NEPCon

Preferred by Nature™

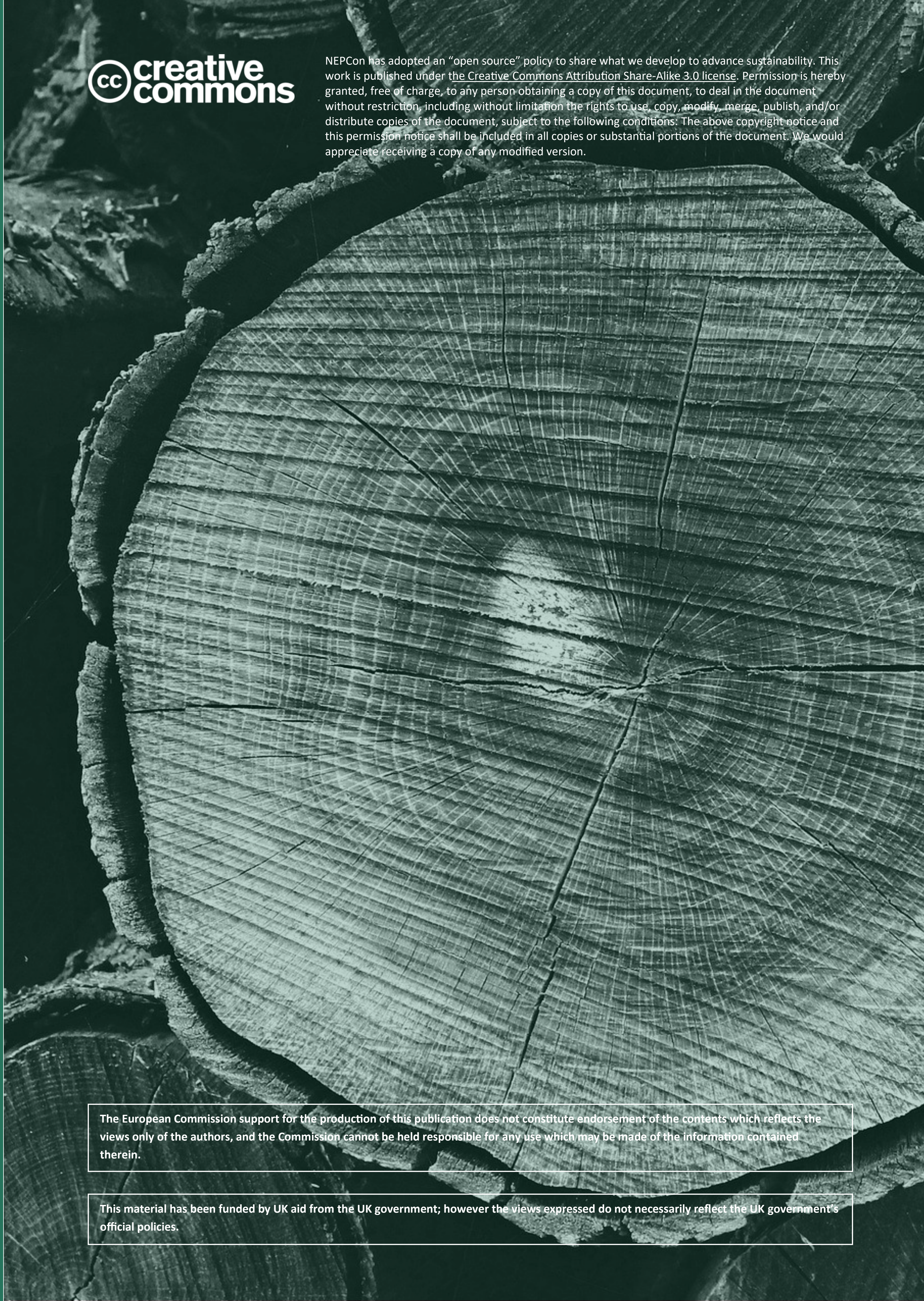
Timber Testing Techniques

A guide to laboratory techniques to determine species and origin of timber products

Thematic article series no. 1

Published February 2017

Developed by NEPCon under the project "Supporting Legal Timber Trade" funded by the EU LIFE programme and UK Aid from the UK government.



Contents

Powerful tools for timber legality: New laboratory techniques that help verify the origin and species of your timber materials

Timber legality legislation, such as the EU Timber Regulation, the US Lacey Act and the Australian Illegal Logging Prohibition Act, have increased the need for industry, government agencies and other stakeholders to be able to identify the species and origin of timber used in wood-based products. This is now even easier through the use of sophisticated laboratory techniques which have been adapted for use on wood and paper products. Such tests provide powerful independent verification of claims made by suppliers regarding the species of materials and their geographic origin. This Thematic Article provides an overview of the dominant scientific tests being used by industry and how they can help you to identify and control risk in your supply chain.

0. Introduction: Which risks can be detected using timber testing techniques?

Conducting due diligence on timber supply chains can be tricky. To ensure your products are not at risk of including illegal timber, a range of factors need to be assessed. Chief among these are the risks associated with the tree *species* included in products and the *origin* of the wood. Species and origin information is often key to indicating legality, because high-value and endangered species are more at risk of illegal harvesting, and some countries and regions are well-known for corruption and poor law enforcement. When collecting information to indicate legality of your timber products you will usually rely on supplier statements and supporting documentation. Now laboratory techniques can offer independent verification of these claims and give you improved confidence that your supplier's statements are true and that their documents are legitimate.

There are many innovative scientific testing methods becoming available to the timber sector. Here we explore the three most prevalent commercially available methods:

1. **Wood anatomy** (macro- and microscopic) **analysis**
2. **DNA analysis**
3. **Stable isotope analysis**

The technique to choose depends on the type of product being tested and the information you are seeking to verify (origin or species) – see Figure 1.

It should be noted that the validity and robustness of the results are not guaranteed and rely on a range of factors such as number of samples taken, quality of the laboratory and availability of reference samples. When undertaking such testing it is important to clearly outline your needs to the laboratory and to ask about the benefits and limitations of your chosen method.

Decision tree: What timber testing technique to use?

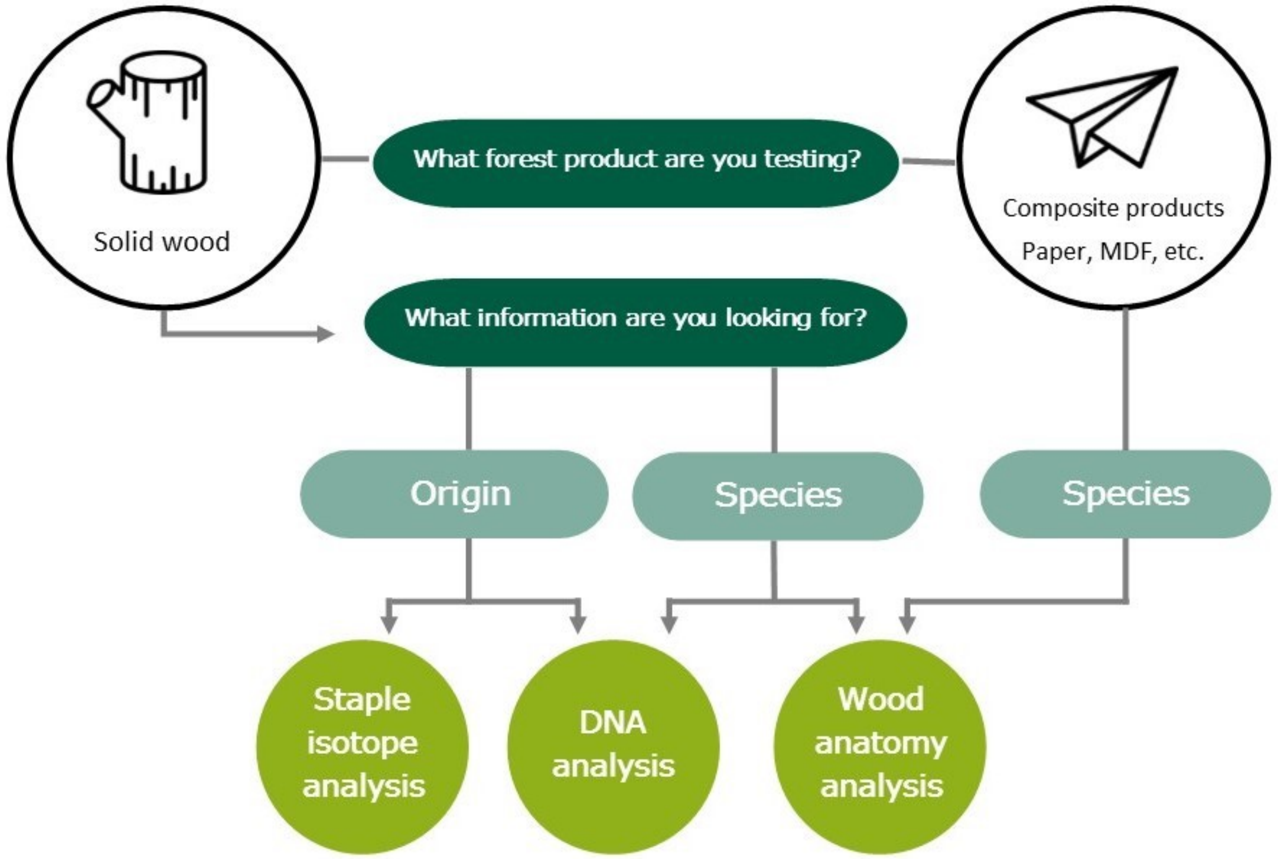


Figure 1: Timber testing techniques based on World Resources Institute's original graphic from this blogpost http://www.wri.org/blog/2015/09/4-cutting-edge-technologies-catch-illegal-loggers (WRI, 2015)

1 Wood Anatomy Analysis

Wood anatomy analysis uses characteristic differences in wood grain, pores and colour to verify timber to genus or sub-genus level.

Tree can be identified down to the level of genus or sub-genus based on macro and microscopic wood anatomy. Observations of the wood are taken in three plane—transverse, radial and tangential—to create a 3D picture of the wood structure. Differences in structural elements between samples can be identified and used to identify the wood species by comparing the structure to libraries of reference material. Reference databases are continually expanding and many are now freely accessible online (e.g. CITESwoodID[1] and InsideWood[2]), especially for CITES-listed species.

1.1 Macroscopic analysis

Macroscopic analysis involves using the wood grain and larger anatomical features of wooden samples with the unaided eye or a hand lens. The technique is quick to conduct, requires limited expertise and is very useful for providing at least an indication of the species group involved. For example, red and white oak species can be distinguished using the naked eye by looking at the endgrain (transverse plane). The pores found in the growth rings of red oak species are open and porous, while white oaks have pores which are plugged with tyloses[3].

Pores can be studied to distinguish East Indian rosewood (*Dalbergia latifolia*) from Brazilian rosewood (*Dalbergia nigra*). East Indian rosewood has about twice as many pores per square inch as Brazilian rosewood. Figures 2 and 3 from the Wood Database[4] show the differences, with Brazilian rosewood having well-spaced pores and East Indian rosewood having much more densely packed pores.[5]

Figure 2: Brazilian rosewood

Figure 3: East Indian rosewood

Similarly, when looking at the transverse plane of oak, it may be possible to distinguish small dark brown streaks (called 'rays'). Red oak species usually have short rays of between 3mm and 13mm (though occasionally up to 25mm in length), whereas white oak species have much longer rays, frequently exceeding 19mm. However, macroscopic techniques are limited by the visibility of identifiable elements with the naked eye or hand lens. This method is only suitable for identifying groups of species as opposed to individual species. It can only be used for solid wood products, not for composite products (e.g. MDF, OSB, paper). Origin cannot be determined by macroscopic analysis.

These tests may be conducted by an experienced staff member internally. Alternatively, most laboratories offering microscopic testing can also provide macroscopic analysis.

Guide to macroscopic analysis

Limitations of macroscopic analysis

- × Only used to identify species (not origin)
- × Only used to identify broad groups of species (e.g. white oaks vs red oaks).
- × Cannot be used on composite products (paper, MDF, oriented strand board).

Costs

€ EUR 100 – 450.

When to use this method

- ✓ When you want a cheap, rough-and-ready in-house check.
- ✓ When origin does not need to be verified.
- ✓ For groups of species which have unique anatomical features.
- ✓ When broad distinction between groups of species is acceptable.

1.2 Microscopic analysis

Microscopic identification involves looking at small anatomical structures of wood, such as tracheids and vessels using a light microscope.

Microscopic analysis is usually adequate to identify a wood sample to the genus or sub-genus level but not to the level of individual species. This means, for example, a sample could be identified as oak (Genus: *Quercus*) or as one of the white oak species (e.g. *Quercus alba, Q. robur, Q. ilex, etc.*), but can not be identified as to which of the white oak species it is. For example, it would not identify if the species is *Quercus alba* or *Quercus robur*.

The utility of microscopic testing was demonstrated in a 2015 study conducted by the UK Competent Authority for the EU Timber Regulation[6]. They looked at 13 samples of Chinese plywood purchased from UK companies using microscopic testing and found that the species contained within nine of the samples did not match the species declaration supplied by the company (Pillet & Sawyer, 2015).

Microscopic analysis can be used for most solid wood specimens, including very thin veneer layers (thickness <0.20 mm) and wood chips. It can also be used for some composite products (e.g. plywood, chipboard, oriented strand board). The utility of microscopic analysis is limited for products in which the structural elements required for identification are very small and for products which have been significantly physically or chemically altered. This includes particleboard, wood-plastic composites, wood flour and some types of fibreboard. The Centre for Wood Anatomy Research of the US Forest Products Laboratory is currently working to improve microscopic techniques for these product types (Wiedenhoeft, 2014). Anatomical uniqueness is also a limiting factor for microscopic analyses. Closely-related timber species can be mistaken due to similar wood anatomical pattern and structure e.g. *Swietenia* species (WWF, 2011). These limitations have led to the use of the techniques described below, which can provide more accurate data on species and origin.

Guide to microscopic analysis

Limitations of microscopic analysis

- × Only used to identify species (not origin).
- × Only used to identify broad groups of species (e.g. white oaks vs red oaks).
- × Composite products with *very* small particles may not be able to be tested (e.g. wood flour, some MDFs, particleboard, etc.) .

Costs

€ Costs for microscopic analysis vary depending on whether you are seeking to test a solid wood or composite product. Test prices typically range from €80–150 per sample for solid wood samples and €120–150 per sample for composite products.

When to use this method

- ✓ When origin does not need to be verified.
- ✓ For groups of species which have unique anatomical features.
- ✓ When broad distinction between species groups is acceptable.
- ✓ Where you do not feel confident enough to use macroscopic techniques yourself.
- ✓ For analysis of composite products (paper, MDF, OSB as well as solid woods).

2 DNA Analysis

DNA analysis compare genetic sequences between timber samples to determine the species or origin of the wood.

Just as humans share more of our DNA in common with chimps than with other animals, so trees and other plants that are more closely related share more similar DNA. The DNA sequence of timber can be compared using genetic techniques. These can both provide information on how similar two test samples are to each other, and can compare a test sample to known samples in a reference library.

There are three main ways DNA analysis can be used:

1. Species identification: Where the aim is to distinguish one species (or group of species) from another species (or group of species).

2. Population identification: Where the aim is to identify different populations or sub-populations *within* a species – usually for the purpose of identifying country or region of origin. Geographic origin may be verified to the level of a region, country or even concession, depending on the species and available reference library.

3. Individual log identification: Where the aim is to identify the passage of an individual tree through the supply chain from harvest, factory to end-product. This method can be used to distinguish a particular individual (or clone) from others within the population. This technique is similar to the forensic DNA methods used in criminal courts of law to identify perpetrators of a crime, by identifying the presence of an individual's DNA.

One key benefit of DNA analysis is that species and geographical origin can be identified with much greater accuracy. DNA analysis can typically identify samples to the species level e.g. *Quercus mongolica*, while microscopic testing can typically only identify the genus (*Quercus spp.)* or sub-genus level (e.g. white oaks). This is useful where a company wishes to distinguish between closely related species—for example, to verify that a supplier is only using US oak, and not Chinese oak in their supply chains.

As with all techniques, genetic analyses rely on the availability of a genetic reference database against which samples can be compared. The International Barcode of Life (iBOL) and Global Timber Tracking Network (GTTN) are at the forefront of efforts to catalogue genetic sequences for timber species (J. MacKay 2015, pers. comm., 19 May 2015). Labs such as the Thünen Institute (Germany), University of Adelaide (Australia), TRACE Wildlife Forensics Network (UK) and Naturalis Biodiversity Centre (Netherlands) all provide various DNA testing services today.

In 2011, the German customs authorities seized timber shipments after DNA analysis showed wood samples were mahogany (*Swietenia mahagoni*), a CITES-listed species, rather than the closely related non-CITES-listed species declared by the importer (WWF, 2011). See Figure 5 for a list of species for which reference data are available.

Population identification has also been used to create a DNA reference library for merbau, using 2,707 samples from Indonesia, Malaysia and Papua New Guinea (Geach, 2014). Testing of samples against this reference library showed that DNA techniques can be used to determine the concession of harvest for merbau products (to within roughly 50km of origin) (Double Helix, 2015).

Individual log identification can be used, for example, in the case of very valuable timber species, where the harvest location of each tree is typically recorded.

Individual log identification was used by the Forest Research Institute Malaysia for Ramin (*Gonystylus bancanus*) to match individual logs to the stumps they came from with a 99.9% accuracy (Lee et al., 2014).

Figure 5: List of tree genera which can be identified using DNA analysis

- *Afzelia*
- *Aningeria*
- *Aucoumea*
- *Baillonella*
- *Bulnesia*
- *Carapa*
- *Cedrela*
- *Cylicodiscus*
- *Endospermum*
- *Entandrophragma*
- *Erythrophleum*
- *Fitzroya*
- *Gonystylus*
- *Guaiacum*
- *Guibourtia*
- *Hymenaea*
- *Intsia*
- *Khaya*
- *Larix*
- *Lophira*
- *Milicia*
- *Millettia*
- *Nauclea*
- *Neolamarckia*
- *Pericopsis*
- *Pinus*
- *Populus*
- *Pterocarpus*
- *Pterygoty*
- *Sequoja*
- *Swietenia*
- *Tabebuia*
- *Tectona*
- *Terminalia*
- *Thuja*
- *Toona*
- *Triplochiton*
- *Quercus*

The technique was used to convict four people for stealing bigleaf maple in a landmark prosecution under the US Lacey Act.

DNA analysis is expensive and therefore only usually used for high value species. For due diligence purposes, the technique could be used where specific harvest permits and plans clearly record the precise GPS location or tagged tree stump. A sample can then be taken from the identified stump at the harvest site and sequenced. A second sample can then be taken from the purchased product (sawnwood, solid furniture, etc.) and sequenced. A match between the two samples can verify that the product purchased was harvested from the stump declared on harvest documentation.

One of the disadvantages of this technique can be the success rate of extracting testable DNA from wood. Some labs report quite low success rates whereas others, such as the University of Adelaide, report more success.[7] It would therefore seem advisable to ask labs what their success rates are before signing any contract with them.

Age, drying methods, moulding, product type and species all affect the possibility of extracting usable DNA.

Highly processed products such as pulp, paper and fibreboard frequently do not contain useable DNA (Crumley, 2014).

DNA techniques are also limited by the number of reliable DNA barcodes sequenced for different species. Fortunately, it is predicted that DNA barcodes for 20-50 tree species will be sequenced each year, significantly increasing the number of species that can be tested (Degen, 2013). Population identification is limited by the number of reliable genetic reference maps available for different species. It is predicted that genetic maps for two to five tree species will be created each year (Degen, 2013). The spatial resolution of genetic maps is also a limiting factor which in the future may be improved through identification of more gene markers within each species.

You should check with different labs to identify if they have the reference data required to conduct tests for your species and origins. Figure 5 shows a list of tree genera for which DNA analysis is possible.

Laboratories tend to build their own private libraries of known reference samples and sharing of this data is low.

When embarking upon DNA testing, it's important to ask the laboratory the expected success rate for DNA extraction from samples for your products. If the likelihood of extracting usable DNA is low, then it may be worth exploring alternative techniques.

Guide for DNA analysis

Limitations of DNA analysis

Limited reference data available (mostly CITES-listed and high value species) – not all species or origins can be tested.

Success rate for DNA extraction is low (especially for composite products and old samples).

Few laboratories offering commercial services, meaning costs are generally high.

Reference data not open-source.

When to use this method

Where distinction between closely related species is required (e.g. *Juglans regia* vs *Juglans mandshurica*).

Where identification of harvest origin is required (region, country, or concession).

Costs

Costs for DNA analysis vary depending on the aim of the test - costs increase for species identification (lowest), population identification (mid-range), individual log identification (highest). Test prices typically range from €200 – 600 per sample.

3 Stable Isotope Analysis

Stable isotope analysis compares the ratios of common elements within timber samples to verify the harvest origin.

Many common elements, such as carbon, hydrogen, oxygen and nitrogen occur naturally in different forms, known as isotopes. These are absorbed and incorporated into the molecular structure of timber as trees grow from the soil, water and air. Isotopic analysis involves measuring natural variations in the ratio of these isotopes.

This means that, because two trees growing in the same area will take up similar water and nutrients from the environment and incorporate them into their timber as they grow, they will have similar isotope signatures to each other, but different signatures compared to trees grown hundreds or thousands of miles 'away. In this way, isotopes mark where a particular tree has been absorbing its water, air and nutrients. This is true not only for tree species, but all living organisms, because all organisms take in elements from their surroundings as part of their growing processes. Figure 6 shows the stable isotope signatures of timber samples from different areas of Central America.

While stable isotope analysis has relatively recently been applied to timber, it has been used for years to identify the provenance of eggs, wine, beef, caviar, fish and other products of the food industry.

Stable isotope analysis was used as part of WWF's 2015 'Forests Campaign'. Timber products were purchased from 17 companies in the UK and tested by Agroisolab.

The lab used isotopic analysis to determine the origin of products. Eight out of 26 products tested contained wood with a different origin to that declared by the suppliers (WWF, 2015).

The Environmental Investigation Agency used this technique to show that oak products being sold in the US and EU came from a particular species of oak (*Quercus mongolica)* that had been harvested in the Russian Far East where illegal logging is rampant (EIA, 2013).

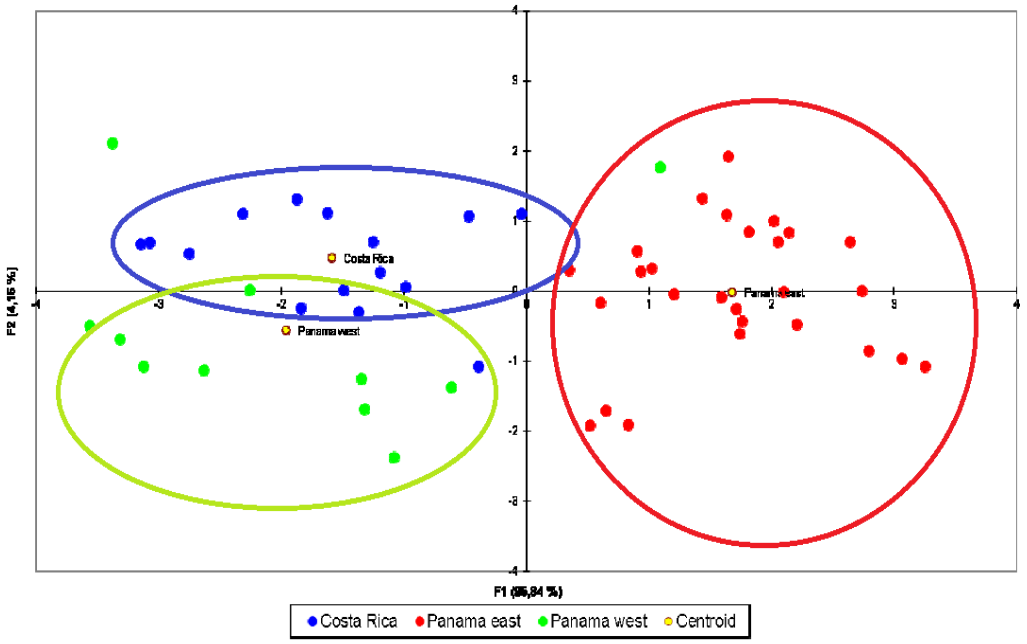


Figure 6: Isotope analysis showing regional differences in teak (re-printed with permission from WWF Germany, 2011

Laboratories conducting stable isotope analysis include Agroisolab, The Reston Stable Isotope Laboratory (RSIL) and UK Food and Environment Research Agency (FERA) (CITES, 2014). Currently, reference data for identifying origin is available for the species shown in figure 7.

Check with different labs to identify if they have the reference data required to conduct tests for your species and origins. Laboratories tend to build their own private libraries of known reference samples and sharing of this data is low.

Stable isotope analysis can only help identify the origin of products, not the species. However, as verifying the origin of harvest is key in concluding low risk for some supply chains, isotope analysis is an extremely useful assessment tool.

Stable isotope analysis is not possible to use on complex composite products such as paper, MDF, chipboard, etc. It is most often applied to solid wood products. Very thin veneers (<0.5mm) may not be possible to test. However, ask laboratories which products they can and cannot analyse.

✓ **Merbau** *(Intsia spp.)*	Indonesia, Malaysia, Papua New Guinea
✓ **Iroko** *(Milicia spp.)*	Ghana, Ivory Coast, Central African Republic, Democratic Republic of Congo, Republic of Congo, Cameroon, Gabon, Kenya
✓ **Oak** *(Quercus spp.)*	Amur region (China/Russia), USA, Croatia, Germany
✓ **Larch** *(Larix spp.)*	W.Europe, Russia, China, Japan
✓ **Sapele** *(Entandrophragma cylindricum)*	Cameroon, Republic of Congo, Democratic Republic of Congo
✓ **Mahogany**	Congo, Costa Rica, Democratic Republic of Congo, Ecuador, Ghana, Honduras, India, Java, Panama, Peru
✓ **Teak** *(Tectona grandis)*	Brazil, Costa Rica, Ghana, Honduras, India, Indonesia, Java, Laos, Myanmar (Burma), Panama, Papua New Guinea, Vietnam
✓ **Ash** *(Fraxinus spp.)*	Amur region (China/Russia)
✓ **Spruce** (Picea spp.)	Austria, Belarus, Finland, Germany, Norway, Poland, Russia, Sweden
✓ **Cedar**	Solomon Islands
✓ **Bintangor** *(Calophyllum spp.)*	Solomon Islands
✓ **Rosewood** *(Dalbergia spp.)*	Brazil, Madagascar

Figure 7: Available reference data for identifying origin

Guide to stable isotype analysis

Limitations of stable isotope analysis

- × Only used to identify origin (not species).
- × Limited reference data available – not all origins can be tested.
- × Composite products (MDF, paper) cannot be tested.
- × Few laboratories offering commercial services, meaning the price is often high.
- × Reference data not open-source.

When to use this method

- ✓ Where identification of harvest origin is required (region, country, or concession).

Costs

€ Costs for stable isotope analysis vary depending on the spatial scale – regional level (lowest), country level (mid-range), concession level (highest). Test prices typically range from €400–750 per sample.

Which laboratories currently offer the timber testing services discussed above?

There are a number of commercial, government and semi-government authorities which offer testing services for timber and paper samples. Some of these laboratories are shown in figure 8 on the next page. This list below is non-exhaustive, especially for wood anatomy testing, which is conducted by many laboratories around the world.

Timber Test	Laboratory
1. Wood anatomy (macroscopic and microscopic)	
Royal Botanic Gardens Kew (UK)	http://www.kew.org/
Thünen Institute (Germany)	https://www.thuenen.de/en/
Wood ID Lab (Italy)	http://www.woodidlab.it/
Innovation Environmental (UK)	http:// www.innovationpropertyuk.com/
Test-Tech (UK)	http://www.test-tech.co.uk/
IPS Testing (USA)	https://ipstesting.com/
Forest Research Institute Malaysia (FRIM) (Malaysia)	http://www.frim.gov.my/
USDA Forest Products Laboratory	http://www.fpl.fs.fed.us/
2. DNA analysis	
Royal Botanic Gardens Kew (UK)	http://www.kew.org/
Thünen Institute (Germany)	https://www.thuenen.de/en/
Naturalis Biodiversity Centre (Netherlands)	http://www.naturalis.nl/
FERA	http://fera.co.uk/
Forest Research Institute Malaysia (FRIM)	http://www.frim.gov.my/
IBL (Forestry Research Institute) (Poland)	http://www.ibles.pl/
USDA Forest Products Laboratory	http://www.fpl.fs.fed.us/
Australian Centre for Evolutionary Biology and Biodiversity, University of Adelaide	http://www.adelaide.edu.au/ directory/andrew.lowe
DoubleHellix	http://www.doublehelixtracking.com/
3. Stable isotope analysis	
Agroisolab (UK & Germany)	http://www.agroisolab.com/
FERA	http://fera.co.uk/
Reston Stable Isotope Laboratory	http://isotopes.usgs.gov/

Figure 8: Timber Testing Laboratories

Want to know more about carrying out risk assessments and tracking timber?

NEPCon is hosting free one-day training sessions to help companies meet the EU Timber Regulation requirements. We will cover how to carry out risk assessments and how to mitigate risks. The training sessions will be held in autumn 2017 in the following countries: Denmark, Poland, Belgium, Netherlands, Germany, Spain, Portugal, Estonia, Latvia, Lithuania, Romania and Hungary.

Forest legality experts will guide you through different techniques and methods for doing risk assessments and how to minimize the risk of illegal timber entering your supply chain.

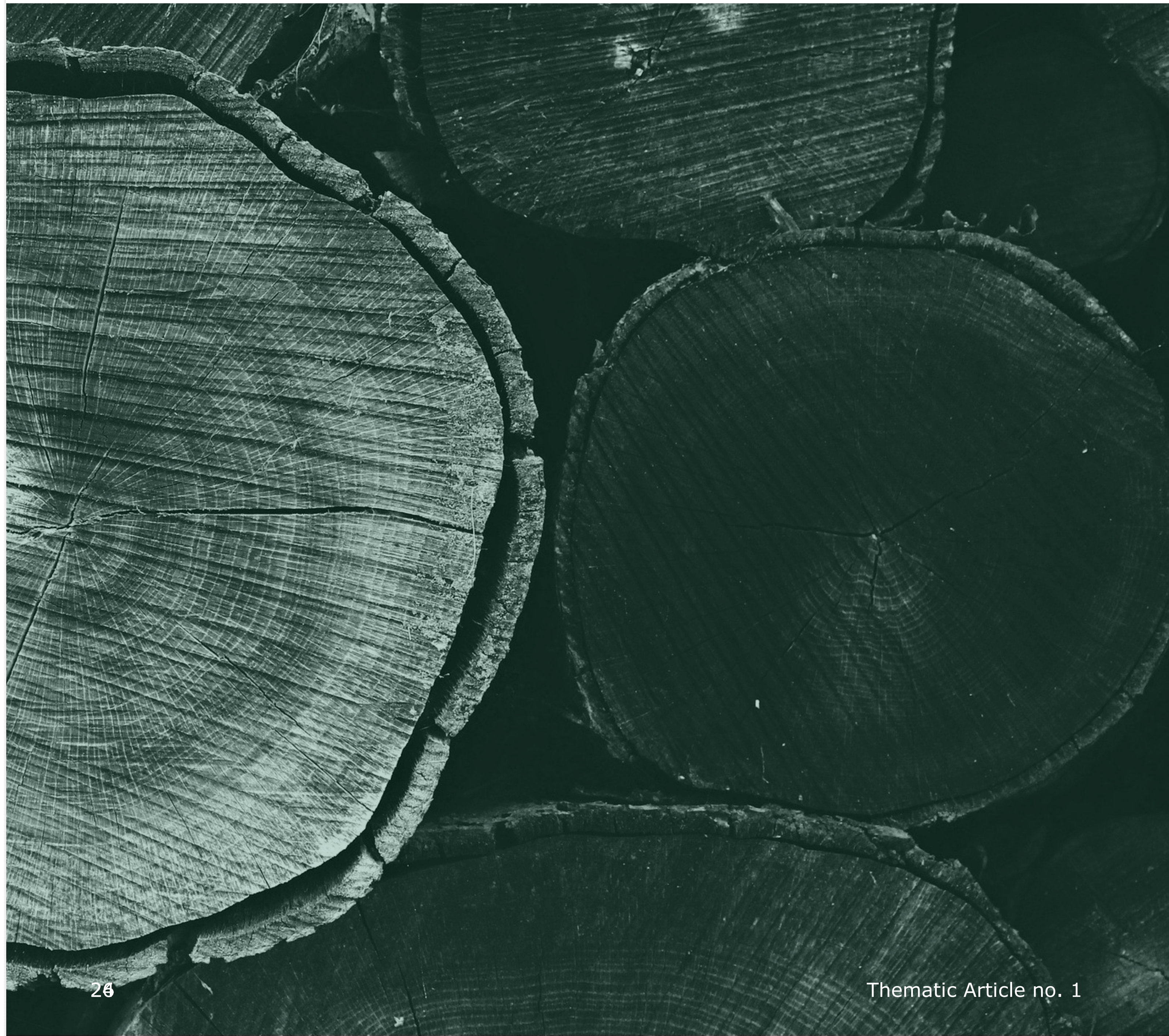
www.nepcon.org/eutr-registration-form

References

- Boner, 2013; Genetic and Isotopic Fingerprinting methods – practical tools to verify the declared origin of wood. Documentation of the international conference. Eschborn 3-4 Nov 2010. GIZ, Bonn.
- CITES, 2014; Twenty-first meeting of the Plants Committee, Veracruz (Mexico), 2-8 May 2014, Interpretation and implementation of the Convention, Trade control and marking, DEVELOPMENT OF A TIMBER IDENTIFICATION DIRECTORY FOR CITES-LISTED SPECIES, PC21 Doc. 15. CITES, Geneva.
- Crumley, 2014; An Overview of FSC's Fiber Testing Pilot. FSC International, Bonn.
- Degen, 2013; Application of DNA fingerprints to control tree species and geographic origin of timber. Thünen Institute of Forest Genetics, Braunschweig.
- Double Helix, 2015; Mapping Merbau. http://www.naturesbarcode.com/mapping-merbau [Accessed: 4th June 2015]. Double Helix Tracking Technologies, Singapore.
- EIA, 2013; Liquidating the Forests. Hardwood Flooring, Organized Crime and World's Last Siberian Tigers. Environmental Investigation Agency, Washington DC.
- Geach, 2014; DNA Analysis Can Reshape Thinking on Supply Chains, in Forest Legality Alliance Newsletter, Feb 2014, Issue 14. Forest Legality Alliance, USA.
- J. MacKay 2015, pers. comm., 19 May.
- Lee et al., 2014; DNA profiling databases to verify the legality of suspected timbers. Forest Resource Institute Malaysia, Kuala Lumpur.
- Meier, E. (2016) Hardwood Anatomy http://www.wood-database.com/wood-articles/hardwood-anatomy/ [Accessed: 27th June 2016]. http://www.wri.org/blog/2015/09/4-cutting-edge-technologies-catch-illegal-loggers
- Pillet & Sawyer, 2015; EUTR: Plywood imported from China. Project prepared for DEFRA. National Measurements Office, London.
- R. Langley 2015, pers. comm., 16 March.
- Wiedenhoeft, 2014; A short report on the feasibility of using fiber testing for wood-composite materials. FSC International, Bonn.
- WRI, 2015; 4 Cutting-Edge Technologies to Catch Illegal Loggers. A blogpost from World Resources Institute about technologies to combat illegal timber. http://www.wri.org/blog/2015/09/4-cutting-edge-technologies-catch-illegal-loggers. (Published September 07, 2015)
- WWF, 2011; Fighting illegal logging through the introduction of a combination of the isotope method for identifying the origins of timber and DNA analysis for differentiation of tree species. WWF-Germany, Berlin.
- WWF, 2015; Do Timber Products in the UK Stack Up? A report on the results of testing selected retail products that aren't covered by the EU Timber Regulation. WWF-UK, London.

Notes

1. More info ftp://delta-intkey.com/citesw/en/intro.htm
2. More info insidewood.lib.ncsu.edu
3. More info http://www.wood-database.com/wood-articles/distinguishing-red-oak-from-white-oak/
4. More info http://www.wood-database.com/
5. More info http://www.wood-database.com/wood-articles/distinguishing-brazilian-rosewood-from-east-indian-and-other-rosewoods/
6. More info: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/402325/Chinese_Plywood_Research_Report.pdf
7. Andrew Loew, University of Adelaide, personal communication



About

Supporting Legal Timber Trade

***Supporting Legal Timber Trade** is a joint initiative run by NEPCon and the Global Timber Forum with the aim of supporting timber-related companies in Europe with knowledge, tools and training in the requirements of the EU Timber Regulation. Knowing your timber's origin is not only good for the forests, but good for business. The joint initiative is funded by the LIFE Programme of the European Union and UK Aid from the UK Government.*

Printing this article?

Chose "landscape" layout. If you are printing on both sides, select "flip sheets on short edge".

NEPCon (Nature Economy and People Connected) is an international, non-profit organisation that builds commitment and capacity for mainstreaming sustainability. Together with our partners, we foster solutions for safeguarding our natural resources and protecting our climate.

NEPCon |
info@nepcon.org | www.nepcon.org

The Global Timber Forum (GTF) supports the initiative "Supporting Legal Timber Trade" in an advisory capacity and provides technical support. Global Timber Forum facilitates specific coalitions between forest & wood-based industries and relevant stakeholders to tackle shared challenges in delivering responsibly sourced and traded products.

The Global Timber Forum |
info@gtf-info.com | www.gtf-info.com