CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Twenty-fifth meeting of the Plants Committee
Online, 2-4, 21 and 23 June 2021

Interpretation and implementation matters

Regulation of trade

ADDENDUM TO IDENTIFICATION OF TIMBER AND OTHER WOOD PRODUCTS

1. This document has been prepared by the co-chairs of the working group on identification of timber and other wood products.*

Update on progress since May 2020

2. Following the postponement due to the COVID-19 pandemic of the 25th meeting of the Plants Committee, scheduled to take place from 17 to 23 July 2020, the Committee took a number of intersessional decisions (see Notification no. 2020/056 of 21 September 2020), including the establishment of an intersessional working group on Identification of timber and other wood products, with the following mandate:

   a) consider the progress reported by the Secretariat in document PC25 Doc. 19 on the implementation of Decisions 18.140 to 18.143 and 16.58 (Rev. CoP18), and any other relevant documentation produced by the Secretariat or published on the CITES website;

   b) determine gaps and complementarities in various tools and knowledge sources for timber identification, such as existing field identification guidelines and keys, and on their availability and usefulness;

   c) develop standardized information templates and other tools that could be used by Parties to facilitate information sharing on the content and status of wood sample collections, and exchange with research institutions, law enforcement agencies, and other authorities;

   d) assist Parties in identifying existing laboratory services for the identification of timber and wood products and in strengthening screening and forensic capacity to identify CITES-listed tree species in trade;

   e) determine methods to stimulate global, regional and national exchange of best practices in wood identification technologies between Parties; and

   f) prepare an update on progress in the implementation of Decision 18.140 for the Standing Committee and draft recommendations for CoP19, as appropriate, for consideration at the next meeting of the Plants Committee.

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* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

3. The membership of the working group was agreed as follows:

   Co-chairs: Rosemarie Gnam (representative for North America), César Augusto Beltetón Chacón (representative for Central and South America and the Caribbean), and Yan Zeng (alternate representative for Asia);

   Members: Ali Mahamane (representative for Africa); Damian Wrigley (representative for Oceania);

   Parties: Argentina, Canada, China, Colombia, Georgia, Germany, Hungary, India, Indonesia, Italy, Peru, Philippines, Republic of Korea, Singapore, Thailand, United Kingdom of Great Britain and Northern Ireland and United States of America;

   Observers: United Nations Office on Drugs and Crime (UNODC), Chambre Syndicale de la Facture Instrumentale (CSFI), Environmental Investigation Agency USA, Forest Based Solutions, Forest Trends, Species Survival Network (SSN), TRAFFIC and World Resources Institute.

4. The outcomes of the working group are reported below, in line with each paragraph of its mandate.

Concerning paragraph 2 a) of the mandate

5. In document PC25 Doc. 19, paragraphs 3 and 4, the Secretariat reported on progress on the implementation of Decisions 16.58 (Rev. CoP18) and 18.141, and published supporting information through information document PC25 Inf. 11 on 'Identification of Timber and Other Wood Products – Supporting Information', consisting of a compendium on: institutions and experts on identification of timber and other wood products; resources relevant to the identification of timber and other wood products; and main gaps and challenges in the identification of timber and wood products in international trade.

6. An overall view suggested by several working group members was that there is no one method or tool that will address all of our timber identification needs. We suggest that two sets of tools are needed: One for frontline enforcement officers who require sufficient information to confirm that the shipment may include CITES-regulated material and that the specimen as stated on the documentation conforms with our understanding of that CITES-listed species, and another for the experts who need to make the definitive identification for forensic or legal purposes at the genus or species level.

7. The working group considered information document PC25 Inf.11 and provided feedback to improve it. The feedback received to the information document has been incorporated by the Secretariat in the revised compendium in the **Annex** to the present Addendum. This Annex also incorporates, to the extent possible, the additional suggestions reported throughout this document under lines of the working group's mandate.

8. As part of the overall effort to consider progress on the implementation of Decisions 18.140 to 18.143 and 16.58 (Rev. CoP18), the working group's review of information document PC25 Inf. 11 also informs the restructuring of the Timber Identification webpage of the CITES website, which at present is only briefly mentioned on the CITES Identification Materials webpage. To this end, the United States of America made the following overarching comments regarding such a webpage:

   a) Parties will benefit from having access to identification materials and guidance on the identification of timber and other wood products that can be found in a reliable location on the CITES website, perhaps as a subpage to the 'CITES Identification Materials' webpage.

   b) Where possible, there is value to including the pdfs of printed identification materials and guidance information produced by and for CITES Parties. And, where copyright does not allow this, a citation or reference list would still be helpful.

   c) Many websites and resources that focus on timber and wood product identification could provide useful information for CITES' timber identification purposes. A goal becomes to acknowledge them, not replicate them. For information that was not produced by CITES Parties and is maintained on websites of other entities, a list of links directly to those sites could decrease maintenance for CITES website upkeep.

9. Noting that paragraphs b) of Decisions 16.58 and 18.142 direct the Secretariat to publish certain material on the CITES website, the working group Chair notes suggestions were provided to identify tools and materials summarized in information document PC25 Inf. 11—namely, the information and materials regarding tools,

procedures for the identification and measurement of CITES-listed tree species, and the physical inspection of timber shipments (Decision 16.58 (Rev. CoP18); and, the currently available guidance on wood identification (Decision 18.142). Where suitable information in response to paragraph b) of the above decisions was identified, the group saw value to include them on a revised Timber Identification page, particularly those materials produced specifically for and by CITES Parties to assist with timber identification.

10. Considerable information in information document PC25 Inf. 11 appeared better suited for internal use by the working group, but needs further discussion and analysis, as follows:

    a) A broad array of expertise and undertakings were represented by the institutions, organizations, and networks (Section 1.1). Without further sorting the resources would not appear to assist frontline or backend timber identification. The WG should sort these entities into categories that would better inform its effort. Then discuss prospects for how to "interact" with the resources.

    b) The names and contact details of experts in various aspects of wood identification were provided but the purpose of this information was unclear (Section 1.2). The value of this information may lay in their ability to assist the group to address its mandate. As such, it was recommended that the group consider how this expertise might assist in addressing gaps in knowledge or understanding, and other aspects of our mandate.

    c) The information on collections and xylotheques did not appear to be readily useful for timber identification but could assist in addressing knowledge gaps (mandate, para. b)), exploring prospects to improve reference libraries or exchange wood sample (mandate, para. c)), and possibly other aspects of the mandate.

    d) Concerning databases (Section 2.2) and identification manuals (Section 2.3), the working group could undertake further work to sort these materials to assist in addressing the gaps and challenges.

    e) The gaps and challenges in the document (Section 3), and others obtained in Notifications to Parties and obtained during these working group discussions, merit further discussion. The group arrived at some initial overarching concepts, as noted below.

    f) The group noted that additional resources for wood identification should also be further sorted to determine their value in addressing the mandate of the working group.

    g) Given the unusual circumstances and lack of in-person meetings during the present intersession, there was a general sense that opportunity for further discussion would greatly improve efforts to address the mandate of this working group. It was also suggested that the group might provide feedback to the revised Timber Identification webpage, should that be desired, prior to its launch.

<u>Concerning paragraph 2 b) of the mandate</u>

11. Regarding gaps and complementarities in available tools and knowledge sources and their availability and usefulness, the full range of available identification methods should continue to be used in a complementary fashion. Overall, while improvements are being made to both rapid "low-tech" field assessments and more definitive lab-based techniques, bringing the two together will clearly require considerable investment, in both technology and human resources. The gaps and challenges identified in information document PC25 Inf. 11 and in related documents and discussions may help prioritize further efforts, but for the foreseeable future, manual and technological identification methods must work together, in a complementary fashion. General observations made by the working group on the complementary sets of manual and technical tools that are needed, mechanisms to improve their access, and suggestions for addressing gaps are elaborated below. The working group was not able to discuss or critically review available resources, though there may be some value to further work in doing so.

12. The group observed that successful use of any identification techniques first relies on a detailed understanding of the legal and illegal timber trades that they are being applied to. Once trading norms in a particular country or setting have been identified following an overview of the trade, the relative risks to species, transit countries and range States can be established. When the risk has been managed, profiles can be set to identify target shipments, and this is where an identification kit will then most effectively play its part.

13. In terms of understanding of the legal and illegal timber trades, trading patterns have traditionally been included in CITES identification materials for the very reason that it can be useful to border officers, and so this information should continue to be included. While the trading patterns for some species may stay the same for years, other trade may shift dramatically or gradually over time. To address the issue of maintaining a current understanding of trade patterns, Parties should evaluate and incorporate changes to trade norms into their trainings and guidance that is developed for their enforcement officials.

14. The CITES Secretariat previously maintained training materials (in the form of Compact Discs) targeted to enforcement officers, judges, and other audiences. These materials may no longer be available from the CITES website or may be available on the Virtual College, but with no direct link to the CITES website. There have been major advancements in providing training materials and the CITES website has undergone some changes, so that it may be useful to revive and provide updated training information as it pertains to identification of timber and other wood products.

15. To better elucidate gaps and availability of tools, it was suggested that there are frontline identification needs to distinguish between identification of species or commodities in trade at borders versus expert identification needs that meet legal standards for law enforcement, prosecution, and legal defense perspectives.

16. The group discussed frontline tools in timber identification. These tools need to be sufficient for enforcement officers to make evaluations in border inspections, which in combination with appropriate training are reliably accurate to meet the needs of most cases. Traditional field identification guides and keys that include wood anatomical and morphological information remain useful tools and are reliable for making initial assessments and quick comparisons. Frontline officers can be trained in the use of hand lenses and a dissecting microscope. Such low-cost, well established methods requiring low-tech tools continue to be valuable techniques for timber identification.

17. Regarding accessibility, many existing timber identification tools and guides can assist to identify CITES-listed timber species, and other resources were identified, several of which are already available in locations associated with CITES webpages. Some of these resources are continuously updated and available online, free of charge. Making these guides and keys, including a centralized repository of high-quality images, available on the CITES website can increase their accessibility. Accessibility options should continue to consider and address the needs of Parties with remote inspection stations that may not have internet access or sufficient bandwidth to accommodate accessing large documents online.

18. Based on the working group's comments, it would be useful to further discuss and possibly consolidate the timber identification materials and guidance already available on the CITES website or affiliates (including the Virtual College), with resources that have been and continue to be regularly shared in response to Notifications to Parties and identification materials updates on the agendas of AC and PC meetings, as well as additional information on new resources under development that were shared during discussions of this working group. A follow-on activity might be for the working group to review and provide an annotated list of the available materials, such as databases, guides, manuals, kits, and software. This could inform the development of the CITES Timber Identification webpage and could help elucidate further gaps or deficiencies in the available information.

19. The group also discussed the need for expert forensic timber identification tools. Methods for experts' accurate and definitive identification at the genus or species level may be needed either to address potential inconsistencies or to meet legal meet forensic, legal, judicial standards to justify seizures or for prosecution. It has previously been noted that the costs associated with detaining shipments of timber and other wood products (from both monetary and industry perspectives) can be considerable.

20. One working group member noted that many customs staff will not be considered "expert witnesses" when it comes to identifying timber, making it difficult for the use of keys or field guides to provide more than an initial (albeit very useful) guide. Should a witness statement be required for court purposes then a specialist wood anatomist would still be required to view the samples provided and give their expert opinion. This process may take at least 72 hours to perform, particularly as samples must first be delivered to the lab, and even this short delay can cause practical issues at the border, as the container has to be stored somewhere while awaiting results. There are ways of preparing samples and taking photos using mobile phones with magnifiers which can be a quick way of getting an enquiry to an "expert." Several existing references and guides can assist in such efforts (among others, see below), but the prospect of converting such technology-assisted field assessments into definitive identifications, however, would still require the use of more specialised equipment and expertise, in the controlled conditions of a lab.

– Wiedenhoeft, A. C. The XyloPhone: toward democratizing access to high-quality macroscopic imaging for wood and other substrates. IAWA Journal 41 (4), 2020: 699-719.

– Palacios, P.de, Esteban, L.G., Gasson, P., García-Fernández, F., Marco, A. de, García-Iruela, A., Esteban, L.G., González-de-Vega, D.G. de. (2020). Using lenses attached to a smartphone as a macroscopic early warning tool in the illegal timber trade, in particular for CITES-listed species. Forests 11: 1147. https://doi.org/10.3390/f11111147

21. There are presently three disciplines with a demonstrated ability to make conclusive species identification of complete unknowns: wood anatomy, genetics, and chemistry. Although this is not a comprehensive list, the actual number of places in the world that can use these techniques for wood identification for forensic purposes are quite limited, with roughly 12 labs worldwide using wood anatomy, two labs using DNA analysis of wood, and three labs that use chemo type analysis of wood. It may not be practical to assume that these handfuls of labs can address the global need for wood identification, nor should they.

22. The use of technology (such as NIRS, DART-TOFMS, DNA Barcoding, machine vision), provide greater certainty over species identity, although these tools can only be used effectively if practitioners have an in depth understanding of their use and scope. Considerable resources are also required to run, maintain and keep high-end technology secure. This includes the training or recruitment of specialist staff, who would need to make regular use of the technology to maintain their skills. The development of human resources in this field is therefore of equal importance to the roll out of new technologies, with increased capacity in both areas required. Building capacity while avoiding forensic techniques becoming prohibitively expensive, represents another fundamental challenge to overcome.

23. To reduce the complexity of the challenge in addressing gaps to meet the needs of expert identification, the needs could be further classified as those of exporting versus importing and re-exporting countries, to reduce the complexity of the challenge. For example:

    a) exporting countries only have a need to identify their exports: Not every country has the same need for wood identification. If a country is only involved in the export of wood, their needs for wood identification is simplified to only those species that are involved in commercial export. This presents opportunities of using alternative techniques such as phone app wood identification, rapid field chemistry tests (Near IR), or Xylotron-like schemes. The reason these approaches would be successful is because the databases would only contain taxonomic reference samples for probably less than 50 species. This approach has already been successful in various countries, where the approach has been to focus on developing a system to validate the exports of timber.

    b) importing countries or trans-shipment countries have a need to identify species from worldwide source: Large wood consumer countries have a need to determine species of timber from worldwide sources. Determining taxonomic source when the provenance is unknown becomes very challenging and has given rise to the concept that isotope analysis can infer geographic source, which then assists the anatomist in reducing the potential number of taxa.

24. Although the finer points of the above approach merits further discussion, the idea of these two focal groups appear to be in keeping with current efforts being undertaken by Parties. For instance, the Republic of Korea has begun a preliminary study on new technology to assist of customs and quarantine officers in their response to timber identification needs for Korean indigenous timber species. The study will develop an automatic identification technology using artificial intelligence and construct a database of anatomical characters of target species required for learning of artificial intelligence systems. If successful, such technologies could be adapted to help address needs for other exporting countries.

25. Arriving at an overarching understanding of the timber identification needs of a Party is a valuable step forward. Taking a more structured approach to the issue could assist in assessing the gaps and challenges, and to take into consideration the needs of priority taxa (*inter alia Dalbergia/Diospyros*). Further work is needed to sort and discuss the gaps and challenges and how the additional information presented in information document PC25 Inf. 11, as well as additional information shared in the course of the working group discussions and in responses to Notifications, can inform this effort.

Concerning paragraph 2 c) of the mandate

26. The development of standardized information templates and other tools that could be used by Parties to facilitate information sharing on the content and status of wood sample collections, and exchange with

research institutions, law enforcement agencies, and other authorities is a complex task. But there are several resources that may assist efforts to develop a template to facilitate sharing of wood samples.

27. One working group member noted that The WorldForestID initiative represents a long-term project to create a standardised wood reference library based on location specific timber samples. Progress on the project can be found here:

    – www.worldforestid.org

    – Gasson, P.E., Lancaster, C.A., Young, R., Redstone, S., Miles-Bunch, I.A., Rees, G., Guillery, R.P., Parker-Forney, M. & Lebow, E.T. (2020). **WorldForestID: addressing the need for standardised wood reference collections to support authentication analysis technologies: a way forward for checking the origin and identity of traded timber.** *Plants People Planet.* DOI: 10.1002/ppp3.10164 https://nph.onlinelibrary.wiley.com/doi/10.1002/ppp3.10164

28. A good amount of information on tools and wood collections are presented in information document PC25 Inf. 11 that could assist in this item and so merit further analysis and discussion. Both the International Association of Wood Anatomists and the International Union of Forest Organizations (IUFRO) working group on wood identification, also have as their mandate to increase the sharing of wood samples. Previous work can inform this effort, such as "Resources for acquiring reference material—New Collections" by the United Office on Drugs and Crime (UNODC) (UNODC 2016 Best Practice Guide for Forensic Timber Identification; pp. 45 and 46).

29. The group considered whether a questionnaire formatted similarly to information document PC25 Inf. 11 might serve as a useful template. While it was considered premature to finalize a template, the following elements might generally inform the need to identify timber and other wood products in trade:

    a) Human resource/ expertise / specialist knowledge[1]

        - Institutions, organizations, networks, and consortiums

        - Individual experts (incl. affiliations)

    b) Resources relevant to timber identification / "Hardware"

        - Timber collections / xylotheques

        - Databases

        - Identification resources: guides, manuals, keys, kits and software)

    c) Main gaps and challenges in timber and wood products identification in international trade

        - Species/Taxa that create identification / enforcement issues

        - Gaps on access to vouchered wood sample reference collections and databases

        - Identification capacity gaps

        - Gaps on a comprehensive overview of networks and resources already available

30. It was viewed that further work is needed to better elucidate the information needs before finalizing a template and that a more specific template could be developed by this working group, based on exchanges of experiences and views. Further discussion will benefit from the expertise represented on the working group as well we information provided in information document PC25 Inf. 11 on experts and institutions who are curators of wood collections. Views both from range countries and importing countries are likely to vary and are important to take into consideration.

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[1] *Names and contact information should not be submitted without the express permission of said individual.*

Concerning paragraph 2 d) of the mandate

31. To assist Parties in identifying existing laboratory services for the identification of timber and wood products and in strengthening screening and forensic capacity to identify CITES-listed tree species in trade, it was noted that information document PC25 Inf. 11 included information that informed this item. Specifically, information document PC25 Inf.11 partially accomplished the first part of this task (identifying existing laboratory services for the identification of timber and wood products). In addition, the experts with wood identification knowledge might serve as an internal source of information to assist this item.

32. Further work on this item is needed. Specifically, the task to assist Parties in strengthening screening and forensic capacity to identify CITES-listed tree species in trade is complex but key to the efficient enforcement of CITES, and merits further efforts.

Concerning paragraph 2 e) of the mandate

33. To determine methods to stimulate global, regional and national exchange of best practices in wood identification technologies between Parties, it was noted that exchange of knowledge and best practice is extremely important to this field, noting the following existing resources (identified by one working group member), may be of help in this regard:

    – UNODC (2016). **Best practice guide for forensic timber identification.** pp. 226. https://www.unodc.org/documents/Wildlife/Guide_Timber.pdf

    – Schmitz, N. (ed.), Blanc-Jolivet, C., Boner, M., Cervera, M.T., Chavesta, M., Cronn, R., Degen, B., Deklerck, V., Diaz-Sala, C., Dormontt, E., Ekué, M., Espinoza, E.O., Gasson, P., Gehl, D., Gehre, M., Haag, V., Hermanson, J.C., Honorio-Coronado, E., Koch, G., Lancaster, C., Lens, F., Liendo-Hoyos, E.P., Martínez-Jarquín, S., Montenegro, R., Paredes-Villanueva, K., Pastore, T., Ramananantoandro, T., Rauber-Coradin, V.T., Ravaomanalina, H., Rees, G., Sebbenn, A.M., Tysklind, N., Vlam, M.,Watkinson, C., Wiemann, M. (2019). **General sampling guide for timber tracking.** Global Timber Tracking Network, GTTN Secretariat, European Forest Institute & Thuenen Institute. DOI:10.13140/RG.2.2.26883.96806; https://globaltimbertrackingnetwork.org/

    – Schmitz, N. (ed.), Beeckman,H., Cabezas, J.A., Cervera, M.T., Espinoza, E., Fernandez-Golfin, J., Gasson, P., Hermanson J.C., Jaime Arteaga, M., Koch, G., Lens, F., Martínez-Jarquín, S., Paredes-Villanueva, K., Pastore, T.C.M., Ramananantoandro, T., Schraml, R., Schröder, H., Sebbenn, A.M., Tysklind, N., Watkinson, C, Wiedenhoeft, A.C. (2019). **The Timber Tracking Tool Infogram. Overview of wood identification methods' capacity.** Global Timber Tracking Network, GTTN Secretariat, European Forest Institute and Thünen Institute. DOI: 10.13140/RG.2.2.27920.25603; https://globaltimbertrackingnetwork.org/

    – Schmitz, N. (ed.), H. Beeckman, C. Blanc-Jolivet, L. Boeschoten, J.W.B. Braga, J.A. Cabezas, G. Chaix, S. Crameri, B. Degen, V. Deklerck, E. Dormontt, E. Espinoza, P. Gasson, V. Haag, S. Helmling, M. Horacek, G. Koch, C. Lancaster, F. Lens, A. Lowe, S. Martínez-Jarquín, J.A. Nowakowska, A. Olbrich, K. Paredes-Villanueva, T.C.M. Pastore, T. Ramananantoandro, A.R. Razafimahatratra, P. Ravindran, G. Rees, L.F. Soares, N. Tysklind, M. Vlam, C. Watkinson, E. Wheeler, R. Winkler, A.C. Wiedenhoeft, V.Th. Zemke, P. Zuidema (2020). **Overview of current practices in data analysis for wood identification. A guide for the different timber tracking methods**. Global Timber Tracking Network, GTTN secretariat, European Forest Institute and Thünen Institute. https://globaltimbertrackingnetwork.org/

34. There were suggestions to provide information on wood identification as part of species proposals, by amending Resolution Conf. 10.13 (Rev. CoP18) on *Implementation of the Convention for tree* species, as part of the section on "Regarding amendment proposals for tree-species." Initial suggestions, not fully discussed within the group, included that Parties:

    – share information on vouchered wood samples;

    – urged to provide such reference samples;

    – include references, if available, about the methods and databases used to identify the taxa at the appropriate level (genus or species); and

– include the names of institutions that have identification expertise (with the agreement of those institutions), which aligns with the requirement in Resolution Conf. 10.13 (Rev. CoP18) to include the names of expert organizations consulted while preparing a proposal.

35. As it pertains to timber species are already included in the CITES Appendices, and related to the issue of addressing gaps in paragraph c), it would be helpful to identify the CITES-listed species for species for which reference samples continue to be lacking, and to facilitate efforts to address needs. The group might explore a means of exchanging wood samples between wood anatomy labs under CITES permit waiver conditions similar to those used by registered scientific institutions.

36. Progress was made to identify potential models for best practices in wood identification technologies, and suggestions to increase the availability of and provide wood reference samples for CITES-listed trees. Further discussions on this item would be beneficial.

Concerning paragraph 2 f) of the mandate

37. Progress has been made on several aspects, but there is a need for further opportunity to advance these issues. There was a desire for further focused discussions, in particular encouraging input from wood identification experts to communicate their knowledge and experiences. Opportunities for dynamic discussions between working group members and the sharing of information on emerging wood identification techniques and applications will be integral to this effort.

38. Recognizing the inherent difficulties of addressing these complex issues virtually during the pandemic, the working group considers that its mandate may not be fulfilled during the present intersessional period. As such, we recommend that Decisions 18.140-18.142 and 16.58 (Rev. CoP18) may need to be renewed or revised so that this work may continue in the next intersession post CoP19.

Revised recommendations

39. The Plants Committee is invited to:

    a) take note of document PC25 Doc. 19 and the present addendum and its Annex;

    b) request the Secretariat to publish on the relevant section of its website relevant elements of the revised compendium of timber identification resources, as contained in the Annex to the present addendum, in line with Decision 16.58 (Rev. CoP18), paragraph b), and Decision 18.142 paragraph b);

    c) based on the progress achieved by the intersessional working group, consider the pertinence of the following draft decisions to continue the work on identification of timber and other wood products:

        19.AA Directed to the Secretariat

        The Secretariat shall, in consultation with the Plants Committee, and subject to external resources:

        a) liaise with relevant organizations and experts in the development of a depository of timber identification resources and a dedicated webpage, taking into account the progress and recommendations reported in document PC25 Doc. 19 and its addendum;

        b) in undertaking the above, consideration should be given to tailor the compilation of timber identification resources for both frontline enforcement officers and to experts involved in identifying timber for forensic or legal purposes; and

        c) report on progress or results of this work to the Plants Committee at its first regular meeting after CoP19 and seek its advice and input.

        19.BB Directed to Parties

        Parties are encouraged to collaborate with the Secretariat in sharing relevant information in support of the implementation of Decision 19.AA.

19.CC Directed to the Plants Committee

The Plants Committee shall:

a) consider progress and results reported by the Secretariat as per Decision 19.AA;

b) make recommendations to the Secretariat, the Standing Committee, and the Conference of the Parties, as appropriate.

19.DD Directed to the Standing Committee

The Standing Committee shall consider any report by the Plants Committee relating to the implementation of Decision 19.CC and convey, as appropriate, any recommendations it may have to the Conference of the Parties.

Revised compendium on timber identification resources*

**Modified by the Secretariat from information document PC25 Inf. 11*

TABLE OF CONTENTS

1. Information on institutions, organizations, networks and consortiums on timber and other wood products

1.1. Agrarian National University La Molina (Peru)

a) Area of expertise: general timber identification.

b) Website: https://www.timeshighereducation.com/world-university-rankings/national-agrarian-university-la-molina

c) Contacts:

- Jorge Chavez, Forest Science Dean: jmchavez@lamolina.edu.pe
- Manuel Chavesta Custodio. Forest specialist: mchavesta@lamolina.edu.pe

1.2. Agroisolab

a) Area of expertise: Stable Isotope Ratio Analysis (SIRA) for the authentication of origin of timber and forest products. Reference database includes timber from USA (Quercus spp.), Peru (~70spp), Gabon (~13 taxa), Solomon Islands (14 taxa), and over 50 timber SIRA databases built before WFID was established. UK Operations Director. Statistical analysis of SIRA measurements, incl. predictive tools to expand SIRA reference data; e.g. to correlate reference SIRA signatures of different taxa at same location to widen value of SIRA dataset to taxa not referenced. Analysing and interpreting SIRA results. Expert in lab management of isotope ratio mass spectrometry (IRMS) and associated wet chemistry for sample preparation.

b) Website: https://www.agroisolab.com/and https://www.agroisolab.com/timber

c) Contacts:

- Charlie Watkinson (UK Operations Director): Charlie.watkinson@agroisolab.com
- Gareth Rees (Food and timber chemist): Gareth.Rees@Agroisolab.com
- Markus Boner (Founder and head of science): M.Boner@agroisolab.de
- Roger Young [CEO of Agroisolab (UK, Germany) and POC for WFID Advisory Board]:
- Roger Young (Service delivery of timber authentication projects): Roger.Young@Agroisolab.com; roger.young@agroisolab.com

1.3. Canadian Forest Service (CFS) of Natural Resources Canada

a) Area of expertise: CFS has initiated a wood identification research project in partnership with Environment and Climate Change Canada and other Canadian and international organizations. The long-term objective is the creation of a Centre of Expertise in Wood Identification within the Government of Canada, including forensic analysis capacity and research to develop and contribute to novel wood identification techniques, methodologies and guides. These include, for example, a new field identification guide for imported species in Canada, image recognition (XyloTron) and mass spectrometry (DART-MS and GC-MS)).. Knowledge products include: scientific publications, training and screening tools for enforcement officers, synthesis of data on legacy wood sample collections in Canada; development and expansion of reference databases for species identification (genomic and chemical signatures, wood anatomy, etc.); increased anatomical and microscopic wood identification capacity and; application of geo-referenced genomics data for Canadian tree species. The project focuses on exotic and CITES-listed species, but attention will be paid to native tree species which closely resemble CITES-listed species.

b) Website: https://www.nrcan.gc.ca/our-natural-resources/forests-forestry/13497

c) Contact:

Wood identification group / Groupe identification du bois (NRCAN/RNCAN)

nrcan.woodidentificationgroup-groupeidentificationdubois.rncan@canada.ca.

1.4. Center for International Forestry Research (CIFOR)

a) Area of expertise: CIFOR is a non-profit, scientific institution that conducts research on the most pressing challenges of forest and landscape management around the world. CIFOR is a CGIAR Research Center, and leads the CGIAR Research Program on Forests, Trees and Agroforestry (FTA). CIFOR has developed a suite of publications relevant to, *inter alia*, timber legality verification and traceability systems.

b) Website: https://www.cifor.org/

c) Contact: Available in https://www.cifor.org/our-work/about-cifor/contact-us/

1.5. Chinese academy of forestry (CAF), Research Institute of Wood Industry

a) Area of expertise: Timber identification of CITES-listed trees, wood anatomy, DNA barcoding, solid wood products, plywood. Based on the largest wood collection of China and professional wood identification laboratory, the group developed wood anatomy, DNA barcoding, computer vision and chemical fingerprinting techniques and established a wood identification database for CITES-listed tree species. The group published more than 60 relevant reserach papers, 5 authorized patents and more than 15 academic books.

b) Website: http://en.caf.ac.cn/ and http://criwi.caf.ac.cn/

c) Contact:

Lichao Jiao
Assistant Professor
86-10-6288-8392
jiaolc@caf.ac.cn
jiaolichao@126.com
China

Yafang Yin
Professor
86-10-6288-9468
yafang@caf.ac.cn
China

1.6. Cite Madera (Peru)

a) Area of expertise: Technical timber investigation and methodologies and instruments to identify sawn wood and timber products. Working in the "Forest Crime Project", one activity is reviewing the “Best Practice Guide for Forensic Timber Identification" to adapt it to national context.

b) Website: https://www.itp.gob.pe/nuestros-cite/madera-y-forestal/cite-madera-lima/

c) Contacts:

- Jessica Moscoso, CiteMadera Director, Minister of Production: jmoscoso@itp.gob.pe
- Jose Ugarte: jugarte@itp.gob.pe

1.7. Environment and Climate Change Canada (ECCC)

a) Area of expertise:

- Pacific Environnemental Science Centre (PESC) : Mass spectrometry-based wood identification techniques, chemical analyses and database creation.

- Wildlife Enforcement Directorate (WED): Legality and enforcement, wood identification knowledge transfer, development of field guides and applications for wood identification.

b) Website: https://www.canada.ca/en/environment-climate-change.html

1.8. Federal Fluminense University, Laboratory of Wood Anatomy and Dendrochronology

a) Area of expertise: Research on wood anatomy, focused on species identification. Member of the Global Timber Tracking Network (GTTN). Produces databases, tools and publications focused on commercial, Atlantic Forest and Brazilian endangered species, some of them are CITES- and IUCN-listed. Maintain a wood collection (Xiloteca do Herbário de Niterói (NITw)) recorded in the Index Xylariorum available in GTTN and International Association of Wood Anatomists (IAWA) web pages.

b) Website: http://gbg.sites.uff.br/lamad/

c) Contact:

Arno Fritz das Neves Brandes
Professor
+55 21 991984952
arnofritz@id.uff.br

1.9. Forensics Laboratory (U.S. Fish and Wildlife Service)

a) Area of expertise:

b) Website: Spectroscopy methods for wood identification. Legality and law enforcement.

c) Contacts: https://www.fws.gov/lab/contact.php

1.10. Forest Stewardship Council (FSC)

a) Area of expertise: Forest management certification. FSC provides access to 1,600 forests certified in over 80 countries with offices in over 50 countries.

b) Website: https://fsc.org/en

c) Contacts:

Phil Guillery (head of supply-chain integrity for FSC and POC for WFID Advisory Board): p.guillery@fsc.org

1.11. Forest Trends

a) Area of expertise: Forest Trends facilitates the Timber Regulation Enforcement Exchange (TREE) project since 2012, supporting enforcement officials responsible for the Lacey Act, Australian ILPA, EU Timber Regulation and similar legislation in the Asia Pacific region. The group meets every six months to share practical enforcement lessons and learn about new tools and research. Science-led enforcement is a major focus since 2018.

b) Website: https://www.forest-trends.org/

c) Contact:

Jade Saunders
Senior Policy Analyst for Forest Trends
+447815063356
jsaunders@forest-trends.org

1.12. Global Timber Tracking Network (GTTN)

a) Area of expertise: GTTN is a network for organizations who are Network Partners, and individuals who make up the Expert Network. GTTN promotes the operationalisation of innovative tools for species identification

and for determining the geographic origin of wood to verify trade claims. It is structured in three levels: i) working groups on standardisation of methods, database development, and communication, policy and advocacy; ii) expert committee that provides technical and expert support to the steering committee; and iii) a steering committee that provides strategic guidance and advice on project operations and conduct regional workshops on timber tracking issues.

b) Website: https://globaltimbertrackingnetwork.org/

c) Contacts: https://globaltimbertrackingnetwork.org/contact-us/

1.13. Instituto de Ecología, México (INECOL)

a) Area of expertise: Identification of wood samples, including from protected species, using the INSIDE WOOD website and the DELTA database (delta-intkey.com) in Australia (Richter, HG & Dallwitz, MJ 2000).) Published descriptions of some species and an identification key for 50 species in DELTA.

b) Website: https://www.inecol.mx/inecol/index.php/es/

c) Contact:

Fernando Ortega Escalona
Técnico Académico Titular C
228 8421800 extension 6104
fernando.ortega@inecol.mx
Fernandoortegaescalona57@gmail.com

1.14. International Association of Wood Anatomists (IAWA)

a) Description: The IAWA network comprises expertise on all aspects relevant to timber identification, in addition to providing extensive timber id resources, contains as well a list of self-declared experts, as provided in the link below.

b) Website: https://www.iawa-website.org/; and the list of anatomical experts is available in the link https://www.iawa-website.org/uploads/soft/Abstracts/List_of_wood_anatomical_experts.xlsx

c) IAWA Journal: https://brill.com/view/journals/iawa/iawa-overview.xml

d) Contact:

- Research Institute of Wood Industry, Chinese Academy of Forestry
  No. 1 Dongxiaofu, Haidian District, Beijing 100091
  P. R. China
  IAWA@caf.ac.cn (Dr. Lichao Jiao, Executive Secretary Office)
  iawa_website@126.com (Dr. Shan Li, IAWA Website)

- Naturalis Biodiversity Center
  P. O. Box 9517, 2300 RA, Leiden
  The Netherlands
  iawa.financial.office@gmail.com (Cees Lut, Treasurer)
  eevn33@kpnmail.nl (Emma E. van Nieuwkoop, IAWA Journal)

- Yafang Yin (Professor): yafang@caf.ac.cn

- Additional contact information here: https://www.iawa-website.org/en/Who_is_who/Secretariat_and_Office.shtml

1.15. International Tropical Timber Organization (ITTO)

a) Area of expertise: ITTO has supported numerous activities throughout the tropics to identify tropical timber species and wood physical characteristics. Its website provides further information on relevant projects and initiatives.

b) Website: https://www.itto.int/

c) Contacts: https://www.itto.int/contact_us/

1.16. International Union of Forest Research Organizations (IUFRO)

a) Area of expertise: IUFRO is a non-profit, non-governmental international network of forest scientists, which promotes global cooperation in forest-related research and enhances the understanding of the ecological, economic and social aspects of forests and trees. IUFRO is "the" global network for forest science cooperation. It unites more than 15,000 scientists in almost 700 Member Organizations in over 125 countries, and is a member of ICSU. Scientists cooperate in IUFRO on a voluntary basis.

Particularly, the IUFRO Research Group (link below) will contribute to academic exchanges and cooperation among global wood identification scientists in the field of collection and exchange of wood specimens, and development of wood identification methods.

b) Website: https://www.iufro.org/; and https://www.iufro.org/science/divisions/division-5/50000/51600/

c) Contact: Available in the link https://www.iufro.org/contact/ and https://www.iufro.org/science/divisions/division-5/50000/51600/

1.17. Naturalis Biodiversity Center

a) Area of expertise: Wood identification (mainly wood anatomy and DNA barcoding), development of databases and scientific reference wood collection (125.000 samples), publications, outreach, implementation CITES-listed tree species, including ebony woods (*Diospyros* and Ebenaceae). According to the information provided to the Secretariat, Naturalis laboratories (link below) have state of the art equipment to perform wood anatomy and DNA barcoding.

b) Website and links: https://www.naturalis.nl/en; https://www.naturalis.nl/en/en/museum/identification-of-traded-timbers; https://www.naturalis.nl/en/naturalis-laboratories

c) Contacts:

- Frederic Lens
  Senior Researcher
  0031683172643
  frederic.lens@naturalis.nl
  https://www.naturalis.nl/en/frederic-lens
- Dr Pieter Baas: Pieter.baas@naturalis.nl
- Naturalis laboratories: expertcentrum@naturalis.nl

1.18. Peru's Environmental Prosecutor, Public Prosecutor Office Forensic Team Lab (EFOMA)

a) Area of expertise: Timber identification, forensic procedures, legality, enforcement and traceability, and development of timber databases.

b) Website: https://www.mpfn.gob.pe/iml/efoma/

c) Contacts:

- Flor de Maria Vega (National Coordinator): coordinacion-fema@mpfn.gob.pe
- Milton Tullume Chavesta (Forest specialist): mtullumechavesta@gmail.com

1.19. Rio de Janeiro Botanical Garden (Jardim Botanico do Rio de Janeiro)

a) Area of expertise: Anatomical identification of commercial, Atlantic Forest and Brazilian endangered species. The Rio de Janeiro botanical garden holds the third largest Brazilian wood collection.

b) Website: http://en.jbrj.gov.br/

c) Contacts:

- Claudia Franca Barros: cbarros@jbrj.gov.br)
- Neusa Tamaio: neusa@jbrj.gov.br

1.20. Royal Botanic Gardens (RBG, Kew), UK CITES Scientific Authority for Flora

a) Area of expertise: The vast collections in the Kew Herbarium include a wealth of herbarium specimens of tree species. Additionally, two-thirds of the Kew site, is an arboretum. Living collections and herbarium specimens act as a source of information, to determine what the plants look like and what morphological and chemical variation occurs, inter alia. Microscopic examination and identification of vegetative plant material, especially woods, is done for a wide range of enquirers including UK Border Force, BEIS, Police, Medics and vets, timber traders, antique dealers, furniture restorers etc. Many publications on wood identification and systematic wood anatomy, some concentrating on CITES woods, *Dalbergia* etc., have been written at Kew. Kew is actively improving its timber reference collections with geo-referenced, botanically named samples of commercial timber species. The Microscope Slide collection at Kew enables it to fulfil its responsibilities to Defra, providing expert identification of timber entering the UK. In 2012, following the closure of government forensic service laboratories, many microscope slides of wood were donated to Kew by the Metropolitan Police Forensic Service and have been incorporated into our slide collection. Currently there are over 150,000 slides in the collection.

b) Website: https://www.kew.org/

c) Contacts:

- Dr Carly Cowell
  Senior Science-Policy (CITES)
  +44 (0)77 75225528
  c.cowell@kew.org
- Dr Peter Gasson
  (Lead wood anatomist and POC for WFID Advisory Board)
  +44 (0)20 8332 5330
  P.Gasson@kew.org
- Dr Alan Paton (Head of Science – Collections): a.paton@kew.org
- Dr Mark Nesbitt (Economic Botany department, uses and trade in wood products): m.nesbitt@kew.org
- Sara Redstone (Plant Health & Quarantine Officer and POC for WFID Advisory Board): S.Redstone@kew.org
- Paul Wilkin (Head of Natural Capital and Plant Health and POC for WFID Advisory Board): P.Wilkin@kew.org

1.21. Royal Museum for Central Africa (RMCA), Tervuren Xylarium

a) Area of expertise: Expertise related to the development of tools for the identification of timber and other wood products incl. plywood and charcoal. Wood forensics, visual identification keys, collection of thin sections and charcoals, lumber yield assessments, sustainable management and inventories. Study sites and collaborations in Cameroun, DRC, Madagascar, Namibia, South Africa, USA, Belgium. Research on wood identification tools, including microscopic analysis of anatomical features and DNA analysis and chemical analysis of the metabolite content (DART-TOFMS) and automatic pattern recognition. Belgian governmental reference collection of wood samples, with specimens from the whole world, particularly rich for Central-

Africa. Includes CITES protected species such as rosewoods, palisander and mahoganies. More than 80 000 specimens from 13 000 species of lignified plants. An online database is available. Belgian Court-approved laboratory for any wood related matters (Belgium). Member of the scientific advisory board, temporary member with credentials of the CITES Scientific Authority, incl. methodology and implementation of non-detriment findings (NDFs).

b) Website:
https://www.africamuseum.be/en/research/collections_libraries/biology/collections/xylarium/browse/l

c) Contacts:

- Hans Beeckman (Head Laboratory for Wood Biology and Xylarium): hans.beeckman@africamuseum.be
- Annelore Nackaerts (Collection / xylarium manager): annelore.nackaerts@africamuseum.be
- Kévin Lievens (wood laboratory technician, microtomist): kevin.lievens@africamuseum.be
- Mélissa Rousseau (wood identification, wood anatomy, dendrochronology, capacity building, responsible for management of wood biology lab in Yangambi, DRC): melissa.rousseau@africamuseum.be
- Nils Bourland (CITES expert for tree species, capacity building and expertise in forest management, silviculture, logging and inventories incl. forest measurements, also with CIFOR and FAO): nils.bourland@aigx.be
- Wannes Hubau (wood anatomy, dendrochronology, atracology): wannes.hubau@africamuseum.be

1.22. Scion Research

a) Area of expertise: Wood identification service to public and private clients including forensic and archaeological investigations. We don't currently develop wood identification tools but we have research capability to do so including anatomical, DNA and chemistry based methods. We curate heritage data on New Zealand native timbers and some Pacific timbers including a xylarium.

b) Website: https://www.scionresearch.com/

c) Contacts:

Dr Lloyd Donaldson
Senior Scientist/Wood Anatomist
+64 7 343 5581
lloyd.donaldson@scionresearch.com

1.23. Swedish University of Agricultural Sciences (SLU)

a) Area of expertise: Routine analysis and identification of wood samples from different sources, applying traditional keys (e.g. The InsideWood Database, http://www.woodanatomy.ch/ident; IAWA Lists of microscopic features for hardwood and softwood identification; H.G. Richter and M.J. Dallwitz; Commercial timbers/DELTA/Intkey). Identification of listed wood samples confiscated under CITES regulations for the Swedish Environmental Protection Agency. Involved in identification and practical use of lesser-known tree species in African countries (e.g. Mozambique) to replace overexploited species.

b) Website: https://www.slu.se/en/

c) Contacts:

Geoffrey Daniel
Professor
+4618672489
geoffrey.daniel@slu.se

1.24. Technical University of Munich (TUM), Research Laboratory Wood

a) Area of expertise: General expertise in the identification of wood species, most common CITES-species, e.g. palisander. Developed an online identification key for the most common European species using macroscopic features. It uses high definition photos, which separates it from other software solutions. It provides different identification keys for beginners as well as experienced users. The laboratory is currently developing a database solution that helps to efficiently organize, access and share data from our reference wood collection. If successful, it should also be available for other institutions in the future.

b) Website: https://www.hfm.tum.de/en/tum-research-laboratory-wood/

c) Contacts:

Michael Risse
phone +49 89 2180 6384
risse@hfm.tum.de

1.25. Thünen Centre of Competence on the Origin of Timber

a) Area of expertise: The Thünen Centre of Competence on the Origin of Timber is the German central contact facility for government agencies, timber trade, consumers and associations to verify the species of wood and/or wood products and its origin. Its xylotheque comprises over 45,000 specimens representing 12,000 species.

Microscopic wood identification: For official/judicable reports on wood identification. Up to 80 structural-anatomical characters can be used for definitive wood identification. Microscopic analyses enable identification of all solid wood specimens including very thin veneer layers (thickness lesser than 0.20 mm) incl. individual wood strands and chips. Wood Genetics: Develops molecular genetic markers (genetic barcodes) to distinguish tree species, even species that cannot be separated by anatomical methods. Assessment of forest certification and verification of legal compliance: Responsible for the assessment of forest certification schemes within the German regulation for the public procurement for wood and wood-based products. This includes both the surveillance of the development of the standards of the certification systems which are under periodical revision and the decision concerning the acceptance of certificates of the systems, comparable certificates or individual specifications in terms of the procurement regulation.

b) Website: www.thuenen.de/timber/

c) Contacts:

- Dr Gerald Koch (Lead): gerald.koch@thuenen.de
- Céline Blanc-Jolivet (Scientist) : +49 (0)4102 696 157 ; celine.blanc-jolivet@thuenen.de

1.26. United Nations Office on Drugs and Crime (UNODC)

a) Area of expertise: The ‘Combating Forest Crime Project’ in Peru helps to coordinate judiciary and administrative actors via a ‘forest crime platform’. The platform includes the Public Prosecutors Office, Judiciary, National Police, National Forest and Wildlife Service (SERFOR), Agency for the Supervision of Forest Resources and Wildlife (OSINFOR), Ministry of Environment, Customs, Regional Governments. These institutions are involved in the adaptation of the Timber Guide and want to use it in the future processes. The Best Practice Guide for Forensic Timber Identification is being used to share and standardize information about timber forensic traceability and different identification methodologies between the law enforcement actors. It will be adapted to the national context in Peru. An app will also be developed as a complimentary technical tool for timber identification. Initially, it will only include Peruvian species.

b) Website: https://www.unodc.org/

c) Contacts:

Lorenzo Vallejos / Pavel Bermudez
Project Coordinator / Forest specialist
+51 999 266 865 / +51 975 594 986
lorenzo.vallejos@un.org
pavel.bermudez@un.org

1.27. Universidad Nacional Agraria la Molina (UNALM, Perú) -Timber identification laboratory

a) Area of expertise: The laboratory is devoted to development of timber identification technologies.

b) Website: http://www.lamolina.edu.pe/FACULTAD/forestales/lab_anatomia_maderas/

c) Contact: Available in the link
http://www.lamolina.edu.pe/FACULTAD/forestales/lab_anatomia_maderas/contactenos.htm

1.28. Université d'Antananarivo, Plant Molecular Biology Lab

a) Area of expertise: Expertise in identification of species of the genus Diospyros and Dalbergia. SPIR (spectroscopie proche infrarouge) expertise. DNA identification.

b) Website: http://www.univ-antananarivo.mg/

c) Contacts:

+261 20 22 326 39
info@univ-antananarivo.mg

1.29. University of Washington

a) Area of expertise: Collaboration on augmentation of tree species databases for the image recognition wood identification tool (Xylotron).

b) Website: https://www.washington.edu/

1.30. USDA (U.S. Department of Agriculture)

a) Area of expertise: Research existing and new methods for wood identification. Develop keys to the identification of CITES-listed species and look-alikes. Publish articles outlining ways to distinguish between protected and unprotected woods. Design and present wood identification short courses (Spanish and English) for government and academic organizations.

b) Website: https://www.usda.gov/

c) Contacts:

Michael C. Wiemann
Botanist
608-231-9258
michael.wiemann@usda.gov
mwiemann@gmail.com

1.31. Wood Identification and Screening Center (WISC) -U.S. Forest Service

a) Area of expertise: WISC performs forensic wood identification for USG regulatory agencies and WFID and has the capacity to accurately identify all CITES wood species and 2000+ commercially significant timber species.

b) Website: https://www.fs.usda.gov/about-agency/international-programs/WISC

c) Contacts:

- Beth Lebow (WISC Center Director and POC for WFID Advisory Board): elizabeth.lebow@usda.gov
- Cady Lancaster (lead scientist): cady.lancaster@usda.gov
- Kristen Finch (lead scientist): finchkri@oregonstate.edu

1.32. Wood and Plant Fibre Research Centre (Bulgaria)

a) Area of expertise: Research on wood and paper identification using light microscopy and scanning electron microscopy.

b) Website: N/A

c) Contacts:

Ms. Valentina Dimitrova (Director): valia@valdi2000.com

1.33. Wood Geographic

a) Area of expertise: Expertise in wood species identification since 2001 and a member of IAWA-China Group since 2013. Created WoodGeographic in 2016. Devoted to anatomical microscopic identification of tropical woods.

b) Website: N/A

1.34. World Forest ID (WFID)

a) Area of expertise: The World Forest ID (WFID) consortium is in the process of building the largest geo-referenced wood sample collection. This much-needed global library of physical forest samples is being used to confirm or disprove claims about the species and provenance of forest products, using all complementary scientific methods. WFID is a collaboration between governments and organizations from the scientific, environment and economic sectors. Five coordinating bodies oversee the WFID consortium in the form of an Advisory Board (AB): World Resources Institute ((WRI) acting (unofficial) Secretariat), Agroisolab, Forest Stewardship Council (FSC), Royal Botanic Gardens Kew (Kew) and the U.S. Forest Service International Programs (USFS IP).

For an overview, see: Gasson, P.E., Lancaster, C.A., Young, R., Redstone, S., Miles-Bunch, I.A., Rees, G., Guillery, R.P., Parker-Forney, M. & Lebow, E.T. (2020). WorldForestID: addressing the need for standardised wood reference collections to support authentication analysis technologies: a way forward for checking the origin and identity of traded timber. Plants People Planet. DOI: 10.1002/ppp3.10164 , https://nph.onlinelibrary.wiley.com/doi/10.1002/ppp3.10164

b) Website: https://worldforestid.org/about/

c) Contacts:

Meaghan Parker-Forney
Science Officer for WRI and Advisory Board member/Secretariat for WFID Consortium
+1 301 215 0501
mparker@wri.org

1.35. World Resources Institute (WRI)

a) Area of expertise: WRI has demonstrated its ability to convene actors across sectors to move forward platforms and initiatives as secretariat for some of the world's biggest and most forward-thinking global development initiatives such as the Global Commission on Adaptation and Initiative 20x20. Under WRI, The Forest Legality Initiative is a multi-stakeholder program focused on reducing illegal logging through supporting the supply of legal forest products. WRI also coordinates domestic and international projects focused on scaling wood identification tools for enforcement and private sectors.

b) Website: https://www.wri.org/

c) Contacts:

Meaghan Parker-Forney (Science officer for WRI's Forest Legality Initiative and POC for WFID Advisory Board): mparker@wri.org

1.36. Xylarium Bogoriense

a) Area of expertise: Xylarium Bogoriense is the centre of the authentic wood collection in Indonesia. The wood has been collected from most regions in the country since 1914. Before 2018, the number of specimens was 45,000, and placed the 3rd or the 4th largest xylarium in the world. Nowadays, in the number of specimens, the Xylarium Bogoriense becomes the largest wood collection with more than 206,000 specimens consisting of 6700 species. In this Xylarium, more than 100 bamboo and rattan species, and wood fossils are also stored.

b) Website: http://xylarium.pustekolah.org/, http://xylariumindonesia.pustekolah.org/

2. Resources relevant to the identification of timber and other wood products

2.1. Collections and xylotheques

2.1.1. Center for Wood Anatomy Research, Forest Products Laboratory (FLP-USDA)

a) Description: The mission of the Center is to combine state-of-the-art knowledge and techniques in botany and wood anatomy in the search for new approaches and improvements to wood identification and to accumulate and make known information on the anatomical and other characteristics of woods that may affect their utilization potential. The website (see below) includes links to wood collections, wood identification resources (including sheets, kits, and techsheets), and other resources.

b) Website: https://www.fpl.fs.fed.us/research/centers/woodanatomy/index.php

c) Contact:

- FLP: https://www.fpl.fs.fed.us/products/library/index.php
- Wood identification assistance: https://www.fpl.fs.fed.us/research/centers/woodanatomy/wood_idfactsheet.php

2.1.2. Economic Botany Collection, Royal Botanic Gardens, Kew

a) Description: This collection illustrates the extent of human use of plants around the world (and also includes 500 specimens of fungi). The variety of objects includes artefacts made from plants as well as raw plant materials, such as wood samples. There are c.100,000 specimens of which about half are wood/timber samples.

b) Website: https://www.kew.org/science/collections-and-resources/collections/economic-botany-collection

c) Contact:

Dr Mark Nesbitt (Economic Botany department, uses and trade in wood products): m.nesbitt@kew.org

Dr Alan Paton (Head of Science – Collections): a.paton@kew.org

2.1.3. Microscope Slide Collection, Royal Botanic Gardens, Kew

a) Description: This collection holds around 150,000 specimens from a diverse range of plant taxa, particularly from seed-producing plants. The slides include leaf surfaces and sections, pollen, wood, woody roots and chromosomes. Regarding CITES-listed flora, according to the information provided to the Secretariat, this collection includes high resolution scans of all microscope slides of CITES-listed woods as well as a set of photos of the *Dalbergia* spp.

b) Website: https://www.kew.org/science/collections-and-resources/collections/microscope-slide-collection

c) Contact:

Tim Fulcher (RBG Kew, Collections Manager) t.fulcher@kew.org

Alicia Musson (RBG Kew, Collections Assistant) a.musson@kew.org

2.1.4. Naturalis Biodiversity Center Collection

a) Description: The collection offers support in safeguarding forests by providing customs officers and other stakeholders with a timber tracking tool aloowing them to identify illegally logged wood samples.

b) Website: https://www.naturalis.nl/en and https://www.naturalis.nl/en/en/museum/identification-of-traded-timbers

c) Contact:

Dr. Frederic Lens
Senior researcher
Understanding Evolution
frederic.lens@naturalis.nl

+31 (0)71 7519320

2.1.5. The Herbarium at the Royal Botanic Gardens, Kew

a) Description: The Herbarium at the Royal Botanic Gardens Kew houses approximately seven million plant specimens, collected from all around the world. Specimens are either pressed and dried or preserved in spirit. These include over 300,000 putative type and historically important specimens collected by plant hunters, explorers and scientists of great renown including Charles Darwin, Joseph Dalton Hooker and Nathaniel Wallich, to name just a few. Regarding CITES-listed flora, according to the information provided to the Secretariat, the herbarium houses 1,518 specimens of *Dalbergia* spp, 69 species of *Guibourtia* spp, and 218 *Cedrela* spp.

b) Website: https://www.gbif.org/dataset/cd6e21c8-9e8a-493a-8a76-fbf7862069e5#:~:text=Description-,The%20Herbarium%20at%20the%20Royal%20Botanic%20Gardens%20Kew%20houses%20approximately,dried%20or%20preserved%20in%20spirit.

c) Contact:

- Metadata author

Herbarium, Library, Art & Archives, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK
herbcat@kew.org; +44 (0)208 332 5206

- Administrative point of contact

Herbarium, Library, Art & Archives, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK
herbcat@kew.org; +44 (0)208 332 5206

2.2.6. The New York Botanical Garden (NYBG)

a) Description: According to their description online, NYBG is a world leader in plant research and conservation, using traditional and cutting-edge tools to discover, understand, and preserve Earth's vast botanical diversity.

b) Website: https://www.nybg.org/plant-research-and-conservation/

c) Contact: https://www.nybg.org/plant-research-and-conservation/about/meet-the-scientists/

2.1.7. The Smithsonian National Museum of Natural History's Botany Collections

a) Description: The plant collections of the Smithsonian Institution began with the acquisition of specimens collected by the United States Exploring Expedition (1838-1842). These formed the foundation of a National Herbarium which today numbers over 5 million historical plant records, placing it among the world's largest and most important. Over 1.7 million specimen records (including over 113,000 type specimens with images) are currently available in this online catalog.

b) Website: https://collections.nmnh.si.edu/search/botany/

c) Contact: See 'feedback' page of the website provided above.

2.1.8. The Smithsonian National Museum of Natural History's Wood Collection

a) Description: This collection contains ca. 42,500 specimens representing almost 3000 genera. Approximately 60% of the specimens are vouchered, with most of the vouchers deposited in the U.S. National Herbarium (US). Approximately 5000 microscope slides are associated with the Wood Collection. Additionally, a number

of card files are tied to the collection. Much, but not all, of the data in these files are being made available electronically in the Wood Collection database.

b) Website: https://naturalhistory.si.edu/research/botany/collections-access/wood-collection

c) Contact: https://naturalhistory.si.edu/research/botany/collections-access/wood-collection/wood-contacts

- Formal requests for material for sectioning must be submitted to the Collections Manager of the U.S. National Herbarium, Department of Botany, MRC-166, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A. (telephone: (202)633-0943; fax: (202)786-2563; e-mail: USNH@si.edu).

- Requests for additional information not found in the database should be directed to: Stanley Yankowski, Department of Botany, MRC-166, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A. (telephone: (202)633- 0962; fax: (202)786-2563; e-mail: yankowss@si.edu).

2.1.9. The Scientific Wood Collection (Xylotheque) of the Thünen Institute in Hamburg

a) Description: The services of the Thünen Centre of Competence can be used by authorities, companies, NGOs, but also by private individuals, on: microscopic wood identification, genetic test on tree species an geographic origin, and assessment of forest certification.

b) Website: https://www.thuenen.de/en/infrastructure/the-thuenen-centre-of-competence-on-the-origin-of-timber/the-scientific-wood-collection-xylothek/

c) Contact: holzherkuenfte@thuenen.de

2.1.10. The Xylotheque at the Wood Research Munich (Technical University of Munich)

a) Description: The xylotheque (wood collection) at the Holzforschung München consists of a scientifically used and a historical collection. The scientific collection includes more than 10'000 wood samples and 22'000 microscopic slides covering more than 5'000 different wooden species from all over the world.

b) Website: https://www.hfm.tum.de/en/tum-research-laboratory-wood/xylotheque/#:~:text=The%20xylotheque%20(wood%20collection)%20at,from%20all%20over%20the%20world.

c) Contact:

Michael Risse, M.Sc.
Chair of Wood Science
location Schwabing-West
Tel. +49 89 2180 6384
risse@hfm.tum.de

2.1.11. The Wood Collection of Chinese Academy of Forestry (CAF)

a) Description: The Wood Collection of Chinese Academy of Forestry is the largest xylarium in China, housing more than 27,000 specimens covering approximately 7632 species and over 35,000 microscopic slides. The wood samples and microscopic slides are being digitalized for accessing online. Based on the wood collections, the xylarium is establishing a wood identification database for wood anatomy, DNA barcoding, computer vision and chemical fingerprinting techniques.

b) Website: http://bbg.criwi.org.cn/

c) Contact:

Tuo He
Assistant Professor
tuohe@caf.ac.cn

2.1.12. Wood Collection, University of Florida Herbarium

a) Description: The University of Florida Wood Collection contains approximately 15,700 accessioned wood samples, approximately 1,000 un-accessioned wood samples, and 1,000+ microscope slides (thin sections, typically transverse radial and tangential views). Woods from all parts of the world are included with an emphasis on those of the tropics. According to the information provided to the Secretariat, this collection is in the process of verifying with the corresponding wood block and those data are being catalogued; the project is more than halfway complete, having reached in the Rosaceae (alphabetically). Future goals for this collection include increasing online accessibility, correlating their holdings with collections at other institutions, and updating nomenclature and cross walking synonymy.

b) Website: https://www.floridamuseum.ufl.edu/herbarium/flaswood.htm

c) Contact:

- Dr. Lucas C. Majure
  Curator of the Herbarium
  Telephone: (352) 273-2102
  lmajure@floridamuseum.ufl.edu
  Projects/specialties: Systematics of Cactaceae, Melastomataceae, Dichanthelium (Poaceae); floristics in the Greater Antilles and SE U.S.

- Kent D. Perkins
  Manager of the Collection
  Telephone: (352) 273-1984
  kperkins@flmnh.ufl.edu
  Projects/specialties: herbarium computerization and data management; endangered species; types of the UF Herbarium

- Marc S. Frank
  Extension Botanist
  Telephone: (352) 273-1994
  plantid@flmnh.ufl.edu
  Projects/specialties: Plant identification; horticulture and horticultural systematics; botanic garden collection management.

2.2. Databases

2.2.1. *Arbor Harbor*

a) Description: Arbor Harbor is a reference system linking information on trees and their global trade, especially species at risk of over harvesting. The system integrates data on taxonomy, conservation, geography, and trade regulations, all acquired from online databases or primary literature. Intended users include professionals or enthusiasts working with forest resources and their sustainable use. According to the information provided to the Secretariat, the system compiles taxonomic data from 25,000 timber producing taxa. The website provides information on wood identification tools, including: Direct Analysis in Real Time Mass Spectrometry (DART-TOFMS), Stable Isotope Ratio Analysis, and XyloTron image analysis.

b) Link: https://woodid.info/

c) Contact: info@woodid.info

2.2.2. China National Gene Bank (CNGB)

a) Description: China's first national-level gene storage bank, approved and funded by the Chinese government. Based in the Dapeng Peninsula of Shenzhen, CNGB's mission is to support public welfare, life science research and innovation, as well as industry incubation, through effective bioresource conservation, digitalization and utilization.

b) Link: https://www.cngb.org/index.html

c) Contact: Available in the link https://www.cngb.org/contact.html

2.2.3. Database for the xylotheque of the Institute of Biology (UNAM, Mexico)

a) Description: The xylotheque of IB-UNAM has around 3,000 wood samples, and an annex collection of around 2,000 pieces. The objective of the collection is to have all Mexican timber species represented. The xlotheque is hosted by CONABIO (Mexico's Scientific Authority). To date, the collection has 945 species represented.

b) Link: https://www.gbif.org/dataset/80c88d00-f762-11e1-a439-00145eb45e9a

c) Contact: Available in the link https://www.gbif.org/dataset/80c88d00-f762-11e1-a439-00145eb45e9a#contacts

2.2.4. DELTA – DEscription Language for TAxonomy

a) Description: The DELTA format (DEscription Language for TAxonomy) is a flexible method for encoding taxonomic descriptions for computer processing. DELTA-format data can be used to produce natural-language descriptions, conventional or interactive keys, cladistic or phenetic classifications, and information-retrieval systems. According to the information provided to the Secretariat, the database contains: wood anatomical macroscopic description and illustration of 130 internationally traded timber (including 16 CITES-protected timbers); and wood anatomical microscopic description and illustration of 53 internationally traded softwoods (including 8 CITES-protected timbers).

b) Link: https://www.delta-intkey.com/ and https://www.delta-intkey.com/wood/index.htm

2.2.5. *GeoAssign Database*

a) Description: Genetic assignment method using origin using genetic, phenotypic and geographic information.

b) Link: https://geoassign.thuenen.de/

2.4.6 *InsideWood Database*, IAWA

a) Description: The InsideWood project integrates wood anatomical information from the literature and original observations into an internet-accessible database useful for research and teaching. The InsideWood database contains brief descriptions of fossil and modern woody dicots (hardwoods) and modern softwoods. It is worldwide in coverage. The database is searchable by an interactive, multiple-entry key. This wood anatomy web site has over 50,000 images showing anatomical details, primarily photomicrographs.

b) Link: https://insidewood.lib.ncsu.edu/search?4

c) Contact: xylem@ncsu.edu ; and tuohe@caf.ac.cn

d) Citation: Wheeler, E.A. 2011. InsideWood - a web resource for hardwood anatomy. IAWA Journal 32 (2): 199-211.

2.2.7. Naturalis Biodiversity Center's Database

a) Description: According to the information provided to the Secretariat, the database covers 125,000 wood specimens in scientific wood collection (second largest in the world), covering many wood lineages.

b) Link: https://bioportal.naturalis.nl/?language=en&back

2.3.8. *PROTA4U Database*

a) Description: PROTA is an international programme concerned with making scientific information about utility plants accessible in Africa, supporting their sustainable use to reduce poverty. The database contains information of approximately 8,000 plants used in tropical Africa.

b) Link: https://www.prota4u.org/database/search.asp

2.2.9. Tervuren Xylarium Wood Database, Royal Museum for Central Africa

a) Description: The database allows to search by scientific, commercial, vernacular or local names. According to the information provided to the Secretariat, the database covers 13,000 species and 83,000 specimens.

b) Link: https://www.africamuseum.be/nl/research/collections_libraries/biology/collections/xylarium

2.2.10. The Global Timber Tracking Network's (GTTN) Reference Database

a) Description: The reference database was developed for wood identification experts to find and share information on wood samples and reference data that have been created thus far, for any wood identification method. The minimum requirement for participating laboratories is to share metadata, which describe the tree species, geographical origin, and laboratory method. This information will be visible to any participating laboratories. In the best case, labs are willing to share vouchered physical wood samples, or even reference data. The metadata is also used in the background to increase the relevance of wood ID service customer queries through the Service Provider Directory.

b) Link: https://globaltimbertrackingnetwork.org/products/reference-database/

c) Contact: Available in the link https://globaltimbertrackingnetwork.org/contact-us/

2.2.11. The Wood Database

a) Description: This database includes a wood finder, of several species of hardwood, softwood and monocot.

b) Link: https://www.wood-database.com/

c) Contact: Available in the link https://www.wood-database.com/about/

2.2.12. TreeSource National database, Natural Resources Canada

a) Description: TreeSource is the National database on wood and trees quality in Canada. Developped by the Canadian Wood Fibre Centre, it aims to gather the largest possible amount of information on trees quality (dendrometry, physico-mechanical and chemical properties) for economically important species across Canada, for research purposes. Data are accessible for the whole forest sector (governments, academia, industry). With more than 530 000 trees, both coniferous and deciduous, over 1.1 millions dendrometrical measurements, and nearly 13 000 samples analyzed for physico-mechanical properties (wood density, MFA), TreeSource stands as the largest reference database on the topic.

b) Link: https://treesource.rncan.gc.ca/en

c) Contact: Available in the link https://treesource.rncan.gc.ca/en/contact

2.2.13. Tropical timber info database, ITTO

a) Description: Tropicaltimber.info enables smart searches of tropical timber species by use, properties and substitution; timber availability and sourcing; tree and wood identification; species distribution and abundance; and replacement or substitution of well-known species.Tropicaltimber.info also contains information and contacts for producers and consumers, including a virtual technical library and classic publications; a multilingual search facility for ITTO projects and links to ITTO statistics and publications; and consumer tips and education.

   According to the information provided to the Secretariat, the database includes 984 tropical timber species from all tropical regions, including lesser-known ones. Profiles of 60 timber species from America.

b) Link: http://www.tropicaltimber.info/

c) Contact: Ramon Carrillo: carrillo@itto.int

2.2.14. Xylarium Bogoriense

a) Description: Integrated Xylarium Bogoriense Database contains detail information of lignocellulose specimens collected in Xylarium Bogoriense including botanical name and synonym, local/trade names, herbarium voucher, wood origin, collection date, collector, wood anatomical structure description, wood identification key, macroscopic images, microscopic images, information of macroscopic, microscopic and fibre slides.

b) Link: http://xylarium.pustekolah.org/, http://xylariumindonesia.pustekolah.org/ http://nebulasolution.net/xylarium/

2.3. Identification resources: guides, manuals, keys, kits and software

2.3.1. Advancing Wood Identification - Anatomical and Molecular (by IAWA)

a) Description: The special edition of IAWA Journal 2020: 41(4) on Wood Identification contains 14 original papers and one review article emphasizing recent research development in wood identification.

b) Link: https://brill.com/view/journals/iawa/41/4/iawa.41.issue-4.xml and http://iawa-website.org/en/News/article_162.shtml

2.3.2. AIKO-KLHK (*Automatic Wood Identification System*)

a) Description: Android based wood identification, consist of 1180 Indonesian wood species, can be accessed freely in Play Store (https://play.google.com/store/apps/details?id=id.codepresso.woodid). The wood collection has played an important role in wood identification process for research, education, as well as bio-forensic which is involving wood as legal evidence. However, the limitation of existing science, technology, and human resource capacity have caused the process of wood identification to date can only be undertaken by experienced and trained researchers or officers. A method that can be considered to facilitate the identification of wood species in the field and industry by using computer vision (AIKO-KLHK). This method is supported by database of macroscopic images of wood cross section (LignoIndo). The automatic wood identification system is also enhanced to differ of wood origin or geographic location.

b) Link: https://play.google.com/store/apps/details?id=id.codepresso.woodid

2.3.3. Anatomical identification key of African tropical timber (by RMCA)

a) Description: The identification key covers 70 commercial species native to the Democratic Republic of Congo, and contains 22 macro and microscopic descriptions.

b) Identification key link and manual:
http://woodbiology.africamuseum.be/sites/woodbiology.africamuseum.be/files/identificationkey.zip; and
http://woodbiology.africamuseum.be/sites/woodbiology.africamuseum.be/files/tutorial.zip

c) Website: http://woodbiology.africamuseum.be/home

2.3.4. *Best Practice Guide for Forensic Timber Identification* (by UNODC)

a) Description: The Guide is intended for worldwide use, with the aim of facilitating the employment of forensic science to the fullest extent possible to combat timber crime. The Guide covers the whole chain of events, providing information on best practices and procedures from the crime scene to the court room. The target audience ranges from front-line officers, crime scene investigators, law enforcement officials, scientists, prosecutors and the judiciary. The Guide, as a whole, represents a starting point for a uniform approach to the collection and forensic analysis of timber for identification purposes. It is hoped that the use of the Guide will lead to more timely, thorough and effective investigations, resulting in an increased number of successful prosecution and a reduction in the illegal timber trade.

b) Link: https://www.unodc.org/documents/Wildlife/Guide_Timber.pdf

2.3.5. CITES I-II-III Timber Species Manual (by USDA)

a) Description: The manual provides the procedures for the enforcement of CITES-timber species listings. This is a first edition (2010).

b) Link: https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/cites.pdf

2.3.6. *CITESwoodID* -mobile application (by the Thuenen Institute and the Federal Agency of Nature Conservation of Germany (BfN))

a) Description: Computer-aided identification and description of CITES-protected timbers. Developed by the Thuenen Institute and BfN. Descriptions, illustrations, identification, and information retrieval. In English, French, German, and Spanish. Version: June 2020. It will be running on devices with Android, iOS and Windows Universal operating systems, downloadable for free via the respective app stores.

b) Mobile application links:

- Google Play: https://play.google.com/store/apps/details?id=de.bfn.CITESwoodID&hl=en&gl=US

- Apple Store: https://apps.apple.com/us/app/citeswoodid/id1534768227

2.3.7. *Crossing Borders* -guide for musicians and ensembles (by Pearle and IFM)

a) Description: The aim of this guide is to provide hands-on information to musicians, music ensembles, groups and orchestras on how to apply for CITES certificates such as the musical instrument certificate (MIC) before going on tour. The guide was last updated on 3 February 2020.

b) Link: https://www.pearle.eu/download/PUBLICATIONS/874dc27be9358a16cb06fcd5cd15c86f/0c207805bb8199b0566c91e929de02a0

c) Website: https://www.pearle.eu/publication/updated-cites-guide-crossing-borders

2.3.8. *Identification keys for timber species* –OSINFOR and INIA (Peru)

a) Description: the identification keys comprise 20 timber tree species native to Peru, including several CITES-listed species.

b) Link: https://www.osinfor.gob.pe/wp-content/uploads/2019/01/A-FICHAS-MADERABLES-OSINFOR-2017-final-comp.pdf

2.3.9. *Pickering Punch* -sampling device (by Agroisolab UK)

a) Description: the device is designed to provide a quick and simple way to collect samples of timber directly from trees. The samples can then be used in reference databases to test against other samples of timber an dsee if the isotope signatures are similar.

b) Link: https://www.agroisolab.com/pickering-punch; and *A new atlas and macroscopic wood identification software package for Italian timber species* https://doi.org/10.1163/22941932-00002102

2.3.10. *SIR-Legno* -atlas and wood identification software

a) Description: The atlas and accompanying software allows the identification of 48 Italian timber species based on a recently proposed list of macroscopic features for wood identification. Inter alia, for each genus covered by the atlas, information of CITES-listing status is provided.

b) Link: https://brill.com/view/journals/iawa/41/4/article-p393_2.xml

2.3.11. *The Timber Tracking Tool Infogram* (by GTTN)

a) Description: The short guide gives an overview of the current capacities of the different timber tracking tools. The only way to be sure that a wood (product) at the end of the supply chain is what the documents say it

is, is to check the inherent wood characteristics that can reveal species and geographic identity. There is an increasing interest to bring clarity into complexity of the global timber supply chains. Depending on the question, one method will be more suitable than the other. The infogram wants to guide here and inform on the different possibilities offered for the different identification requests. The guide links to a list of experts in timber tracking.

b) Link: https://globaltimbertrackingnetwork.org/portfolios/timber-tracking-tool-infogram/; and 10.13140/RG.2.2.27920.25603

2.3.12. Tropical Timber Atlas (by ITTO)

a) Description: The Atlas covers over 300 tropical timber tree species.

b) Link: https://www.itto.int/files/itto_project_db_input/3028/Technical/E-TMT-SDP-010-12-R1-M-Tropical%20Timber%20Atlas.pdf

2.3.13. *Vida Silvestre* -mobile application (by ROAVIS)

a) Description: Identification tool designed for enforcement officers, customs inspectors and governmental officers, to provide them with relevant information regarding protection, conservation and trade of wildlife, as well as to facilitate reporting of illegal trade through new technologies.

b) Mobile application links:

- Apple Store : https://apps.apple.com/us/app/vida-silvestre/id1230816633?l=es

- Google Play: http://bit.ly/vida-silvestre

c) Website: https://vidasilvestre.net/

2.3.14. *Xylorix Macroscopic Wood Identification System* -mobile application and kit

a) Description: The system allows wood identification using simple tools. It relies on taking pictures with macro lens to get identification results by using a mobile application. The website also includes a link to a wood identification kit.

b) Mobile application links:

- Google Play: https://www.xylorix.com/static/media/google_play_icon.63baf38f.png

- Apple Store: https://www.xylorix.com/static/media/app_store_icon.e79ea504.png;

c) WIDK-24X01 Kit: https://www.xylorix.com/products/widk24x01

d) Website: https://www.xylorix.com/; and https://www.agritix.com/

e) Contact: agritix@agritix.com

3. Main gaps and challenges in the identification of timber and wood products in international trade

Based on the information provided by Parties and stakeholders, the Secretariat has grouped the gaps mentioned as follows. Gaps are listed and described in descending order of the frequency and priority, with which the responses mentioned them.

3.1. Gaps on access to vouchered wood sample reference collections and databases

Many responses highlight access to vouchered wood sample reference collections and their associated databases as a major gap. Specific challenges include the sampling and management of such collections according to the standards required by law enforcement and prosecution, global cooperation for facilitating international access and exchange of such samples, and the availability of open source material. Responses point to the lack of such samples in virtually all tropical species, in particular in exporting countries. Yet, even well-known collections, such as those at RBG Kew, mention a lack of availability of reference samples for some timber species (*Caryocar*, *Aniba*, many *Dalbergia* species, Malagasy *Diospyros*), or for relevant look-alikes. One response emphasises the need for associated databases to contain georeferenced points of origin in addition to taxonomic identification, in order to allow verification of legality. Suggestions to address this challenge include increased public support and funding, including via ODA, political or diplomatic channels, and enhanced personnel and technical infrastructure. Two responses propose global cooperation, or a dedicated working group to facilitate protocols enhance international access to and exchange of samples. One response suggests that CITES Authorities might be able to help to provide samples. One response suggests that samples could be collected at the time of felling or on botanical collecting expeditions, and ideally be part of WorldForestID.

3.2. Identification capacity gaps

a) Overall, the development of useful wood identification tools for enforcement and customs officials, increased capacity building and regular training for enforcement officials, and for developing protocols for collection of wood samples and database information is needed. Field guides to assist with the use of digital tools are highlighted as a specific gap. One response suggests to define in country capacity building prior to the delivery of technological ODA support, to ensure countries possess the required networking, research, and service delivery capacities. It also suggests to explore such measures as potential conditionality for receiving technological ODA support.

b) Many responses emphasized gaps and challenges in databases and identification technologies. Several responses emphasize challenges to DNA based methods, including extraction techniques and sample processing, since DNA material extracted from timber and processed woods may be small in quantity and highly degraded. Responses remark that establishment of points of origin, including for specimen derived from artificial propagation or plantations, requires many fresh georeferenced samples, such as leaves, and that such reference data is missing (see also the paragraph above). Another challenge is the location of most capacitated laboratories in the northern hemisphere, while exchange of samples and results with countries from the South was burdensome and slow, and thus created delays and fines for forest products importers and exporters. Further reported challenges include the combination of different identification tools and a comprehensive database combining information from all available identification tools (anatomy, DART TOFMS, DNA barcoding), which may yield different results depending on the identification tool used. Forensic protocols, and artificial intelligence tools to assist non-experts involved in timber inspection are also highlighted. One response suggests to determine correlations between SIRA signatures of different species in multiple locations, which could allow to predict signatures of non-sampled species in a specific location from other species in the same location. One response points to the need of determining the credibility (scope, error, reliability) of the various identification methods for judicial purposes.

c) Responses suggest several taxa or products for which identification challenges are most urgent due to look-alike issues with non-listed species. Several responses emphasize rosewoods and palisanders, including *Dalbergia* spp., *Diospyros* spp., *Pterocarpus* spp., and *Guibourtia* spp. Several non-listed taxa, including the genus *Machaerium* spp., are suggested as look-alikes or trade substitutes, which are currently not listed under CITES, and which can, at the moment not be distinguished from listed species with common identification techniques. Responses also suggest identification challenges with the genera *Pinus* spp. and *Quercus* spp., of which only individual species are currently listed under CITES. A general taxonomic challenge of confusion between scientific, local and trade names is also reported. Intraspecific identification challenges are reported in some responses, including between different provenances, and between cross-border populations for which legal export regulations may differ significantly between neighbouring States. Products that pose particular identification challenges are charcoal and plywood.

d) Individual responses highlight need for strengthened national policies for wood verification (e.g.in Brazil), a need to explore how inventory tactics should proceed under different legal frameworks (EUTR, Lacey, inter alia) once identification suggests the products not to be from the declared origin, and a need to educate people responsible for export of timbers in countries with high incidence of illegal logging.

3.3. Gaps on a comprehensive overview of networks and resources already available

a) ITTO points out that extensive identification material exists for most tropical timber species. The main challenge was to synthetize this material in a way that makes it useful and usable for people responsible for implementing CITES, including robust and preferably non-destructive field identification techniques that don't require a laboratory to implement.

b) The Wood and Plant Fibre Research Centre (Bulgaria) points out that regional organizations may have strong expertise in identifying local species and products. Regional organizations may be able to provide quick investigations and answers to inquiries by local law enforcement authorities. Therefore, the Decision of the CITES Conference to collect information and cooperate with local organizations will considerably help the timber tracking efforts locally as well as globally.

4. Additional information relevant to Decisions 16.58 (Rev. CoP18) and 18.140 to 18.143

In addition to the information compiled in the previous sections, some Parties provided additional information on ongoing initiatives or resources that they wished to highlight for the purposes of the implementation of Decisions 16.58 (Rev. CoP18) and 18.140 to 18.143.

4.1. Canada

a) In 2002, Environment Canada, in collaboration with the CITES Secretariat and the United States Department of Agriculture (USDA) Forest Service and Animal and Plant Health Inspection Service published the *CITES Identification Guide – Tropical Woods*. Currently, an identification guide for exotic wood species is being developed jointly by Environment and Climate Change Canada, and the Canadian Forest Service of Natural Resources Canada. The guide will combine a range of previously verified field tests, including use of ethanol reagents, ultraviolet light, odor, color, weight, and hardness tests, in a format that will facilitate the work of enforcement agents who are required to make rapid, regulatory decisions while inspecting shipments of exotic wood imported into Canada.

b) Canada is conducting wood identification research focused on developing wood anatomy techniques, genomic markers, biochemical analysis using mass spectrometry, protocols for sampling and collecting vouchered wood samples, wood screening and testing tools for enforcement officers, and information for contribution to global geo-referenced wood sample databases. The initiative includes ongoing collaboration with (inter alia) the USDA Forest Service, the World Resources Institute, and the Global Timber Identification Network.

c) Since 2018, Canada has conducted training courses on wood anatomy and practical wood for enforcement and customs officers, through collaborative efforts of Canadian wood anatomists and wildlife enforcement officers. The training is focused on wood anatomy and fundamental identification techniques, and aims to provide field officers with knowledge sufficient to make informed and rapid decisions when inspecting exotic wood shipments entering Canada. The training also provides field officers with contacts for wood identification experts who can support their work when needed, as well as standardised sampling methods suitable for court cases.

d) In 2018, Canada began an integrated wood identification research initiative, with a long-term goal of developing a Canadian Centre of Expertise in Wood Identification. While the initiative is currently in the development phase, Canada will look for opportunities in future, to share with the Plants Committee information regarding the outcomes of current research, specific expertise at relevant laboratories, and regarding effective tools and protocols developed for use by enforcement and customs officers.

4.2. China

a) In recent ten years, China developed newly identification technologies, i.e. DNA, computer vision, chemical fingerprint, etc., to promote of the conservation of tree species diversity, legal and sustainable trade in the timber industry chains.

b) In 2015 and 2016, the Identification Manual of Endangered and Precious Timber Species Common in Trades (in Chinese and English) was co-published by the Management Authority in China of CITES and the Research Institute of Wood Industry, Chinese Academy of Forestry. It provided an important reference for law enforcement and customs of China and other countries, and strengthened management of imports and exports of endangered and precious timber species.

c) The organization of the International Conferences on Wood Identification, IAWA-IUFRO International Symposium “Challenges and Opportunities for Updating Wood Identification” in 2019 and XXV IUFRO World Congress LPF/SFB-IAWA Panel Discussion “New Methods and Applications of Tropical Timber Identification to Promote Legal Logging” in 2019, had established a good platform for international cooperation in wood identification technology.

4.3. France

France provided an additional list of institutions that could be relevant for the purposes of the implementation of the timber identification mandates in effect:

Institution or laboratory	Contact	Link
Laboratoire MSMAP	https://www.labo-msmap.com/contact/	https://www.labo-msmap.com/laboratoire-analyse-identification-bois/
xylotree	xylotree@gmail.com	https://www.xylotree.fr/
CIRAD	-	https://www.cirad.fr/innovation-expertise/produits-et-services/identification-anatomique-des-bois
Muséum national d'Histoire naturelle à Paris	-	https://www.mnhn.fr/fr
FCBA	+33 5 56 43 63 76	https://laboratoires-essais.fcba.fr/essais/identification-dessence/
ALCEBOIS	-	https://www.alcebois.fr/identification-des-essences-et-des-insectes-du-bois/
ABARCO	analyse@expert-bois.fr	https://www.expert-bois.fr/identification-essences-bois-expert-bois-ABARCO-EXPERTISES
Xylodata	info@xylodata.fr	https://www.xylodata.fr/page.php?lg=1&ra=2&rb=7&tp=7
LERMAB	-	https://lermab.univ-lorraine.fr/

4.4. Madagascar

Madagascar provided additional information regarding the ongoing development of identification resources for native species of *Dalbergia* and *Diospyros*. These include updates on anatomical identification, DNA-based identification technologies, and infrared spectroscopy and chemical identification of timber.

4.5. Mexico

Mexico also informed on the outcomes of the regional workshop held from 5-7 November 2018, in the framework of the CEC project in support of the sustainable trade of CITES-listed species. Information on this can be found in the link: http://www.cec.org/events/regional-training-workshop-on-capacity-assessment-on-wood-identification-for-the-trade-of-cites-listed-priority-timber-species/

4.6. United Kingdom of Great Britain and Northern Ireland

a) RBG Kew highlight that the enforcement of timber regulations (including CITES, Lacey and EUTR), could be enhanced by increasing the supply of suitable reference samples from producer countries wishing to export timber products.

b) UK Border Force highlight that detailed reviews of timber imports help enable targeted enforcement work in importing countries. Advances in timber ID techniques would greatly assist with such operations, which are dependent on resources and technology.

4.7. United States of America

USA noted that there seems to be a vision that all countries have the same need for wood species identification, we might approach the issue from a different angle, such as classifying the need per country, to reduce the complexity of the challenge. For example:

- Exporting countries only have a need to identify their exports: Not every country has the same need for wood id. If a country is only involved in the export of wood, their needs for wood identification is simplified to only those species that are involved in commercial export. This presents opportunities of using alternative techniques such as phone app ID's, rapid field chemistry tests (Near IR), or Xylotron like schemes. The reason these approaches would be successful is because the databases would only contain taxonomic reference samples for probably less than 50 species. This approach has already been successful in various countries, where the approach has been to focus on developing a system to validate the exports of timber.

- Importing countries or Trans-shipment countries have a need to identify species from worldwide sources: Large wood consumer countries have a need to determine species of timber from worldwide sources. Determining taxonomic source when the provenance is unknown becomes very challenging and has given rise to the concept that isotope analysis can infer geographic source, which then assists the anatomist in reducing the potential number of taxa. It seems to be that when CITES thinks of wood ID, it is this group that they have in mind.

For example, Gabon is known to be an active exporting country, and the total number of valuable tree species in that region is probably between 20 –30 taxa. Gabon has no need to identify *Dalbergia nigra* (App I), *Dalbergia retusa* (App II), or *Quercus mongolica* (App III) since they are not known to be an importing timber. In this example, Gabon may be a great example where an alternate approach to species identification may yield very accurate results.

Once we "bin" countries as exporter only, then a second step would be to evaluate the number of taxa and determine what is the best approach to that need. This would allow CITES to deal with the challenges of species identification in a structured manner yet reduced in complexity.

In addition to their contributions to the previous sections, USA provided the Secretariat supporting files relevant to identification keys, and specific guides relevant to Congo and Costa Rica. The Secretariat recommends Parties and stakeholders to contact USA's Management Authority to request access to this information, should it be of their interest, these are:

- Identification of endangered or threatened Costa Rican tree species by wood anatomy and fluorescence activity (Moya et al. 2012)

- CITES Congo guide (Born Free and FWS 2018)

- Stem Anatomy of *Dalbergia* and *Diospyros* Species from Madagascar: with a special focus on wood id. 2017. By Bako Harisoa Ravaomanalina, Alan Crivellaro, Fritz Hans Schweingruber. *Available via Kindle and hardcopy.*