Executive Summary[1]

Seattle Dialogue on
Development and Scaling of Innovative Technologies for Wood Identification

University of Washington

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Co-Conveners

World Resources Institute
U.S. Forest Service – International Programs
World Wildlife Fund
Center for International Trade in Forest Products

I. Introduction

The Seattle Dialogue was convened to help harness wood identification (hereafter "wood ID") technologies as part of efforts to combat illegal logging and associated trade. The meeting brought together some 60 participants, including many of the most renowned wood ID scientists in the United States (and several from overseas), with representatives of federal and state government agencies, key international institutions, NGOs, and illegal logging policy experts. The Dialogue's objectives were to: share perspectives and information on the current state of wood ID technologies and their practical applications; identify major challenges; map out potential roads to resolving those challenges; and catalyze new partnerships for the road ahead.

The Dialogue focused on four wood ID methods: wood anatomy; DNA-based methods; stable isotope analysis; and spectrographic chemical analysis. While additional technologies are being tested, scientists utilizing these four technologies have published evidence of concrete success with identification of wood specimens with respect to either species, origin, or both.

In addition to the plenary discussions detailed in this Summary, participants were also able to spend one morning split up into four groups in University of Washington laboratories specializing in the four wood identification methods that were the focus of the meeting. These hands-on sessions provided participants who were not wood ID scientists with a valuable opportunity to more deeply understand how the various technologies worked, and the challenges they face. For the scientists, these lab sessions provided an opportunity to hear the

[1] This Executive Summary was produced by the World Resources Institute.

kinds of questions and perceptions on wood ID arising from the policy and enforcement communities.

The participants' main task was to evaluate the state of various wood ID technologies, explore potential synergies among them, and "ground truth" the technologies' promise against the realities of forensic investigation and law enforcement. U.S. federal and state enforcement agents were asked to provide insights on field applicability of current methods and government and NGO affiliates were asked to provide contextual information on trends in international forest products trade, national and international policy developments, legislation and relevant research initiatives.

The Seattle Dialogue was convened to explore the ways in which emerging technologies for wood identification can more effectively contribute to combating illegal logging and associated trade, which is widely recognized as a key forest management and natural resources crime issue.

II. Summary of Plenary Sessions

Welcome and Overview

Dr. Charles Barber, Director of the Forest Legality Initiative at the World Resources Institute (WRI) kicked off the meeting by calling attention to the environmental, economic, social and security interests threatened by widespread illegal logging and associated trade. He noted that WRI believes in the importance of linking innovations in science and technology with policy and practical action on the ground. With respect to illegal logging, he noted that WRI distinguishes four key areas where innovative technologies are poised to play a key role:

Perimeter defense in the forest itself, utilizing remote sensing, unmanned aerial vehicles (drones), hand-help mobile devices in the hands of forest defenders, and anything else that operates in near-real time to prevent illegal logging before it happens, or identify offenders in time to apprehend and sanction them;

Timber traceability technologies and systems (ranging from simple hammer marks to barcodes and nanotechnology-based paint markers) which allow tracking particular units of wood product from the forest to their ultimate market destinations;

Data management and exchange platforms, which apply "big data" analytics to supplying information transparency on who is cutting, trading, buying and selling forest products across global supply chains; and

Wood identification technologies – the focus of the Seattle Dialogue – which permit identification of the species and provenance of particular wood specimens.

Dr. Barber concluded by inviting participants to focus on three outcomes:

- Conducting a rich exchange of information on the latest developments and key challenges related to wood identification;
- Translating this information into actions and policies to support law enforcement, as well as legality-verified timber supply chains in the private sector; and
- Incubating concrete partnerships and projects among the participating institutions to move forward on action.

Professor Elizabeth Van Volkenburgh, Interim Director of the University of Washington School of Environmental and Forest Sciences (SEFS), welcomed the participants and noted that SEFS, founded in 1907 with the mandate of "creating futures", was one of the first natural resources programs established at a university in the United States. Building on this broad and forward-looking mandate, SEFS has embraced a broad agenda on forests, natural resources, and the broader environment. She noted that the University of Washington was known for bringing together people with different areas of expertise around common themes and problems, and that this Dialogue clearly fell into that tradition.

Understanding the Policy Context

Ms. Linda Walker, Director for Responsible Forestry and Trade at WWF-US, noted that WWF has been in existence for more than 50 years, operates in more than 100 countries, and has some 5 million members. With an overall mission to conserve nature and alleviate the most pressing threats to biodiversity, illegal logging is a necessary priority for the organization, since it impacts on WWF priority wildlife species, places and local communities; hurts developing country governments; and impacts on business trying to practice legal and responsible sourcing of wood products.

Ms. Walker explained that illegal timber trade is often closely linked to other forms of natural resources crime like wildlife trafficking, and even to illicit trade in arms, drugs, and human trafficking. Financial losses are difficult to pinpoint, but estimates show illegal logging is responsible for annual losses of between $30-100 billion, a staggering amount. Illegal logging hotspots, she noted, are mostly far from the United States, in the tropics or the Russian Far East. Much of the illegally-logged wood, however, ends up nonetheless in the U.S.

Finally, she drew attention to the critical links between illegal logging of some key endangered timber species and high-priority threatened animal species:

- Exploitation of Mongolian oak (*Quercus mongolica*) and Manchurian ash (*Fraxinus mandshurica*) in the Russian Far East threatens the few hundred Amur tigers left in the wild – the largest species of tiger.
- Cutting of "African teak" (*Pericopsis elata*, also known as Afrormosia) in the Congo Basin is impacting critically endangered gorilla populations;
- The fevered plunder of Siamese rosewood (Dalbergia cochinchinensis) in the countries of mainland Southeast Asia is compounding threats to the critically endangered Saola, a

rare wild cattle relative
- In Indonesia, the relentless hunt for prized ramin wood (*Gonstylus spp*.)
- In the Amazon, illegal cutting of Brazilian rosewood (*Dalbergia nigra*), Spanish cedar (*Cedrela odorata*), and Bigleaf mahogany (*Swietenia macrophylla*) threatens the jaguar

Prof. Ivan Eastin, Director of the University of Washington Center for International Trade in Forest Products (CINTRAFOR) provided a summary of the global state of forest products trade, noting that the United States is the largest importer of solid wood and wooden furniture products in the world, while China is the second-largest importer of wood and the largest exporter of furniture, with one-third of global exports. He went on to review recent measures on timber legality put in place by the United States, EU, Australia and, most recently Japan. He cautioned that despite heightened regulatory and press attention, illegal logging is still a major problem. Finally, he drew attention to a recent CINTRAFOR study on awareness of and attitudes about illegal logging and associated trade in China and Vietnam. One interesting finding of the study was that industry in China is relatively well aware of the rising tide of regulatory and other attention to illegal logging, but is not happy about it, while industry in Vietnam are more pro-regulation, but are less aware of international policy developments.

Dr. Milena Sosa-Schmidt, Senior Scientific Support Officer for Flora with the Secretariat of the CITES Convention,[2] introduced some of the current issues CITES is facing with the lack of reliable methods to identify timber. The trade in rosewood (*Dalbergia spp*.) – an entire genus put under CITES regulation in October 2016 – is a perfect example. With over 250 species in the genus – many of which are indistinct and have a long list of lookalikes – trying to determine the risk or vulnerability of each species is a daunting, expensive task. (Ironically, the entire genus, rather than a particular *Dalbergia* species, was listed by CITES in large part because of the difficulty of telling species within the genus apart.) So, although the entire genus was recently listed on CITES Appendix II (the listing came into force on January 2, 2017), range states for Dalbergia must, under CITES rules, conduct species-specific "non-detriment findings" (that set sustainable harvest levels) before allowing any trade in species from the genus.

Improving credible and practical methods for identifying rosewood species is, therefore, a very real and pressing challenge for CITES and its member governments, in combating a large and growing illicit trade tied in many places to organized crime and violence, due to the very high value of rosewood timbers.

Dr. Alex Moad, Assistant Director for Policy at the U.S. Forest Service International Programs Office, explained that while USFS is largely a domestically-focused agency, it also works

[2] CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international treaty established to reduce threats to wild species of animals and plants in international trade. International trade in some species has been completely banned under CITES. Trade in most CITES-listed species, however, is regulated by a regime under which range states for a species conduct a "non-detriment finding" – an assessment of what level of international trade can co-exist along with the health of the species in question. Export quotas and licenses are then granted on the basis of this NDF.

internationally on both technical cooperation around traditional forest management issues (e.g. firefighting, wood harvesting practices, protected areas management) and key policy issues such as illegal logging and forest governance. He noted that USFS prioritizes illegal logging because it has such an outsize impact on forest degradation and forest integrity, frequently serving as the catalyst for wholesale deforestation, fires, and land degradation.

Dr. Moad noted that while there is an obvious political transition underway in Washington, which may reverse a number of policy directions of the previous administration on environment and forests, he was optimistic that U.S. leadership on combating illegal logging will be sustained. He observed that combating illegal logging generally has received bipartisan support over at least the past decade, since it addresses both conserving biodiversity and safeguarding U.S. industry from being undercut by cheap, illegal timber from abroad.

Mr. Mike Cenci, Deputy Chief of the Washington State Department of Fish and Wildlife's Law Enforcement Program, provided the Dialogue with the very interesting perspective of state-level law enforcement. He began by explaining that his agency has "general authority", meaning they are empowered to enforce both state and federal laws related to natural resources crime. He noted that most natural resource crimes had links to other forms of crime, and that complex financial crimes were also often part of the picture, requiring specialized detectives. Locally-important forest species include various species of old-growth timber, prized "figured" or "flamed" maple, cedar, and various other specialized forest products. Key enforcement challenges, he noted, include coordinating intelligence centrally; jurisdictional complexities with federal, state, and private landowners; and difficulties in tracing materials once it goes to the mill and beyond.

Turning to the application of wood identification technologies, he noted that different technological applications are more or less suitable for different stages of the criminal investigation and prosecution process. The kind of evidence that might be perfectly credible for establishing "probably cause" for an investigation or search, for example, might not stand up to the evidentiary standards for proving guilt "beyond a reasonable doubt" in court.

He concluded by noting the importance of cooperation and partnerships across the scientific and non-governmental communities for effective law enforcement responses to forest and other natural resources crime.

Wood Identification Technologies

The wood anatomy panel focused on the identification and classification of the physical properties of wood along with wood anatomy's appropriateness as a 'first line of defense' for the enforcement community. ***Dr. Mike Wiemann*** of the U.S. Forest Products Laboratory presented his work on traditional wood anatomy using microscopy and spoke about the limitations of this analysis method. ***Dr. John Hermanson*** who works with Dr. Wiemann at the Forest Products Lab presented his work on the development of the "Xylotron" and its current

capabilities. The Xylotron technology takes traditional wood anatomy methods – where an investigator analyzes diagnostic characteristics found within the transverse, tangential and radial planes of a wood sample, using a high-resolution microscope – one step further by employing algorithms akin to human facial recognition software on images of microscopic wood slides. The power in this method comes from the system's ability to compare thousands of digitized microscopic wood slide images to rapidly identify a sample's genus and potentially, delimitate species based on subtle diagnostic characters that may likely be unidentifiable by the human eye.

The DNA analysis panel focused on the power of DNA analysis in the context of both service provider and academic settings. ***Dr. Valerie Hipkins***, Director of the National Forest Genetics Laboratory (NFGEL) described how the development of new techniques is dependent upon the services her lab is requested to provide. More specifically, the types of services her lab provides – such as reconstructing the scene of a fire, or identifying original seed sources – are time-limited projects with finite funding which can prohibit any concerted efforts to develop new methods unless they are directly related to that project.

As a contrast to NFGEL's work, ***Dr. Brook Milligan*** discussed the academic approach to wood ID research and stressed the importance of obtaining funding to support development of new and innovative methods for DNA-based wood ID. Wood ID scientists agree, he noted, that, when it is possible to obtain DNA from wood or forest products, DNA analysis has the potential to be the most powerful tool available to accurately identify both species and origin of trees. Dr. Milligan then presented his work on a new approach to genetically identifying species and origin, which have yet to be demonstrated on wood-based products. Alternative to scouring a species' chloroplast and nuclear genome in hopes to identify markers that effectively discriminate species from one another (or discern a geographic region), Dr. Milligan and his colleagues are setting out to build reference databases for entire nuclear and chloroplast genomes of highly traded, vulnerable timber species. This method will allow Dr. Milligan and his colleagues to map fragmented DNA obtained from suspicious wood products back to a genomic reference library populated with different species' nuclear and chloroplast genomes. An approach such as this has the potential to significantly alleviate the current pinch-point of having to develop diagnostic markers for each tree species – which can be a costly and time consuming endeavor that must be carried out for each species.

While DNA analysis may in theory be the best method for identifying species and origin of a wood product, there are many limitations to overcome in practice. First and most obviously, is the ability the to reliably obtain non-degraded DNA from wood and wood-based products. Second, as Dr. Hipkins noted, the specific genetic markers a researcher has identified as reliably diagnostic for one particular species using one particular methodology may become obsolete if the methodology itself is replaced by a more advanced successor, or totally obsolete if analyzing a different species.

The stable isotope panel addressed a relatively established method in which the investigator analyzes ratios of isotopes which have been taken up by a tree from the surrounding water, air and soil where the tree was harvested. Because ratios of these naturally-occurring "stable" isotopes (carbon, hydrogen, oxygen, nitrogen, strontium and sulphur) are influenced by various factors related to climate and geology, they are indicative of specific regions on the earth. These isotopic rations are well known and widely published in the scientific literature, a great advantage in using this technology relative to others discussed in the dialogue, where reference datasets are patchy. By obtaining the most common ratios from the sample and comparing it to reference data, a researcher can identify the origin of a wood sample. This is relatively easy and very reliable for differentiating, for example, wood from the Russian Far East versus North America. More granular identification of location (e.g., forest concession A versus forest concession B, in the same region) is less reliable and is still the subject of research employing sophisticated statistical analyses with the addition of data obtained from rare earth and trace elements.

Dr. Markus Boner, Chief Scientist at Agroisolab GmbH, presented the results of a project to utilize stable isotope analysis to map the geographic origin of samples of iroko (*Milicia excels*), a highly-prized African timber species. The project, which ran from 2012-2016, was funded by the International Tropical Timber Organization. Dr. Boner and his colleagues were given blind samples of Iroko from eight African countries and asked to map the geographic origin of each sample. They first analyzed hydrogen and oxygen ratios to identify the rough placement of the trees on the African continent, they then moved on to analyze the carbon and strontium ratios to identify where, on a country level, these samples originated. Finally, to identify the local origin of the samples, Dr. Boner analyzed their nitrogen and sulfur ratios. This method proved to be successful, as the team was able to accurately identify the origin of 72% of the samples.

Dr. Ty Coplen of the US Geological Survey Stable Isotope Laboratory noted that the stable isotope method, on its own, can perform two important wood identification functions. First, the method allows the analyst to determine that a sample ***does not*** come from a particular location. Second the technology can say something about where the sample ***does*** come from with 80 percent confidence, although the granularity of that determination is dependent on the comprehensiveness of the reference collection against which data from the sample can be compared. He noted that there is significant interest in combining stable isotope analysis with other wood identification technologies such as DNA analysis, near infrared spectroscopy, and analysis of trace and rare-earth elements. (Potential synergies between various wood identification technologies are discussed below.) Dr. Coplen also drew attention so some hurdles that have yet to be overcome. These include the lack of sharing of data and reference material between labs (and because of this, an inability to accurately reproduce analyses between labs); and cost – stable isotope technology is more expensive than some other methods of wood sample identification, and there are only a few labs around the world that have the capacity to apply stable isotope analysis to wood.

The mass spectrometry panel focused on a specific technology known as the **D**irect **A**nalysis in **R**eal **T**ime - **T**ime **o**f **F**light **M**ass **S**pectrometer (DART-TOFMS). DART-TOFMS is a technological

approach that applies a stream of helium ions heated to 450°C to volatilize chemicals found within and on the surface of a wood sample, providing a full chemical profile for that sample. The power of this tool comes from the rapid ability to analyze the sample non-destructively with little or no sample preparation. Its weakness – shared by the other techniques discussed above in varying degrees – is that the lack of robust reference data means that the chemical profile obtained by the DART-TOFMS for a specific sample may have yet to be identified or published in any chemical database.

Dr. Rabi Musah of the State University of New York at Albany presented her collaborative work with ***Dr. Ed Espinoza*** of the U.S. Fish and Wildlife Service Forensic Laboratory on the identification of *Dalbergia spp*. and *Eucalyptus spp.* They hypothesized that the molecules/chemicals found in the timbers are defined by the tree's genome and because of this, chemical analysis may be as well suited as DNA for species identification. Their results confirmed that they could identify species based on the specific chemical composition of the wood.

Dr. Espinoza followed up with a presentation on other wood ID work that he has been carrying out at the USFWS Forensics lab. Working with a wood anatomist who can provide the genus of the sample, Dr. Espinoza can – in 8 seconds, for $0.10/sample – obtain the chemical composition of the wood he is trying to identify. He cautioned, however, that this method is not reliable for all species. Nevertheless, of the 152 species he has characterized using the DART TOFMS, 129 (87%) have species-specific chemotypes. Echoing many other participants, Dr. Espinoza stressed the need for synergistic approaches to wood identification, using multiple methods in combination, noting that no method is 100 percent accurate.

The developing synergies panel addressed underlying commonalities between technologies, prospects for collaboration, and showcased some specific examples of projects that use multiple approaches.

Dr. Tereza Pastore from the Brazilian Forest Service's Forest Products Laboratory discussed two projects that seek to join wood anatomy and near infrared spectroscopy (NIRS) to make species-level determinations. The projects on mahogany (*Swietenia spp.*) and rosewood (*Dalbergia spp.*) were largely successful, and both demonstrated that power of NIRS combined with wood anatomy to identify a specimen's species was superior to results obtained using either of the technologies by themselves. Echoing a common theme of the Dialogue, Dr. Pastore noted that large collections of reference material were needed in order to develop a statistical model sufficiently robust to make consistently accurate species-level determinations.

University of Washington bioengineering graduate student, ***Hal Holmes*** discussed his research using microfluidics[1] for designing DNA extraction and amplification tests for wood and forest products. More specifically, Mr. Holmes' research is focused on the manipulation 'micro' volumes of water droplets as a vehicle to transport samples, such as sawdust from timber, and

perform the necessary reactions for extraction and amplification of DNA. He is working as part of a bigger project with Conservation X Labs on the development of a handheld, field-ready, genetic sequencer.

U.S. Forest Service Research Geneticist and Oregon State University Professor ***Dr. Rich Cronn*** discussed a project where he and his colleagues built collated databases using chemical and genetic data to assess if combining these technologies could produce a more robust species identification and whether or not this combined approach could help discern potential geographic structure. To test this integrated approach, Dr. Cronn and his colleagues chose a tree species abundant in the US Pacific Northwest, Douglas fir, to surmount the common obstacles faced when dealing with high-value, threatened tree species specifically, the lack of available reference material and the lack of taxonomic knowledge about the species. Dr. Cronn also discussed that the added value of such an integrated approach was to better understand how and where each technology contributed positively to the analysis. He gave a 'spoiler alert' mentioning exciting results found with respect to the identification of geographic structure and stated that the results of this work would be available via publication, shortly.

Dr. Yafang Yin gave the final presentation of the "Developing Synergies" panel. Dr. Yin is Professor and Chief of the Department of Wood Anatomy and Utilization at the Chinese Academy of Forestry (CAF), and a 2016-2017 visiting scientist at the USFS Forest Products Laboratory. Dr. Yin spoke about China's motivation to comply with CITES, as well as timber legality measures enacted by China's trading partners including Australia, the European Union, and the United States. Traditional wood anatomy techniques, he argued, still provide a fundamental set of tools for implementing these legislative measures, and highlighted CAF's early participation in the International Association of Wood Anatomists (IAWA), founded in 1931. He noted, however, that traditional wood anatomy presents some limitations, and described how CAF is attempting to integrate more novel wood identification technologies with its longstanding work in traditional wood anatomy. Specifically, CAF has been working to combine wood anatomy, genetics, and chemical analyses, and to maintain connection to international research networks for each. CAF researchers have combined wood anatomy with DNA-based analysis for both *Dalbergia spp.* and *Pterocarpus spp.*, and found that the success rate for reliable identification increased considerably. Dr. Yin also summarized similar CAF work on integration of wood anatomy, genetics, and chemical analysis for Agarwood (*Aquilaria spp*.).

Preconditions for Successful Scaling of Wood Identification Technologies

Participants in this session repeatedly and uniformly stressed that the most daunting hurdle identified across technologies was the lack of access to reference material and the lack of coordination with respect to sharing reference material across disciplines and labs. Researchers who go to the field to collect reference samples usually do so to meet their own specific needs, without coordinating or communicating with other researchers who might be working on the same species or regions, but with another technology.

At a session on the second day, presenters and participants sketched out some of the other preconditions for moving wood identification technologies out of the laboratory and the pilot project and into a scaled-up presence in real-world efforts to control illegal logging and associated trade.

Dr. Richard Olmstead, Professor of Biology and Curator of the Burke Herbarium kicked off this discussion with a presentation on the role of herbaria in archiving physical specimens for plant research and reference purposes. The fundamental role of herbaria in providing the scientific and reference data bases for wood identification technologies and efforts is frequently cited, but less-frequently well understood. Dr. Olmstead noted that Burke holds some 650,000 specimens – mostly vascular plants – archived in its cabinets. Burke is only one of nearly 3,000 herbaria, which are spread across 176 countries (although, according to Dr. Olmstead, the "top 24", and the best 44 out of 50, are located in the European Union and the United States. In total, these herbaria hold over 380 million specimens. The cornerstone of herbaria collections are "voucher" specimens: Those specimens that have reference material from the plant collected in nature, with key elements necessary to identify the species (e.g. fruit vessel).

Xylaria are a sub-set of herbaria, and are held by approximately 160 institutions around the world. The conditions of these xylaria vary widely. The xylarium in the Sao Paulo herbarium, for example, contains a relatively small collection, focusing on Brazilian woody plants. While all specimens are vouchered and all are accessible to researchers, none of them are digitized. In addition, the herbarium is built on a pond, which creates some moisture problems. The USFS Forest Products Lab has a large collection of 103,000 specimens, but only 25,000 are vouchered. Burke has 5,500 specimens, but none of them are vouchered. This is a problem because when a specimen is not vouchered, one has no way to go back to the source for verification, and must take the word of the collector who deposited the specimen. This is a problem as many specimens are in fact misclassified, or classified with incorrect names.

Mr. Phil Guillery, Program Director for Supply Chain Integrity at the Forest Stewardship Council (FSC) International, discussed the need for and utility of more robust wood identification technologies for FSC's certification processes. FSC, Mr. Guillery noted, is the world's leading forest certification body, with 1,471 forests totaling some 194 million ha. certified in over 50 countries. FSC's certifications encompass over 2,000 timber species, and more than 30,000 companies participating in FSC's "chain of custody" certification.

Certified entities undergo required annual third party audits, in which auditors visit sites to verify that certification requirements have been met. Wood identification as a verification tool for certification is growing in importance, for both solid wood and fiber (for pulp and paper). FSC has therefore worked with the USFS Forest Products Laboratory on developing methods to deter and detect fraud in FSC supply chains. FSC has also worked with Agroisolab (e.g., on white oak), since stable isotope technology is particularly useful for determining whether

samples do or do not originate from particular forest units.

FSC therefore believes that wood identification technologies can be useful in bolstering the credibility of FSC's certification process. At the same time, FSC, through its broad on-the-ground network, can play an important role in collecting reference samples to assist in the core task of improving the scope and accessibility of wood and fiber reference collections.

Ms. Pacyinz Lyfoung, an attorney specializing in intellectual property and Program Director for Public Interest Intellectual Property Advisors (PIIPA), described PIIPA's ongoing work on a study about the intellectual property dimensions of efforts to develop and scale wood identification technologies. Supported by WRI and the USFS-IP, the study seeks answers to the question of which intellectual property (IP) tools, models and instruments are most conducive to the development and implementation of wood ID technologies. The study has focused particularly on DNA-based systems, since IP questions appear to be most complex a difficult for that set of technologies. Questions arise around proprietary dimensions of hardware and software elements of technologies, as well as ownership of and access to reference databases and material. The study is addressing these basic questions, across a variety of key jurisdictions worldwide:

- What is the right IP system to meet both private and public interests?
- What is the right IP system to meet the needs of this space that involves genetic resources, data and software issues?
- What is the right IP for specific products or specific parts of the system?
- What would a well-functioning system look like?

Ms. Lyfoung noted that the study is due to be finalized in the latter part of 2017, and will be widely disseminated.

Mr. Eric Marek**,** Resident Agent in Charge for Washington and Idaho for the U.S. Fish and Wildlife Service hailed the new advances in wood identification technology being discussed at the Dialogue, but cautioned that acceptance and use of these technologies for criminal investigation and prosecution faces a number of challenges. First, the great volume of imports make random wood identification checks a logistical challenge, so it is important that technologies be integrated into broader strategies of deterrence and detection. Second, for the uptake of any technological approach to be successful, the technology has to have the ability to be fully embedded into a relevant government system. Additionally, bureaucrats must to see value in these new approaches so as to champion them within and among other collaborative agencies. Third, these technologies need to stand up to legal standards and scrutiny for use in court. Finally, new technologies need to be practical to use, and cost effective. None of these are impossible, but they need to be seriously taken into account by technology proponents.

III. Summary Synthesis

Reflecting on the rich inputs and interchanges at the Seattle Dialogue, WRI offers the following synthesis of key points:

- One of the biggest barriers to successfully enforcing legislation has been the inability of investigators, customs officials, and enforcement officials to verify a product's species and origin. Clear identification of allegedly illegally traded wood is generally required by legislation and by courts. More fundamentally, if we cannot identify the species of a sample and where it came from, it's impossible to determine whether it was legally traded.

- Problems with mixing and mislabeling (whether intentionally or unintentionally) in wood supply chains are widespread. In certain countries, customs documentation is sometimes falsified.

- Specialists in wood anatomy – the oldest and most developed wood identification methodology – have the ability to identify the genus and potentially, the species of a wood sample and could provide a valuable near-real-time assessment of suspicious material if enough wood anatomists were accessible, but few such experts exist. Further, the volume of wood entering any given port makes traditional wood anatomy difficult to apply at scale. Alternatively, automated wood anatomy, using a system such as the 'Xylotron', shows promise for brining wood anatomical analysis to scale.

- A number of newer analytical methods allow for the identification of species and origin of wood but expertise in applying these methods is limited, costs can be high, and the necessary reference databases are only now under development.

- Conversely, responsible businesses who wish to demonstrate that they know where their wood was sourced and that it was legally harvested and traded, do not have cost-effective access to technologies that would allow them to do so.

- Border officials, government and state investigative agencies, the forest products industry, certification bodies such as the Forestry Stewardship Council (FSC), and environmental NGOs are thus increasingly interested in supporting the development and scaling of innovative technological applications to enable wood identification (hereafter "wood ID").

- These entities see the role of wood ID technologies as a method to help monitor and enforce regulations as well as aid the private sector - interested in protecting the environment as well as their reputation - in vetting their supply chains.

Looking forward, participants in the Dialogue agreed to work towards the following outcomes:

- Generate broader interest in wood ID work among the scientific, government,

enforcement and private sector communities by;

- Building partnerships between scientists with expertise in wood ID and scientists well acquainted with the methods used in wood ID, but who have yet to apply these methods on wood or forest products;

- Increasing the number of labs interested in working on wood ID, expand the capacity of labs already working on wood ID, and scale the number of wood ID labs providing identification services;

- Better understanding the intellectual property (IP) dimensions of wood ID technologies and the implications of different IP regimes and options.