Cites and Wood Data Bases

Computer-Aided Identification And Description Of Cites Protected Trade Timbers

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Abstract

The knowledge about recognition of CITES-protected wood species is of prime importance to control trade with and enforce regulations to protected species. A valuable support for computer-assisted wood identification based on macroscopic features is already available from a database developed in the DELTA-INTKEY-System. This database contains descriptions and an interactive identification system for 8 CITES-protected timbers (7 hardwoods, 1 softwood) known for their potential in the manufacture of lumber and downstream processing into products, and 41 trade timbers which can be easily mistaken for CITES-protected timbers due to a very similar appearance and/or wood anatomical pattern. The database is primarily designed for institutions and persons involved in controlling import as well as export of wood and wood products under consideration of CITES regulations. It also serves to all primary and secondary educational facilities active in teaching wood anatomy and wood identification.

Keywords: CITESwoodID, database, wood identification

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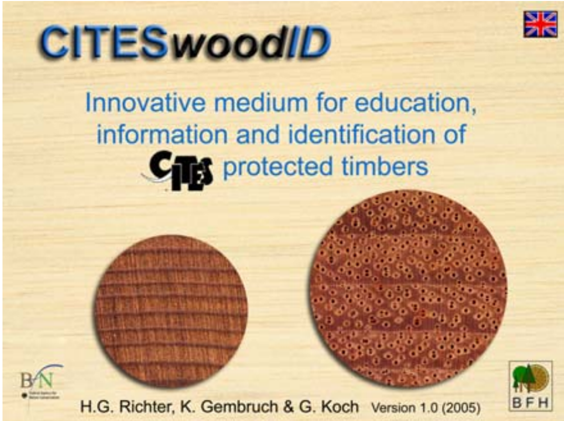
1 Introduction

The computer-aided identification program CITES*woodID* was developed in response to a proposal by the German CITES Scientific Authority at the Institute for Wood Biology and Wood Protection of the Federal Research Centre for Forestry and Forest Products (BFH), Hamburg, and is at present available in the four languages English, German, French and Spanish.



CITES*woodID* enables the user to identify trade timbers controlled under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) by means of macroscopic characters. Macroscopic characters are all those, which can be observed or perceived, respectively, with the unaided eye and a handlens of approximately 10-fold magnification.

Particular interest has been taken to provide high quality photographic illustrations with the database of both the characters used for identification and the timbers comprising the database. The photomacrographs of transverse sections were taken at a magnification commensurate with that of a handlens (ca. 10-fold). Illustrations of wood surfaces are reproduced in natural size (1:1). These illustrations provide an excellent means of visualizing certain character expressions and directly compare the results of an identification run and the unknown object to be identified. Furthermore, nearly all characters used for description and identification are accompanied by explanatory notes with definitions, examples, procedures, etc.

2 Objectives of the database

CITES*woodID* serves as a visual (illustrations) and textual (descriptions) identification tool to all institutions and persons involved in controlling import as well as export of wood and wood products under particular consideration of CITES regulations. It also serves to all primary and secondary educational facilities active in teaching wood anatomy and wood identification.

The database contains a) the 8 CITES-protected timbers (7 hardwoods, 1 softwood) known for their potential in the manufacture of lumber and downstream processing into products, and b) 41 trade timbers which can be easily mistaken for CITES-protected timbers due to a very similar appearance and/or wood anatomical pattern. CITES-protected plants/trees utilized for non-wood products are not included.

Table 1:
List of CITES protected trade timbers in the database

Botanical name	Trade name	CITES Appendix
Caesalpinia echinata	Brazil wood	CITES II
Cedrela odorata	Cedro	CITES III
Dalbergia nigra	Brazilian rosewood	CITES I
Fitzroya cupressoides	Patagonian cypress	CITES I
Gonystylus spp.	Ramin	CITES II
Guaiacum spp.	Guaiacum wood	CITES II
Intsia spp.	Merbau	“observation”
Pericopsis elata	Afrormosia	CITES II
Swietenia spp.	American mahogany	CITES II

Table 2:
Information on trading of CITES protected timbers (data of the German CITES Scientific Authority, 2006)

Species	Annex	Trading	Quantity [m³/a]
Cedro	CITES III	Bolivia, Peru ⇨ USA	45.000
Brazilian rosewood	CITES I	*trade is not allowed*	
Ramin	CITES II	Malaysia ⇨ Italy, China	70.000
Guaiacum wood	CITES II	Mexico ⇨ Germany	100t
Afrormosia	CITES II	Congo, Cameron ⇨ Italy, Belgium	15.000
American mahogany	CITES II	Bolivia, Peru ⇨ USA	none information
Merbau	“observation”	Indonesia, PNG ⇨ China, Germany, Netherlands	660.000 (illegal logging)

3 Basics on macroscopic wood identification

Observations made in these different planes add up to a three-dimensional picture of the gross wood structure. Observed differences in structure between the various timbers can be described, attributed to certain characters, and used for wood identification with the help of reference material for comparison.

3.1 Macroscopic structure of hardwoods

Hardwoods are composed of the following main tissues:

- Fibres (mechanical support),
- Parenchyma (storage and transport of nutrients),
- Vessels (conduction of water) and, of rather rare occurrence,
- Resin canals (secretory tissue)

In simple terms, fibres impart mechanical strength. They are responsible for resisting the many dynamic and static stresses in the living tree and in wood under load. Fibres usually make up the largest part of the wood volume. They are among the smallest diameter cells and, because of their often thick walls, appear as darker areas when seen en masse in cross section. At the macroscopic level they simply form a (usually darker) background for pores, rays and parenchyma.

The vessels of hardwoods constitute the principal passageways in the living tree for axial transport of water from the roots to the crown. On cross sections they are visible as pores (openings) arranged in a variety of distinctive patterns, on longitudinal sections as shallow grooves (vessel lines). Vessels are the only cells, which expand to dimensions (diameter, length) visible to the unaided eye or with a handlens.

Figure 2:
Distribution of vessels in hardwoods. (left): ring-porous structure of oak; (middle): semi-ring-porous structure of walnut, (right): diffuse-porous structure of American mahogany

Figure 3:
Various pattern of axial parenchyma in hardwoods. (left): aliform and confluent parenchyma in Afzelia/Doussie, (middle): reticulate pattern with rays in Pterygota, (right): marginal parenchyma bands in American mahogany

Parenchyma cells are responsible for axial and radial transport and storage of nutrients in the living tree and serve as depositories of accessory compounds during heartwood formation. Parenchyma tissues are orientated axially (parallel to the stem axis = axial parenchyma) or horizontally (perpendicular to the stem axis = rays). Parenchyma cells are nearly always thin-walled and become visible macroscopically only when forming larger agglomerates. In hardwoods, the axial parenchyma can be very conspicuous and its various expressions are of high diagnostic value.

The rays also have an important role in macroscopic wood identification, particularly as regards size (width and height) and arrangement on tangential surfaces (storied vs. not storied).

Few hardwoods also possess longitudinal and/or radial (forming part of a ray) resin canals, tubular passages in wood, which are actually intercellular spaces surrounded by specialized secretory cells. Resin canals are a characteristic feature of some tropical timbers, for instance of the large Dipterocarp family. Presence vs. absence, size and arrangement of axial resin canals are often highly diagnostic features. On cross sections, resin canals are difficult to distinguish from the vessels/pores unless still exuding resin (dark irregular patches around the openings) or containing crystallized dry resin of a brilliant white colour.

3.2 Macroscopic structure of softwoods

Conifers, here referred to as softwoods, evolved prior to the angiosperms (hardwoods), and retain a relatively primitive wood structure compared with the more specialized and complex structure of hardwoods. Because macroscopic identification of softwoods is much more difficult due to the lack of distinctive features they are discussed here last. Essentially, softwoods are characterized by only three cell elements or tissues:

- Tracheids (combined mechanical and conductive functions),
- Parenchyma (storage tissue), and
- Resin canals (secretory tissue).

The tracheids of softwoods serve the combined functions of mechanical strength and conduction. Their diameter is highly variable and rarely large enough to become visible under a 6x—12x magnifying lens. Nevertheless, tracheids produced early and late in the growing season of a tree may differ in size and, particularly, cell wall thickness, thus forming lighter coloured earlywood and darker coloured latewood. Latewood width and the appearance of the transition of earlywood to latewood within a growth ring is, in some instances, a very useful feature in macroscopic softwood identification.

Axial parenchyma cells, though present in many softwoods, never form large enough agglomerates to become macroscopically visible. Rays in all softwoods, composed of radial parenchyma cells, are generally uniseriate (narrow) and low, and therefore cannot contribute to the distinction of individual softwood timbers. Rays containing radial resin canals ("fusiform rays") are the exception to the rule and, when large enough, may also be a useful feature in softwood identification.

Resin canals occur in all species of several genera within the pine family (*Pinaceae*), among them pine (*Pinus* spp.), spruce (*Picea* spp.), larch (*Larix* spp.) and Douglas fir (*Pseudotsuga* spp.), which contain both axial and radial resin canals. The presence of resin canals thus provides an initial basis for separating pine, spruce, larch and Douglas fir from the remaining

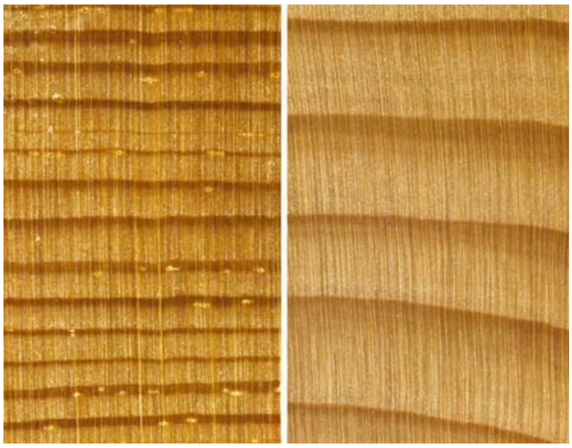


Figure 4:
Macroscopic structure of softwoods. (left): transverse plane of spruce with the occurrence of resin canals. (right): transverse plane of white fir without resin canals

conifers. Size, frequency and arrangement of axial resin canals can be helpful for distinction between and within these four taxonomic groups.

4 How to use CITESwoodID for wood identification

When initiating the identification process, the user has several options to follow. The program starts in the *normal working mode*, i.e., the available features are listed in a sequence of "best characters" with the character on top of the list which, by definition, is best suited for separating the (remaining) taxa in the database. Following these suggestions is the approach recommended for inexperienced users. If a more experienced user is sure of the detection of a certain character it can immediately be chosen. The search function in the toolbar facilitates locating the desired character. A further option is using the natural order of the characters as represented in the original character list.

Each character is accompanied by notes with information on definitions, explanations as to how observations can be correctly interpreted, procedures concerning specimen preparation for certain purposes, examples of timbers with a very typical expression of the character in questions, cautionary notes on how to guard against misinterpretation, information on specific wood characters not covered by the character list, etc. In addition, characters and the timbers in the database are accompanied by high quality colour images illustrating important macroscopic features on both transverse and longitudinal

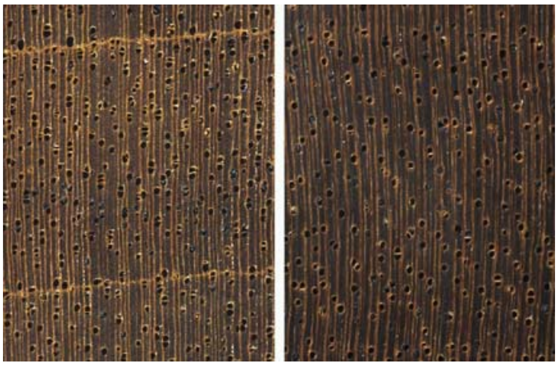


Figure 5:
American mahogany = *Swietenia* spp. (CITES Annex II, left) are very similar to khaya = *Khaya* spp. (right) in external appearance. The two timber groups differ significantly by the lack of macroscopically visible axial parenchyma in *Khaya* spp.

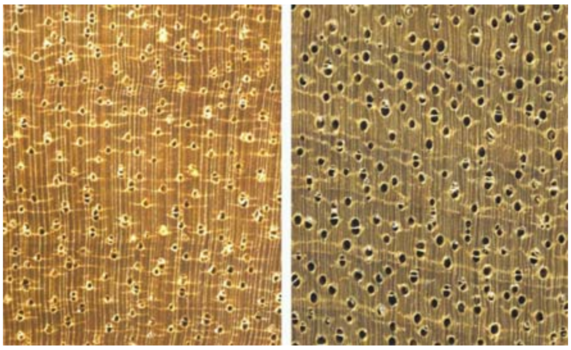


Figure 6:
Ramin = *Gonystylus* spp. (CITES Annex II, left) and limba = *Terminalia superba* (right) are similar in appearance and structure. However, limba has much larger and fewer vessels often filled with tyloses. Furthermore, the wood of limba is darker with a greenish hue

Figure 7:
Alerce = *Fitzroya cupressoides* (CITES Annex I, left) and Western Red Cedar = *Thuja plicata* are virtually indistinguishable given their similar structure. The aromatic odour and yellowish hue of Western Red Cedar, however, is of much help in separating the two timbers

faces. These images can be of considerable help in finding a character and using it in an appropriate way. Images are also very useful when it comes to confirming identification results by visual comparison.

CITES*woodID* also offers complete program-generated wood descriptions. These encompass all relevant information contained in coded form in the database, converted into a natural language text and saved in a single file. The individual wood description can be used interactively for consultation and/or printing at any point of an identification run.

At least it must be quite clear to the user that the possibilities of macroscopic wood identification are much more limited than those of microscopic study. Firstly, the number of characters available for observation is considerably smaller. Secondly, in macroscopic identification one has to rely quite often on characters subject to a high variability due to different growth conditions of the tree (viz. formation of growth rings) or exposure to oxygen and UV radiation (viz. wood colour). This may lead to subjective judgement on behalf of the user, and errors which might result in wrong decisions. In fact, in cases of closely related trade timbers, the use of macroscopic characters will end with a choice of several likely matches whose safe separation must be left to microscopic study performed by any of the scientific institutions in Europe with the necessary equipment and experienced staff, in Germany the Federal Research Institute for Rural Areas, Forestry and Fisheries with its Institute of Wood Technology and Wood Biology, Hamburg (www.vti.bund.de/en/institutes/htb/).

5 References

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