ANNEX 3

Technical report on wood anatomy

ITTO project *"Development and implementation of a species identification and timber tracking system in Africa with DNA fingerprints and stable isotopes"*

Report: Wood Anatomy

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Introduction

The control of internationally traded timber requires reliable methods for a doubtless identification of the wood species (botanical taxa). The clear identification of the timber is also important for the assessment of product properties "consumer protection" as lower-grade substitute timbers are imported at a distinctly increasing rate. In the context of these major challenges wood anatomy provides the most valuable support for practical wood identification. The methods for the macroscopic and microscopic wood identification are basically established and routinely applied since more than 100 years.

Macroscopic wood identification is based on observations in the three anatomical planes of a wood specimen: transverse (perpendicular to the stem axis), radial (parallel to the stem axis) and tangential (parallel to the stem axis) which can be observed with the unaided eye or with the help of a magnifying lens. The method is suitable for a first reliable determination of the declared taxon. For the macroscopic wood identification, the transverse planes of the specimens are smoothed using a cutter or carpet knife and examined with a hand lens (recommended magnification 10-12x, see Fig. 1).

Fig. 1. Preparation of the transverse plane and macroscopic observation / identification of the timber

For "official" or "judicable" wood identification, microscopic analyses are routinely conducted. Using light microscopic techniques, up to 100 anatomical characters can be used which are internationally standardized according to the IAWA lists of "Microscopic Features for Hardwood and Softwood Identification". The defined microscopic features describe the individual tissue types: vessels, parenchyma and fibres and provide additional information about mineral inclusions as part of a wood "anatomical fingerprint". Overall, the microscopic description of about 6,700 wood timbers (wood genus/species) are currently available and documented in several computerized databases, e.g., InsideWood (2004 onwards) or Commercial timbers (delta-intkey, 2000 onwards).

Material and methods

The Thünen Institute of Wood Research (Wood Anatomical Laboratory) received two collectives of solid wood samples (overall 50 specimens) for microscopic wood identification and verification of the declared botanical nomenclature "blind test on species declaration".

One collective (25 samples with the codes RM_2014 and X2) was provided by WWF, Deutschland (contact person: J. Zahnen). The second collective (25 sample with the codes G2S_S) was submitted by G2S (contact person for the documentation of the results: G. Yene).

For the microscopic wood identification thin sectionings (10 to 20 µm thickness in the three anatomical directions: transversal, radial and tangential) were cut on a sliding microtome from aligned wood blocks (dimension of approx. 5 - 10 mm^3) of the individual 50 samples (Fig. 2).

The wood anatomical structures of the specimens were microscopically investigated using a standard light microscope with polarized light device (magnification of the objectives 4x to 40x) and directly

compared with reference slides (vouchered material of the scientific wood collection RBHw*) and microscopic wood slides prepared within the ITTO project (Fig. 3, Master thesis of. V. Haag).

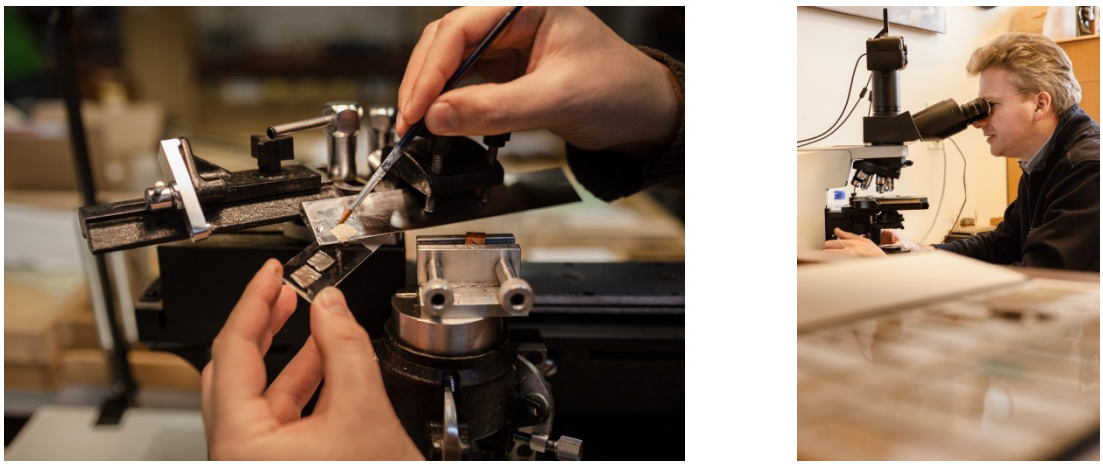

Fig. 2. Preparation (microtome) and microscopic analysis of the wood sections

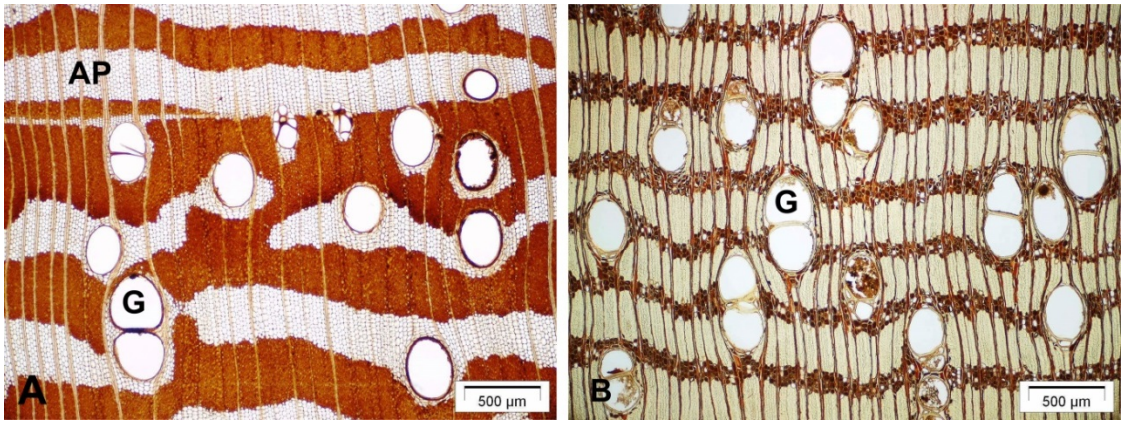

Fig. 3. Microscopic transverse sections of Millettia spp. (left) and Lophira alata (right); references for the microscopic wood identification

The wood anatomical structures of the microscopically identified timber are also compared with the descriptions in the computerised database *Commercial timbers* in the Delta-Intkey-System. This very established database was also applied for the microscopic wood identification of the blind-test samples.

Results

The results of the microscopic wood identification are presented in the following tables Part I (samples provided by the WWF) and Part II (samples provided by the Thünen Institute of Forest Genetics) with the specified information/columns: sample codes, claims, results of microscopic identification and comments.

The evaluation of the provided results reveals the high capability of the wood anatomical analyses: All individual samples (100%) of both collectives were clearly identified on the genus level which defines the relevant trade names according to the EN Standard 13556 *"Nomenclature of timbers used in Europe"* and the requirements of the European Timber Regulation (EUTR). The identification of individual wood species, e.g. *Entandrophragma cylindricum* or *Triplochiton scleroxylon,* etc., was successfully achieved for 56% (part I) and 60% (part II) of the analysed samples. Comments to the "maximal" possible differentiation or identification of the individual samples are provided in detail (see table 1 and 2). The investigated wood blocks and microscopic slides are carefully preserved and documented at the Thünen Institute of Wood Research for additional microscopic analyses or verification.

**RBHw = acronym of the Thünen Wood Collection according to the Index Xylariorum*

Table 1: Results of the microscopic wood identification - Part I: Collectives RM_2014 and X2 provided by WWF, Deutschland

Sample code	Claims on species name	Results of lab	Results of the microscopic wood identification (wood anatomy)	Comments
RM_2014_03	*Milicia excelsa*	false ✖	***Millettia* spp. = Wengé or Panga Panga**	*correct trade name **Wengé / Panga Panga***
RM_2014_04	*Erythrophleum ivorense*	*correct* ✔	***Erythrophleum* spp. = Tali**	*the individual species within the genus **Erythrophleum** can´t be distinguished microscopically*
RM_2014_13	*Khaya ivorensis*	*correct* ✔	***Khaya* spp. = Khaya**	*the individual species within the genus **Khaya** can´t be distinguished microscopically*
RM_2014_37	*Erythrophleum suaveolens*	*correct* ✔	***Erythrophleum* spp. = Tali**	*the individual species within the genus **Erythrophleum** can´t be distinguished microscopically*
RM_2014_39	*Entandrophragma utile*	false ✖	***Aucoumea klaineana* = Okoumé**	*correct trade name **Okoumé***
RM_2014_42	*Entandrophragma angolense*	false ✖	***Nauclea diderrichii* = Bilinga**	*correct trade name **Bilinga***
RM_2014_45	*Afzelia pachyloba*	*correct* ✔	***Afzelia* spp. = Afzelia**	*the individual species within the genus **Afzelia** can´t be distinguished microscopically*
RM_2014_48	*Entandrophragma cylindricum*	false ✖	***Entandrophragma angolense* = Tiama**	*correct declaration **Tiama***
RM_2014_49	*Aningeria robusta*	false ✖	***Baillonella toxisperma = Moabi***	*correct declaration **Moabi***
RM_2014_59	*Aucoumea klaineana*	false ✖	***Afzelia* spp. = Afzelia**	*correct trade name **Afzelia***
RM_2014_60	*Cylicodiscus gabunensis*	false ✖	***Entandrophragma utile*= Sipo**	*correct trade name **Sipo***
X2-57	*Pterocarpus soyauxii*	false ✖	***Pericopsis elata* = Afrormosia**	*correct trade name **Afrormosia** (CITES-species)*
X2-58	*Baillonella toxisperma*	false ✖	***Pouteria* spp. (*Aningeria* spp.) = Aningré**	*correct trade name **Aningré***
X2-59	*Afzelia bipindensis*	*correct* ✔	***Afzelia* spp. = Afzelia**	*the individual species within the genus **Afzelia** can´t be distinguished microscopically*
X2-65	*Guibourtia ehie*	false ✖	***Guibourtia* spp. = Bubinga**	*The wood anatomical characters show best agreement with **Bubinga**; the individual species G. ehie = Ovengkol can be excluded*
X2-66	*Millettia laurentii*	false ✖	***Milicia* cf. *excelsa* = Iroko**	*correct trade name **Iroko***
X2-67	*Khaya grandiflora*	*correct* ✔	***Khaya* spp. = Khaya**	*the individual species within the genus **Khaya** can´t be distinguished microscopically*
X2-68	*Milicia regia*	*correct* ✔	***Milicia* spp. = Iroko**	*the individual species within the genus **Milicia** can´t be distinguished microscopically*
X2-69	*Terminalia superba*	*correct* ✔	***Terminalia superba* = Limba**	*correct declaration*
X2-74	*Pericopsis elata*	false ✖	***Pterocarpus soyauxii* = Padouk**	*correct trade name **Padouk***
X2-75	*Nauclea diderrichii*	false ✖	***Aucoumea klaineana* = Okoumé**	*correct trade name **Okoumé***
X2-76	*Khaya ivorensis*	false ✖	***Entandrophragma cylindricum* = Sapelli**	*correct trade name **Sapelli***
X2-78	*Triplochiton scleroxylon*	*correct* ✔	***Triplochiton scleroxylon* = Abachi**	*correct declaration*
X2-79	*Pericopsis elata*	false ✖	***Cylicodiscus gabunensis* = Okan**	*correct trade name **Okan***
X2-81	*Lophira alata*	*correct* ✔	***Lophira alata* = Bongossi**	*correct declaration*

Table 2: Results of the microscopic wood identification - Part II: Collective G2S_S provided by the Thünen Institute of Forest Genetics

Sample code	Claims on species name	Result of lab	Result of the microscopic wood identification (wood anatomy)	Comments
G2S_S_1.0	*Guibourtia ehie*	false ✗	***Afzelia* spp. = Afzelia**	*correct trade name* ***Afzelia***
G2S_S_1.5	*Baillonella toxisperma*	false ✗	***Afzelia* spp. = Afzelia**	*correct trade name* ***Afzelia***
G2S_S_2.0	*Khaya anthotheca*	correct ✓	***Khaya* spp. = Khaya**	*the individual species within the genus* ***Khaya*** *can´t be distinguished microscopically*
G2S_S_3.5	*Baillonella toxisperma*	correct ✓	***Baillonella toxisperma* = Moabi**	*correct declaration*
G2S_S_5.0	*Entandrophragma cylindricum*	false ✗	***Entandrophragma angolense* = Tiama**	*correct trade name* ***Tiama***
G2S_S_8.0	*Entandrophragma candollei*	false ✗	***Entandrophragma utile* = Sipo**	*correct trade name* ***Sipo***
G2S_S_8.5	*Entandrophragma cylindricum*	false ✗	***Khaya* spp. = Khaya**	*correct trade name* ***Khaya***
G2S_S_10.0	*Milicia excelsa*	false ✗	***Erythrophleum* spp. = Tali**	*correct trade name* ***Tali***
G2S_S_11.5	*Guibourtia* spp.	correct ✓	***Guibourtia* spp. = Bubinga**	*correct declaration*
G2S_S_13.0	*Lophira alata*	correct ✓	***Lophira alata* = Bongossi**	*correct declaration*
G2S_S_13.5	*Lophira alata*	correct ✓	***Lophira alata* = Bongossi**	*correct declaration*
G2S_S_14.0	*Erythrophleum suaveolens*	false ✗	***Milicia* spp. = Iroko**	*correct trade name* ***Iroko***
G2S_S_15.0	*Milicia regia*	correct ✓	***Milicia* spp. = Iroko**	*the individual species within the genus* ***Milicia*** *can´t be distinguished microscopically*
G2S_S_16.5	*Millettia laurentii*	correct ✓	***Millettia* spp. = Wengé (Panga Panga)**	*Millettia laurentii = Wengé and Millettia stuhlmannii* = Panga panga *can´t be distinguished microscopically*
G2S_S_18.5	*Khaya* spp.	false ✗	***Pericopsis elata* = Afrormosia**	*correct trade name* ***Afrormosia*** *(CITES-species)*
G2S_S_20.0	*Terminalia superba*	correct ✓	***Terminalia superba* = Limba**	*correct declaration*
G2S_S_21.5	*Pterocarpus soyauxii*	correct ✓	***Pterocarpus soyauxii* = Padouk**	*correct declaration*
G2S_S_24.0	*Triplochiton scleroxylon*	correct ✓	***Triplochiton scleroxylon* = Abachi**	*correct declaration*
G2S_S_25.5	*Entandrophragma utile*	false ✗	***Mansonia altissima* = Mansonia, Béte**	*correct trade name* ***Mansonia*** *note: Mansonia doesn't belong to the ITTO-species list of the 21 selected taxa*
G2S_S_30.5	*Triplochiton scleroxylon*	correct ✓	***Triplochiton scleroxylon* = Abachi**	*correct declaration*
G2S_S_33.5	*Erythrophleum ivorense*	false ✗	***Lovoa trichilioides* = Dibétou**	*correct trade name* **Dibétou** *note: Dibétou doesn't belong to the ITTO-species list of the 21 selected taxa*
G2S_S_35.5	*Afzelia* spp.	correct ✓	***Afzelia* spp. = Afzelia**	*correct declaration*
G2S_S_38.5	*Nauclea diderrichii*	false ✗	***Guarea* spp. = Bossé**	*correct trade name* **Bossé** *note: Bossé doesn't belong to the ITTO-species list of the 21 selected taxa*
G2S_S_41.5	*Aningeria robusta*	false ✗	***Mansonia altissima* = Mansonia, Béte**	*correct trade name* ***Mansonia*** *note: Mansonia doesn't belong to the ITTO-species list of the 21 selected taxa*
G2S_S_47.5	*Cylicodiscus gabunensis*	correct ✓	***Cylicodiscus gabunensis* = Okan**	*correct declaration*

Conclusions

Regarding the role of wood anatomy in the control of internationally traded timber -*successfully applied within the ITTO blind test*- it can be clearly stated that the microscopic analysis is currently the most feasible and competitive method to identify wood. The microscopic analysis allows access to a large number of references (anatomical description of about 6,700 wood species) including the increasingly traded "lesser known species". Wood anatomy is routinely applied in the daily control of wood and wood products and false declarations can be proven in a short time. However, the important information about the geographic origin of the timber can't be determined by wood structure. To obtain this information, an interdisciplinary combination of genetic-, isotope-, and microscopic techniques is a very feasible solution. In general, the methods of macroscopic and microscopic wood identification can be relatively easy transferred to international working groups involved in the control of timber trade (relative low investment costs for the microscopic techniques). However, the reliable identification based on microscopic wood structure requires considerable professional expertise, a rather sophisticated infrastructure, and a well-sorted reference wood collection (Fig. 4).

Fig. 4. Scientific wood collections at the Thünen Institute of Wood Research, Hamburg