forest Genetic (TI-FG)
  - **- Genetic identification of wood species and origin**
- Thünen Institute of Forestry (TI-WF)
  - **- Evaluation of certificates and timber market analyses**

Homepage: https://www.thuenen.de/en/thuenen-institute/compound-structures/thuenen-kompetenzzentrum-holzherkuenfte

Thünen Centre of Competence - Wood anatomy



Participating institutes: Thünen Institute of Wood Research (TI-HF)

Macroscopic and microscopic wood identification (1,077 reports in 2022)

Four permanent scientist


Dr. Andrea Olbrich


Dr. Immo Heinz


Dr. Volker Haag


PD Dr. Gerald Koch

Three scientific project members (currently)

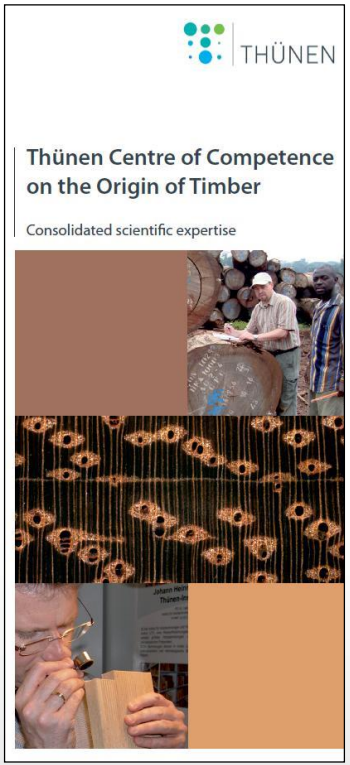

Dr. Stephanie Helmling


Jördis Sieburg-Rockel


Tim Lewandrowski

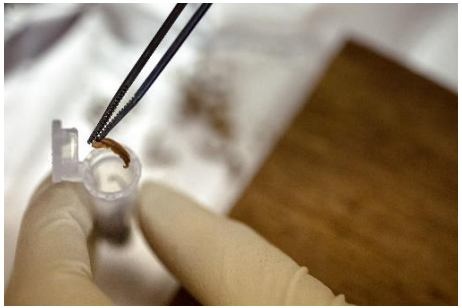
Five technical assistants with permanent positions

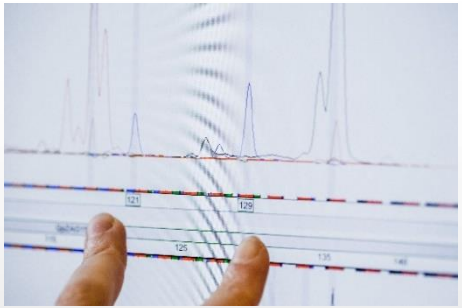
Thünen Centre of Competence - Forest Genetics

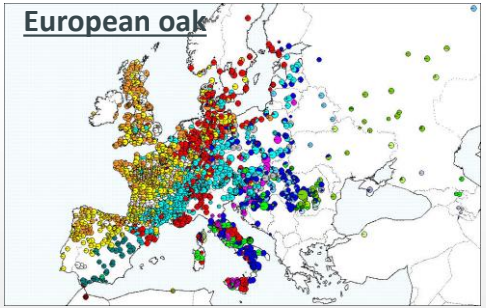


Participating institutes: Thünen Institute of Forest Genetics (TI-FG)

Genetic identification of wood species and origin







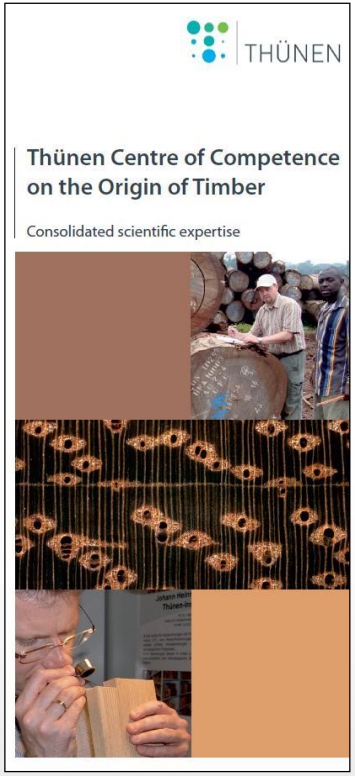
Permanent scientist

Dr. Hilke Schröder

Dr. Céline Blanc-Jolivet

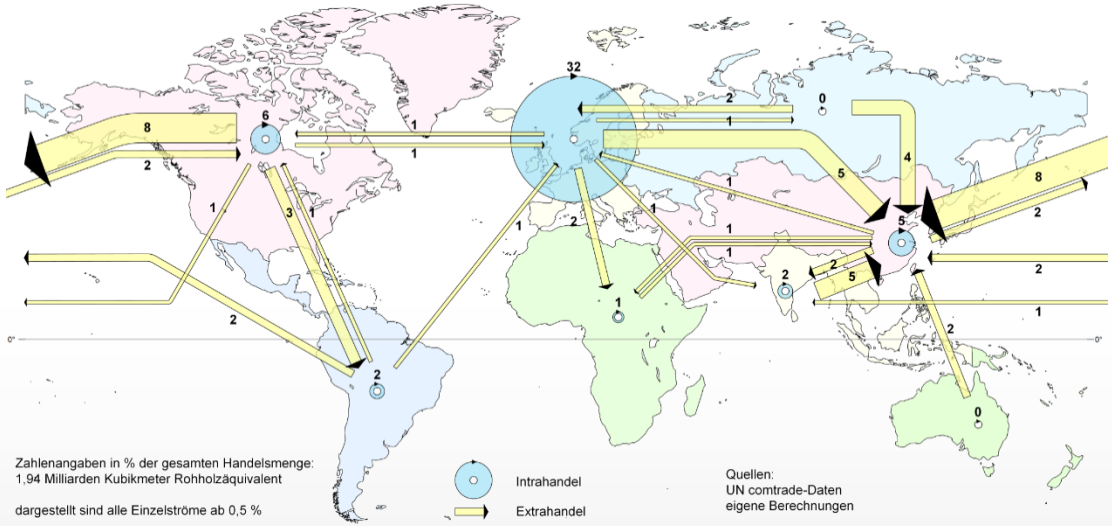
Genetic analyses of about 3,000 specimens regarding EUTR regulation since 2013

Thünen Centre of Competence - Forestry



Participating institutes: Thünen Institute of Forestry (TI-WF)

Evaluation of certificates and timber market analyses



Permanent scientist

Dr. Margret Köthke

Dr. Matthias Bösch

Global trade with wood products - Trade of world regions
Data describes shares of total global trade: 1.94 billion cubic metres roundwood equivalent

Thünen Centre of Competence - Scientific reports

Daily submissions of samples from the fields

- **Wood trade (approx. 75%)**
- **Customs and environmental agencies (approx. 20%)**
- **NGOs (approx. 3%)**
- **Private consumer (approx. 2%)**

Increasing identification of **lesser known species**, especially in products that are manufactured in Asia

Detailed market survey/observation of the internationally traded timber

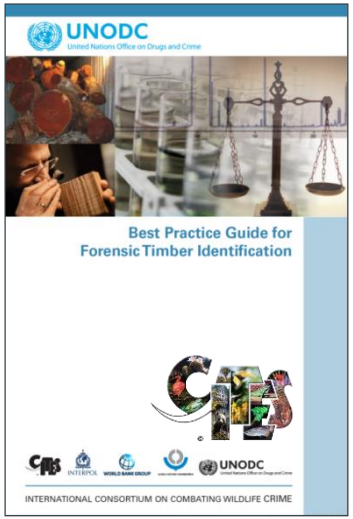
European Timber Regulation - (EUTR)

European Timber Regulation (EUTR)

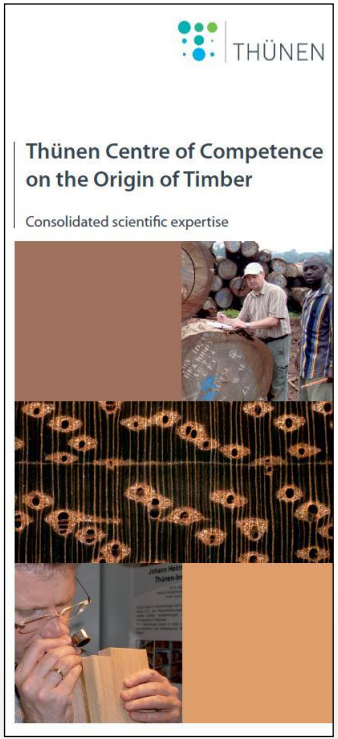
ANNEX

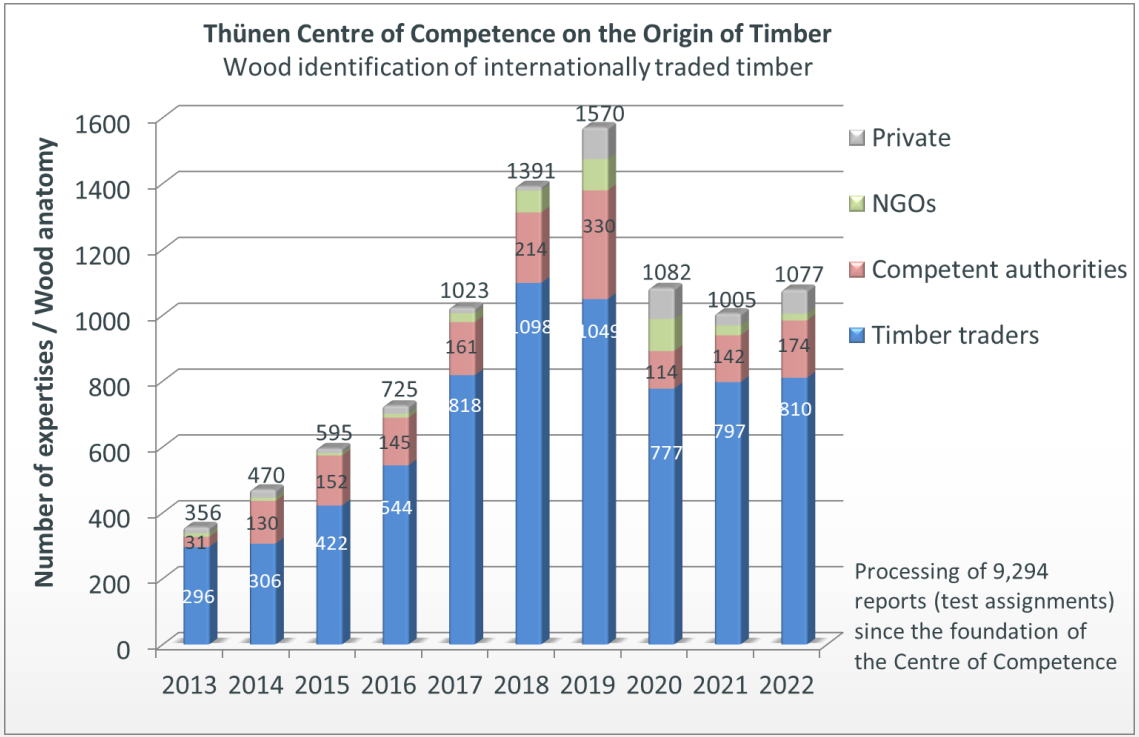
Timber and timber products as classified in the Combined Nomenclature in Annex I to Regulation (EEC) No. 2658/87

- 4401 **Fuel wood**, in logs, billets, pellets or similar forms;
- 4403 **Wood (solid)**, not stripped, stripped of bark or two- or four-sided trimmed;
- 4406 **Timber railway sleepers**;
- 4407 **Wood (sawn)** or chipped lengthwise with a thickness exceeding 6 mm;
- 4408 **Veneer sheets** for plywood or for similar laminated wood
- 4410 **Particle board**, "oriented strand board" plates and similar plates
- 4411 **Fibreboard of wood**, agglomerated with resins or other organic substances;
- 4412 **Plywood**, veneered panels and similar laminated wood;
- 4415 **Packing cases**, boxes, and similar packing's
- 940330, 940340, 94035000, 940360 and 94039030 **wood furniture**
- **Pulp and paper** of chapters 47 and 48 of the Combined Nomenclature



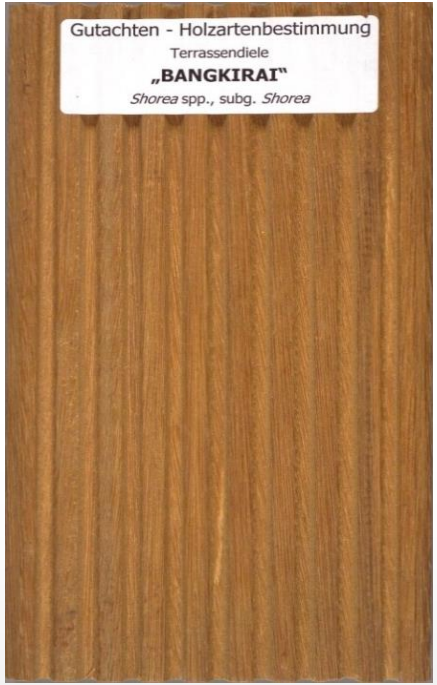
Thünen Centre of Competence - Evaluation of scientific reports

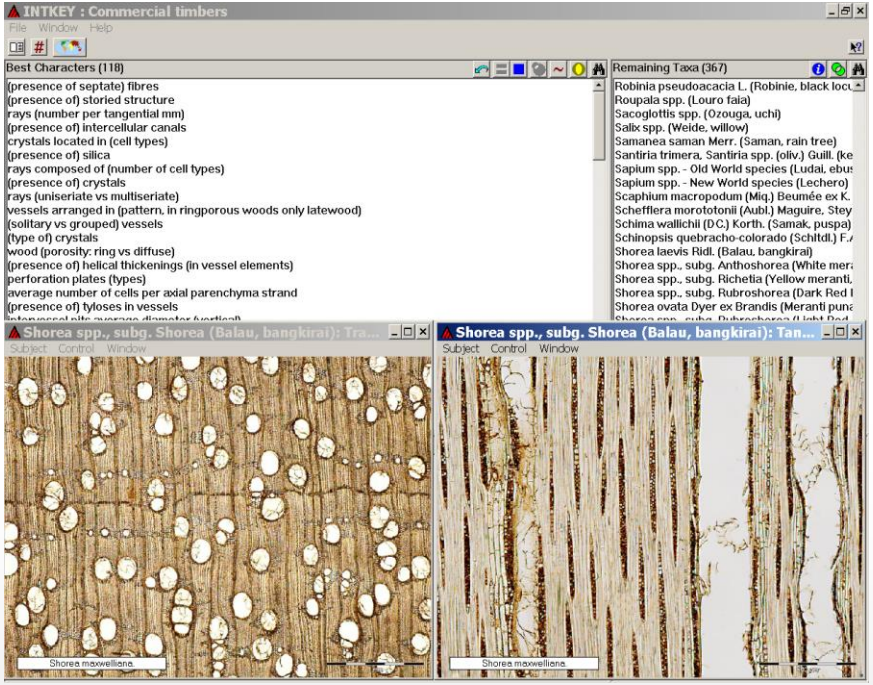




- Statistics (reports) on the service “wood identification” at the Institute of Wood Research since 2013

Microscopic wood identification - Database Commercial timbers





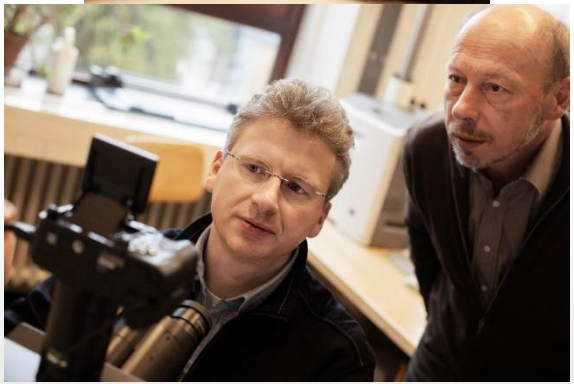
- Description and illustrations of **Bangkirai** for the microscopic wood identification

Wood anatomy - Microscopic wood identification

- **Microscopic analyses:** the standard method for wood anatomical description and identification of wood taxa (genera and species)

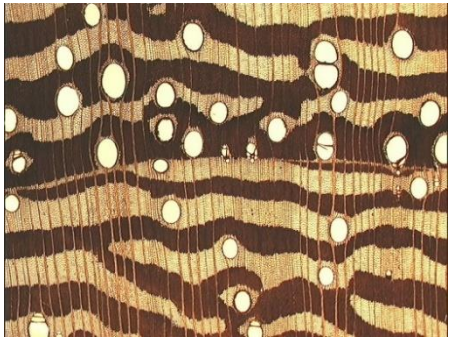
(© Ilja Hendel)

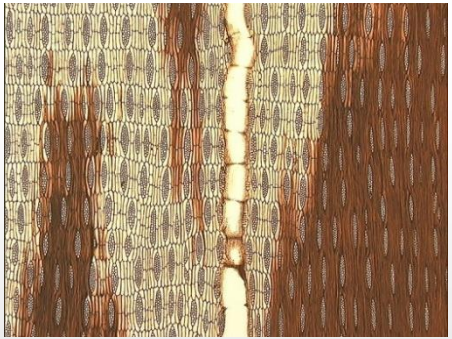
(© Ilja Hendel)



(© Ilja Hendel)

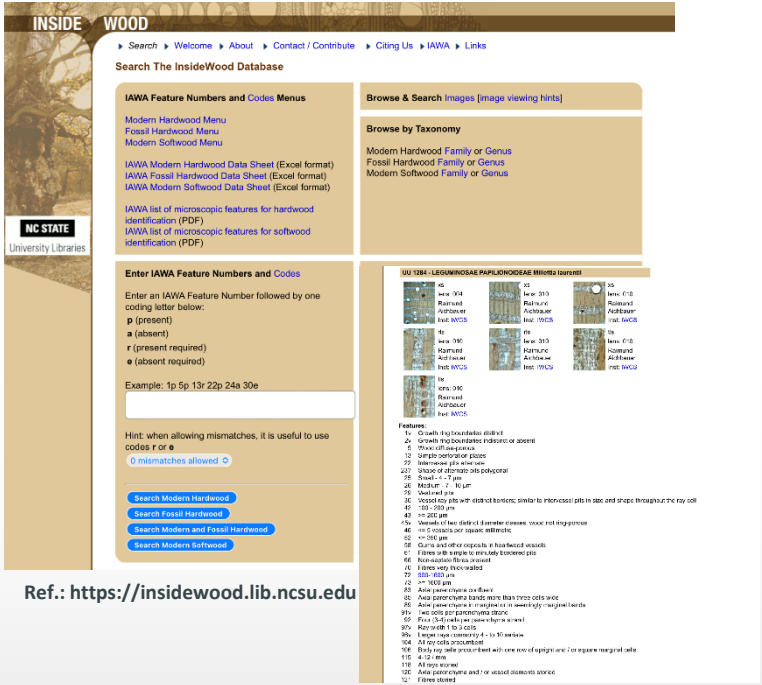
Wengé (*Millettia* sp.)





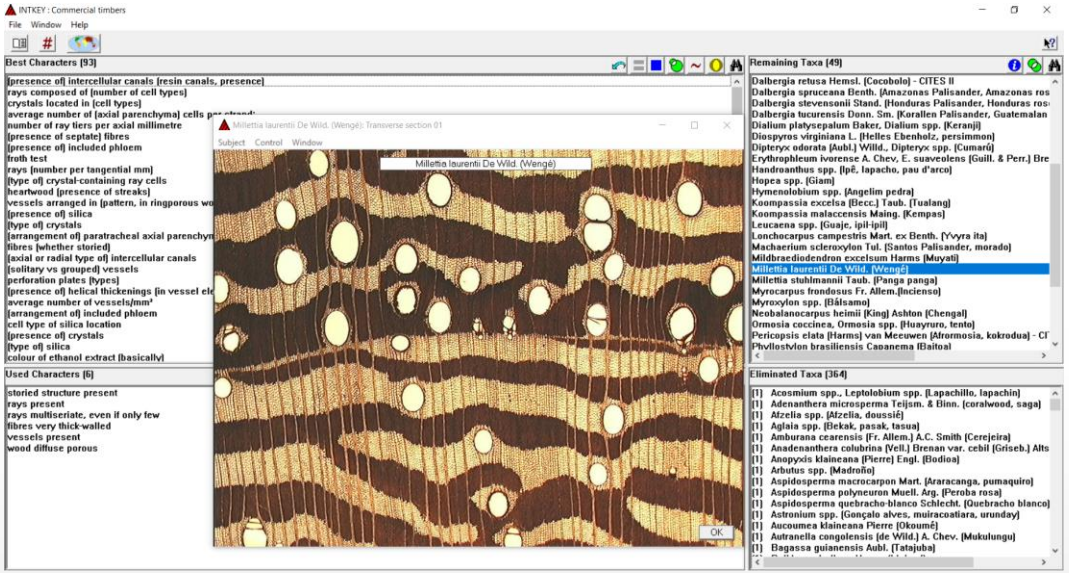
Wood anatomy - Access to digital databases worldwide

The database **InsideWood**



Ref.: https://insidewood.lib.ncsu.edu

The database **Commercial timbers**, delta-intkey system

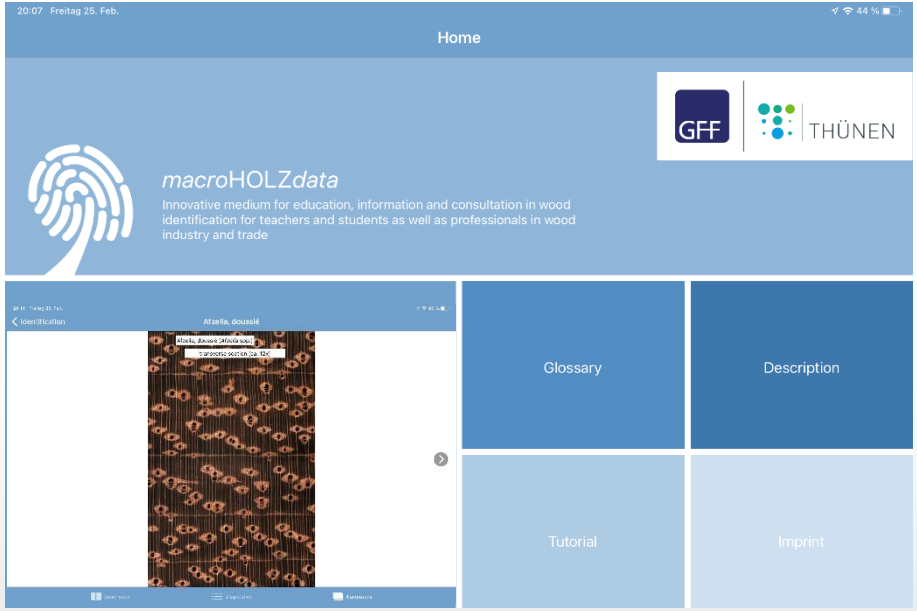


Ref.: https://www.delta-intkey.com/wood/en/index.htm

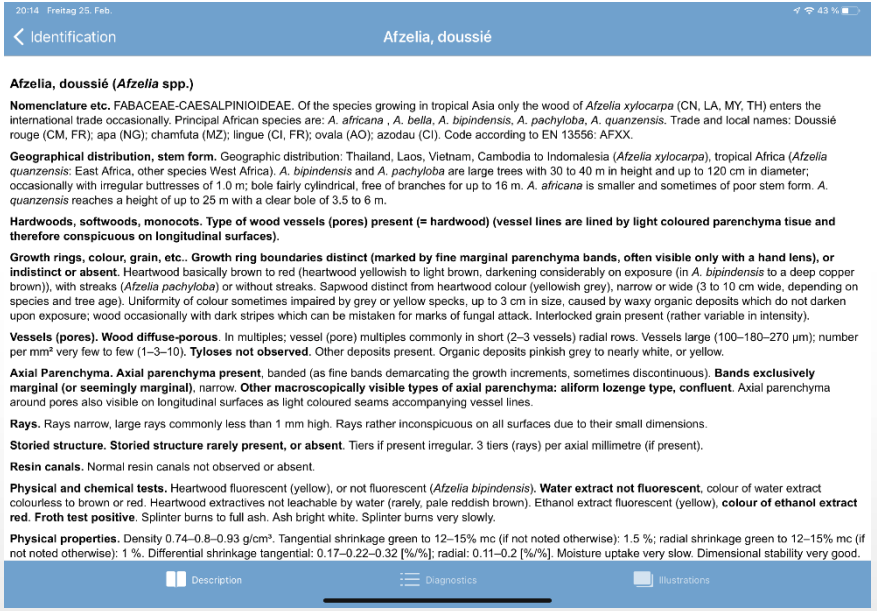
- Wood anatomical description of Wengé (*Millettia* sp.) according to the IAWA character list

Macroscopic wood identification - App macroHOLZdata

- **App macroHOLZdata**: descriptions, illustrations, identification, and retrieval of technical information: Innovative digital tool for **macroscopic wood identification** and **information retrieval** for educational facilities and professionals in wood industry and trade



Description of *Afzelia* sp. (Afzelia/Doussié)



Afzelia, doussié (*Afzelia* spp.)

Nomenclature etc. FABACEAE-CAESALPINIOIDEAE. Of the species growing in tropical Asia only the wood of *Afzelia xylocarpa* (CN, LA, MY, TH) enters the international trade occasionally. Principal African species are: *A. africana* , *A. bella*, *A. bipindensis*, *A. pachyloba*, *A. quanzensis*. Trade and local names: Doussié rouge (CM, FR); apa (NG); chamfuta (MZ); lingue (CI, FR); ovala (AO); azodau (CI). Code according to EN 13556: AFXX.

Geographical distribution, stem form. Geographic distribution: Thailand, Laos, Vietnam, Cambodia to Indomalesia (*Afzelia xylocarpa*), tropical Africa (*Afzelia quanzensis*: East Africa, other species West Africa). *A. bipindensis* and *A. pachyloba* are large trees with 30 to 40 m in height and up to 120 cm in diameter; occasionally with irregular buttresses of 1.0 m; bole fairly cylindrical, free of branches for up to 16 m. *A. africana* is smaller and sometimes of poor stem form. *A. quanzensis* reaches a height of up to 25 m with a clear bole of 3.5 to 6 m.

Hardwoods, softwoods, monocots. Type of wood vessels (pores) present (= hardwood) (vessel lines are lined by light coloured parenchyma tisue and therefore conspicuous on longitudinal surfaces).

Growth rings, colour, grain, etc.. Growth ring boundaries distinct (marked by fine marginal parenchyma bands, often visible only with a hand lens), or indistinct or absent. Heartwood basically brown to red (heartwood yellowish to light brown, darkening considerably on exposure (in *A. bipindensis* to a deep copper brown)), with streaks (*Afzelia pachyloba*) or without streaks. Sapwood distinct from heartwood colour (yellowish grey), narrow or wide (3 to 10 cm wide, depending on species and tree age). Uniformity of colour sometimes impaired by grey or yellow specks, up to 3 cm in size, caused by waxy organic deposits which do not darken upon exposure; wood occasionally with dark stripes which can be mistaken for marks of fungal attack. Interlocked grain present (rather variable in intensity).

Vessels (pores). Wood diffuse-porous. In multiples; vessel (pore) multiples commonly in short (2–3 vessels) radial rows. Vessels large (100–180–270 µm); number per mm² very few to few (1–3–10). **Tyloses not observed.** Other deposits present. Organic deposits pinkish grey to nearly white, or yellow.

Axial Parenchyma. Axial parenchyma present, banded (as fine bands demarcating the growth increments, sometimes discontinuous). **Bands exclusively marginal (or seemingly marginal)**, narrow. **Other macroscopically visible types of axial parenchyma: aliform lozenge type, confluent**. Axial parenchyma around pores also visible on longitudinal surfaces as light coloured seams accompanying vessel lines.

Rays. Rays narrow, large rays commonly less than 1 mm high. Rays rather inconspicuous on all surfaces due to their small dimensions.

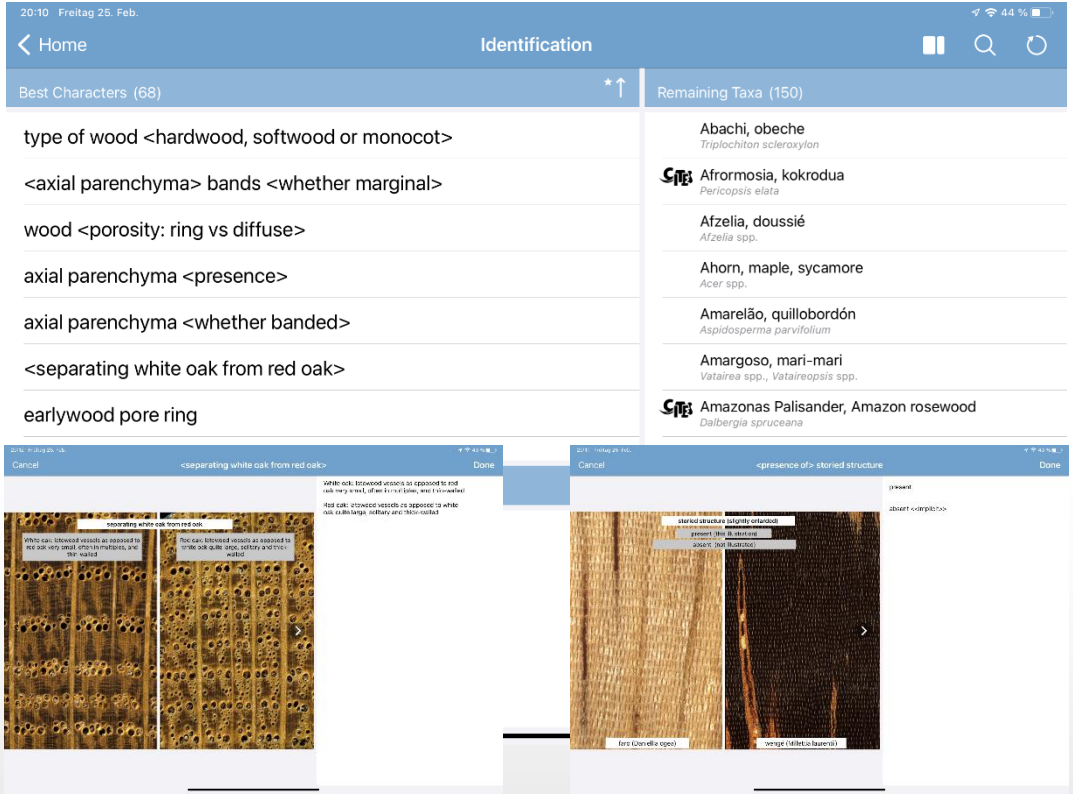
Storied structure. Storied structure rarely present, or absent. Tiers if present irregular. 3 tiers (rays) per axial millimetre (if present).

Resin canals. Normal resin canals not observed or absent.

Physical and chemical tests. Heartwood fluorescent (yellow), or not fluorescent (*Afzelia bipindensis*). **Water extract not fluorescent**, colour of water extract colourless to brown or red. Heartwood extractives not leachable by water (rarely, pale reddish brown). Ethanol extract fluorescent (yellow), **colour of ethanol extract red**. **Froth test positive**. Splinter burns to full ash. Ash bright white. Splinter burns very slowly.

Physical properties. Density 0.74–0.8–0.93 g/cm³. Tangential shrinkage green to 12–15% mc (if not noted otherwise): 1.5 %; radial shrinkage green to 12–15% mc (if not noted otherwise): 1 %. Differential shrinkage tangential: 0.17–0.22–0.32 [%/%]; radial: 0.11–0.2 [%/%]. Moisture uptake very slow. Dimensional stability very good.

Macroscopic wood identification - App macroHOLZdata



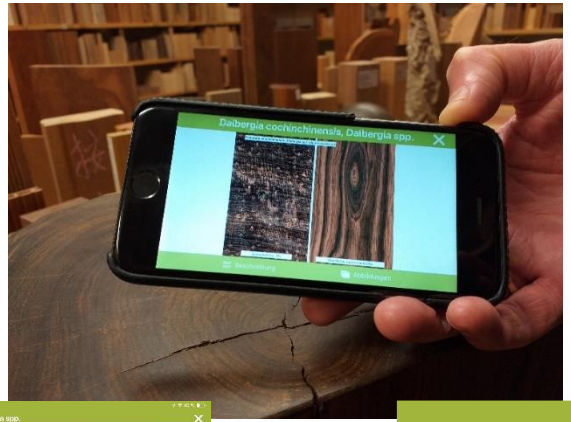
What has *macroHOLZdata* to offer:

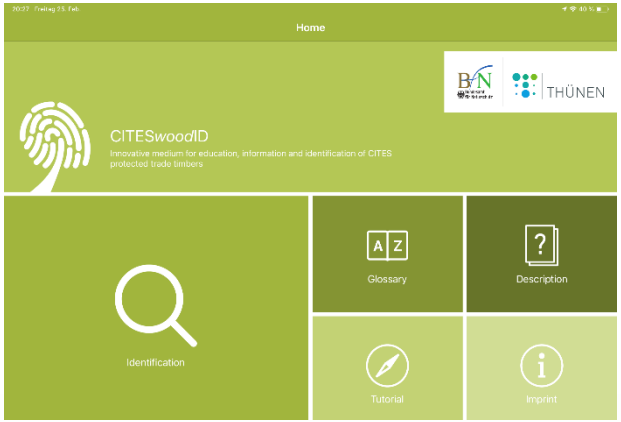
- available in **three languages** (English, German and Spanish)
- interactive identification of common **150 trade timbers** (hardwoods and softwoods) based on macroscopic features to be observed with the unaided eye or with a hand lens
- high **quality colour illustrations** of wood characters and timbers featuring transverse (10x) and longitudinal planes (natural size)
- pertinent information on **wood properties, processing**, and **utilization**

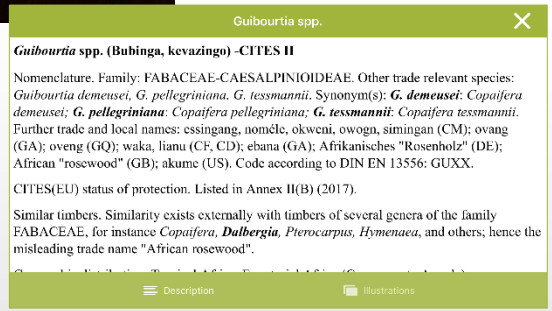
- **Free access: AppStore and Google Play**

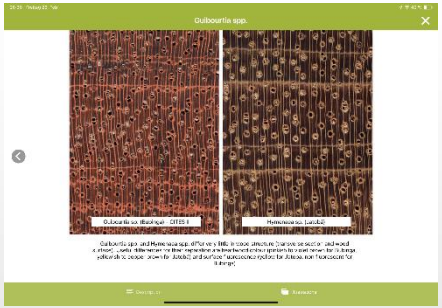
Macroscopic wood identification - App CITES*wood*ID

- Development and application of the **App CITES*wood*ID** - a modern and freely available tool for the description and identification of **CITES-protected timber**



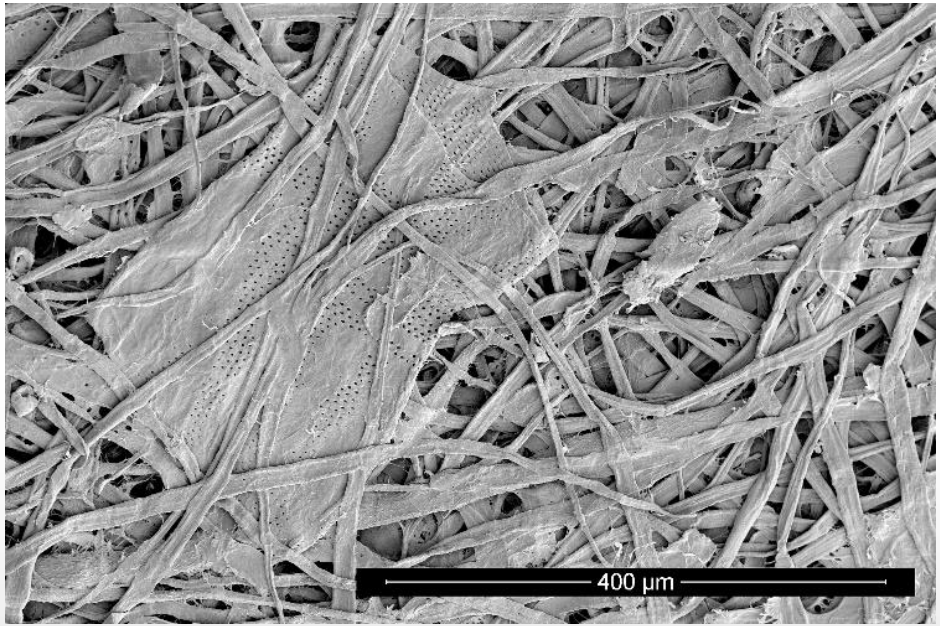




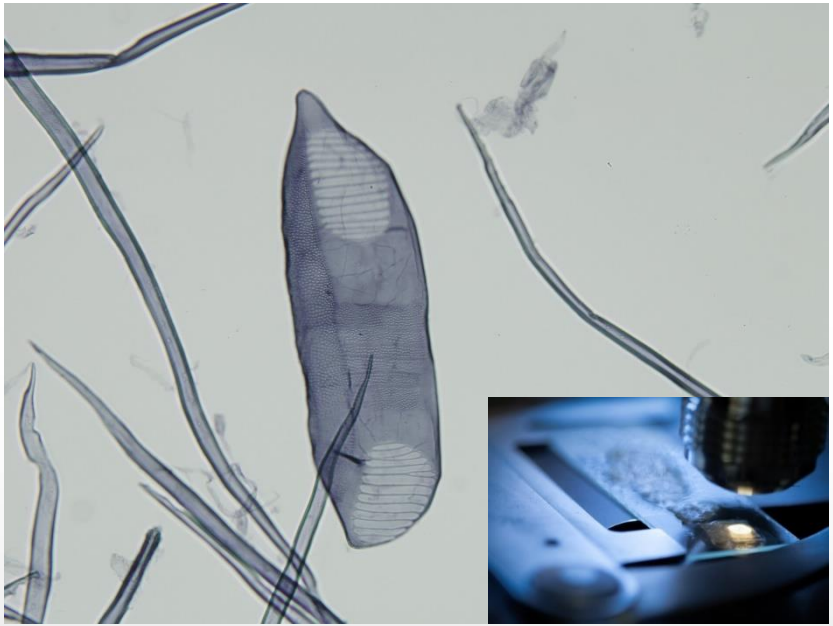


Applied wood anatomy - Identification of fibre based materials

- **Microscopic wood identification** of individual cell elements in pulp and paper



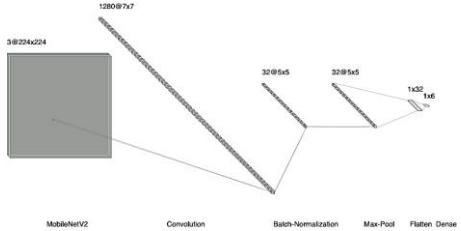
Individual vessel element of *Acacia* sp. in paper products



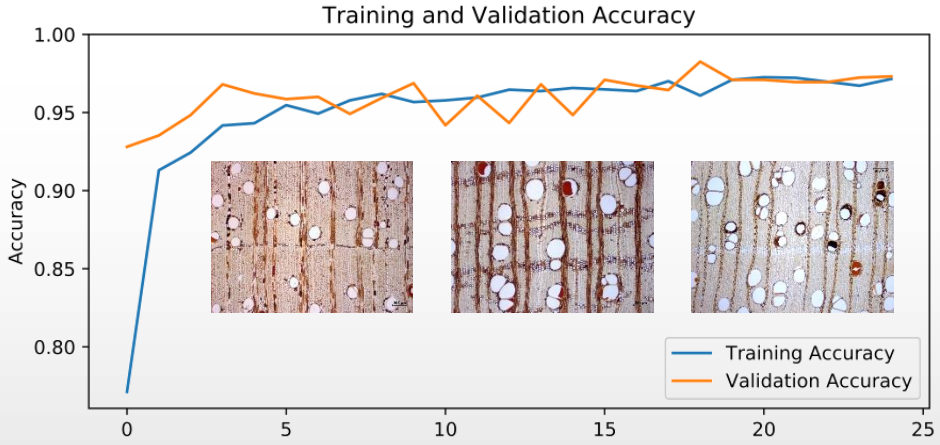
Individual vessel element of *Betula* sp. in fibre boards (MDF)

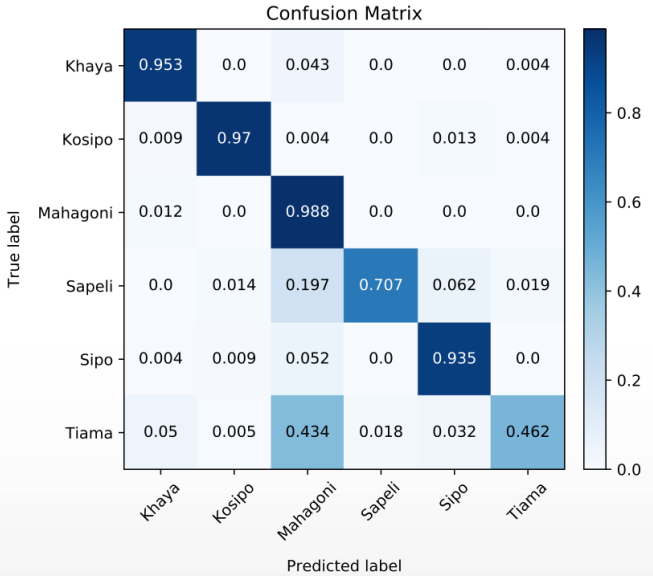
Modern wood anatomy - Machine learning

- Development and application of **Convolutional Neural Networks (CNNs)** for an automated (digital) identification of internationally traded timber based on macroscopic and microscopic images



For the training of the **neural network** a total of 6964 microscopic cross-sectional images (4x objective magnification) of the MELIACEAE species were generated and analysed



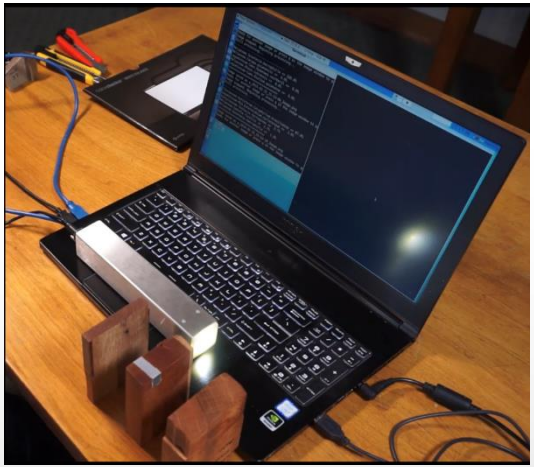


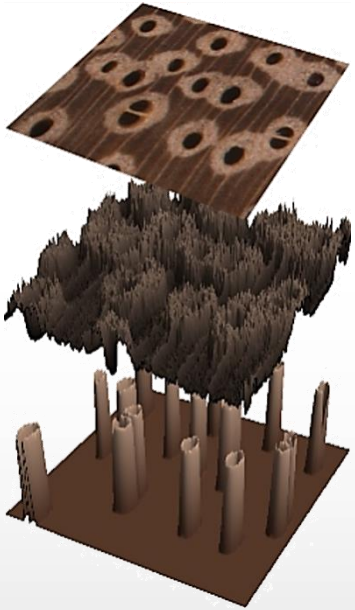
Results of an **automated microscopic wood identification** of six species within the family MELIACEAE using a **MobileNetV2-system**

Modern wood anatomy - Computerized wood identification

The Xylotron: A Field-Deployable Machine-Vision Wood Identification System

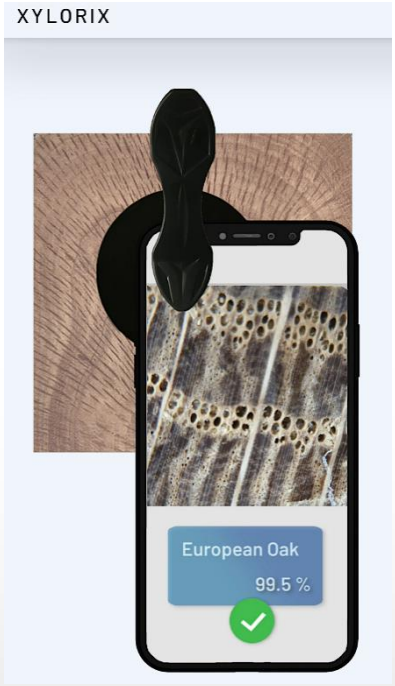
USDA U.S. FOREST SERVICE
Caring for the land and serving people

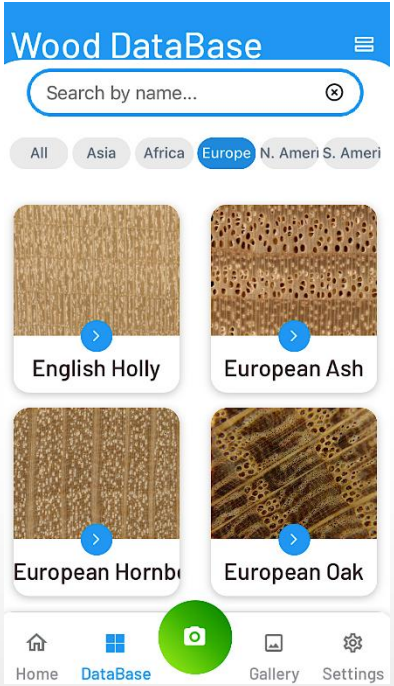




Ref.: https://xylotron.org/

Xylorix: Automated Wood Identification System

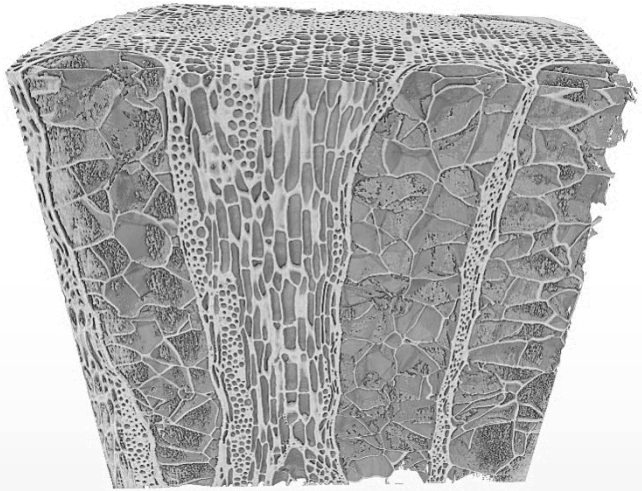


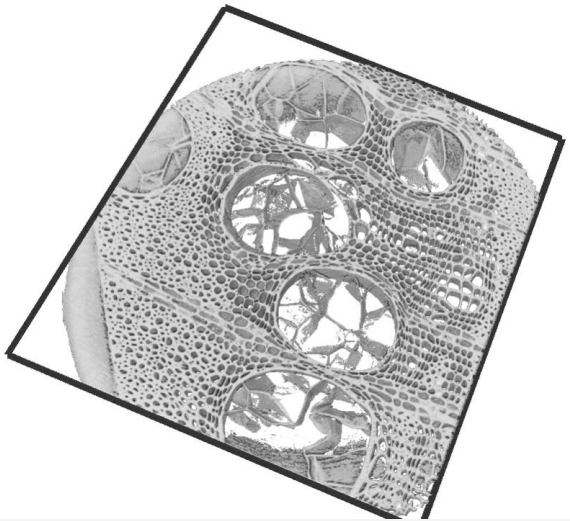


Ref.: https://www.xylorix.com/

Modern wood anatomy - Computer tomography (CT)

- Three-dimensional animation (video) of the cellular structures (cell types and cell wall layers) using **Computer-tomography (CT)**





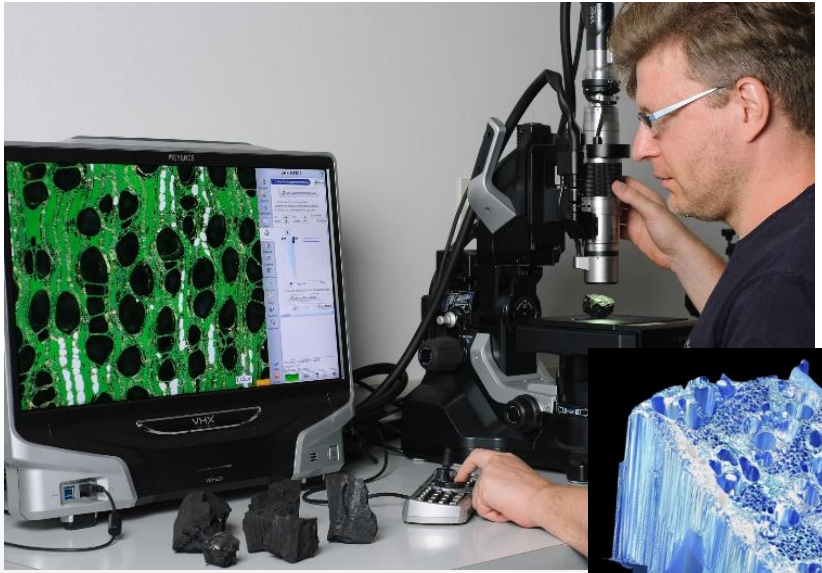
***Robinia pseudoacacia* (tangential)**

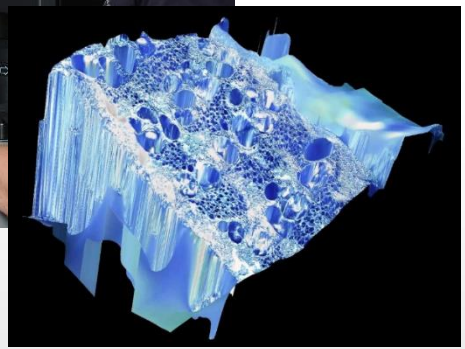
***Robinia pseudoacacia* (transversal)**

Ref.: Dremel & Zabler, Fraunhofer EZRT and Haag, Thünen-Institute

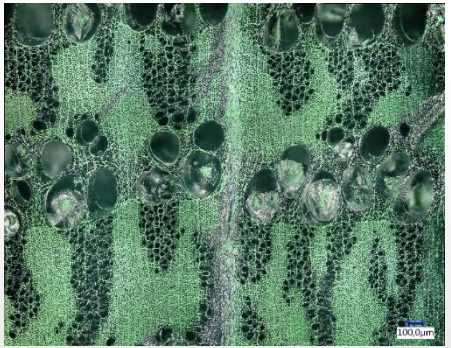
Modern wood anatomy - Identification of charcoal

- Application of a **3D scanning microscopy** for the identification of charcoal

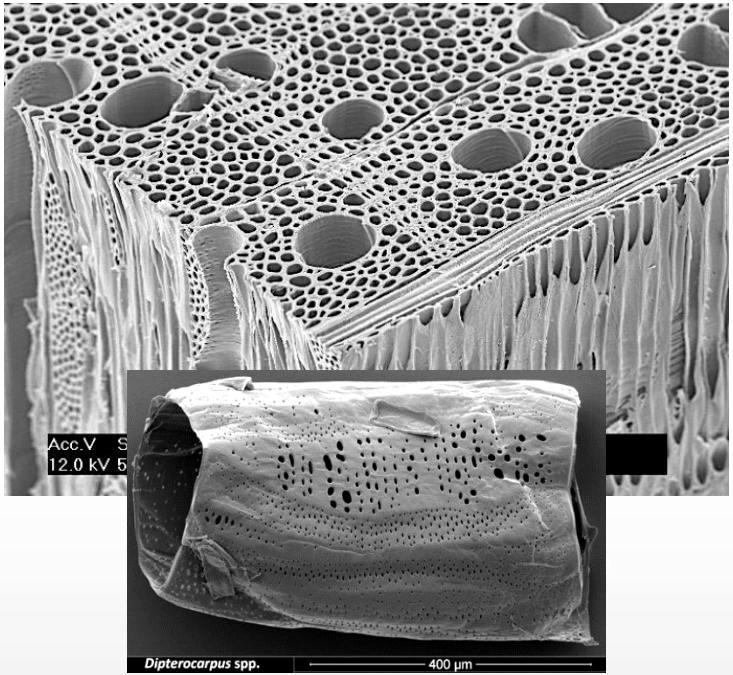




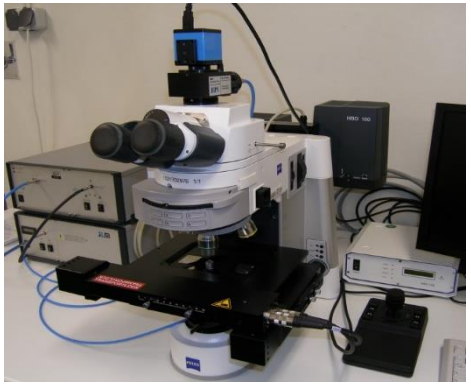
***Quercus* sp. (White oak)**

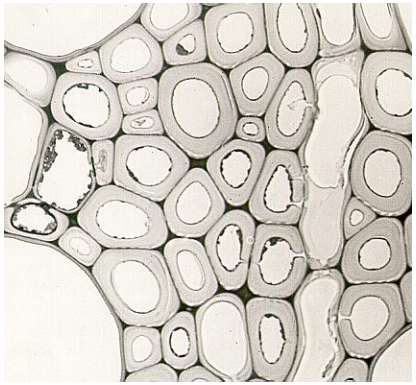


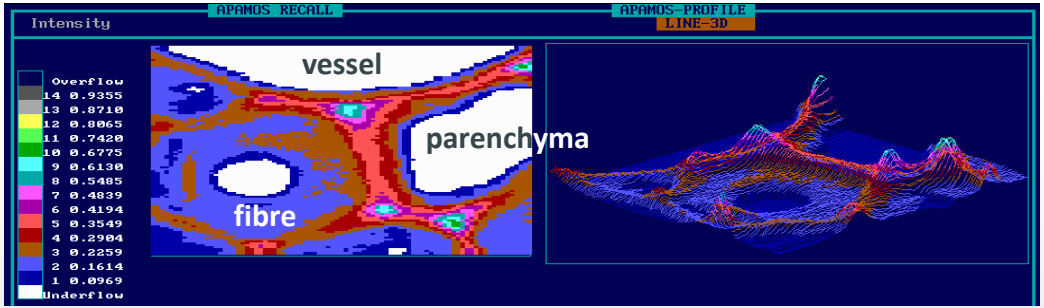
Wood anatomy - Electron microscopy and Cellular Spectroscopy



Electron microscopy of wood tissues and individual cell types



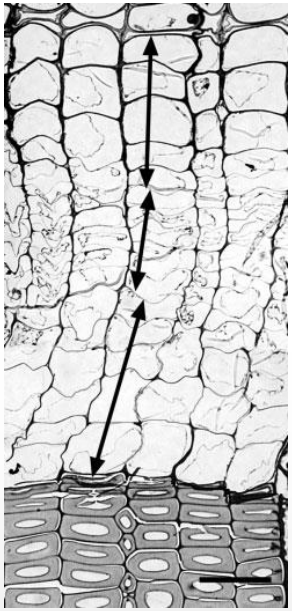




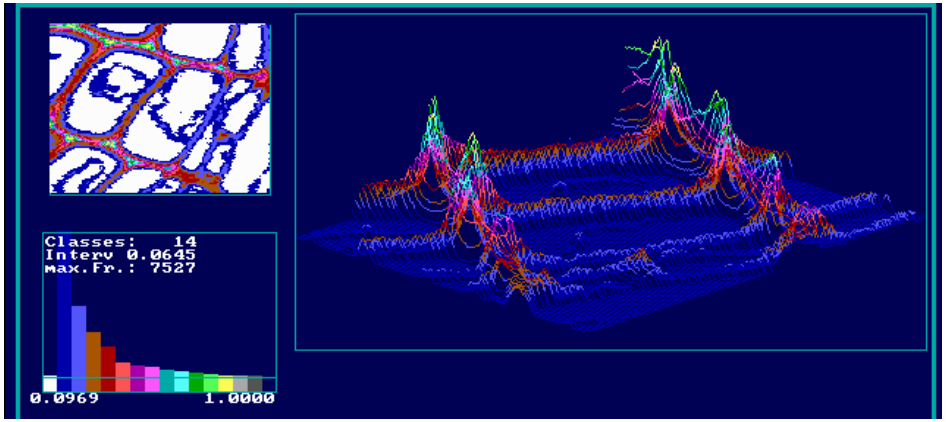
Topochemical **detection of lignin** in individual cell wall layers

Functional wood anatomy - wood formation

- **Wood formation** of spruce in the context of climate change

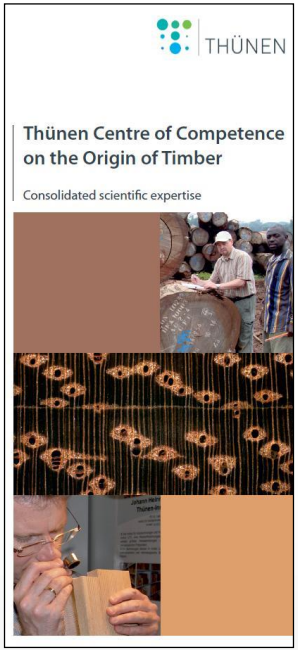


Cambial **wood formation** of spruce under drought stress



Topochemical analyses: Effect of local heating and cooling on cambial activity and cell differentiation / lignification in stem of Norway Spruce (*Picea abies*) *Annals of Botany*

The Thünen Institute of Wood Research



iawa

GTTN
Global Timber Tracking Network

Contact: Thünen Centre of Competence on the Origin of Timber
gerald.koch@thuenen.de, www.thuenen.de/holzherkuenfte