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ITTO

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ITTO and CITES: an enduring partnership

In 2004, the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) began considering capacity-building efforts to assist countries in implementing the growing number of timber species listings in the CITES Appendices. In early 2005, the CITES Secretariat invited the ITTO Secretariat to collaborate in a joint programme, and the two secretariats worked closely to develop and complete a proposal for donor consideration. Beginning in late 2006, the European Commission (EC), together with other donors, funded the proposal through ITTO's 2006–2007 work programme. This special edition of the *TFU* presents some of the outcomes of work undertaken as part of what is now known as the ITTO–CITES Programme for Implementing CITES Listings of Tropical Tree Species.

Inside: ITTO–CITES Programme; mahogany; red cedar; agarwood; DNA tracking; bubinga; more

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Images: Forest scientists Mark Schulze (left) and Miguel Cruz are about to measure the stem diameter of a big-leaf mahogany (*Swietenia macrophylla*) at Marajoara, Brazil. The step stool across buttresses at the base of the tree will help. *Photo: S. Hirakuri* (cover); agarwood chips, the product of a community enterprise in Assam, India. *Photo: Assam Agarwood Association* (above).

... Editorial continued

The initial four-year proposal, "Ensuring that international trade in CITES-listed timber species is consistent with their sustainable management and conservation", had a budget of more than US$3.3 million dollars, 80% of which was provided by the European Union (through the EC) and the remainder by other donors. The importance of this joint work was recognized in CITES Resolution Conf. 14.4, "Cooperation between CITES and ITTO regarding trade in tropical timber", agreed in 2007 at the 14th meeting of the Conference of the Parties to CITES (CoP14, The Hague, June 2007) and several earlier decisions of the International Tropical Timber Council, which reinforced the need for cooperation between the two organizations.

Amid concern that the long-term survival of commercially valuable timber species was threatened by over-exploitation, the valuable and relatively high-trade-volume species afromosia (*Pericopsis elata*), big-leaf mahogany (*Swietenia macrophylla*) and ramin (*Gonystylus* spp.) were included in CITES Appendix II in 1992, 2003 and 2005, respectively. The listings meant that specimens of those species could only be traded if exporting countries had established that such exports would not be detrimental to the long-term survival of the species in the wild (the "non-detriment finding", NDF, outlined in Article IV of CITES). Signatory countries to CITES need to adopt national legislation coherent with CITES requirements to ensure the proper implementation of the Convention.

Phase 1

From 2006 to 2011, Phase I of the ITTO–CITES Programme assisted range States in building coherent policy frameworks that benefited the timber industry, local communities that depend on tropical forests, and the biodiversity-rich forests themselves. This phase focused on the internationally most-traded tropical timber species listed (at that time) in CITES Appendix II: afromosia, big-leaf mahogany and ramin. In 2009, the ITTO–CITES Programme began supporting the efforts of range States to carry out similar work on the African cherry tree (*Prunus africana*), of which the dry bark is the main product traded internationally.

Phase 2

Given that the demand for support from the ITTO–CITES Programme substantially exceeded available resources in Phase I, the ITTO and CITES secretariats submitted a second grant application to the European Union through the EC covering the 4-year period 2012–15, for a total amount of €7.5 million (about US$9 million), one-third of which was to come from other donors. Phase II of the Programme—"CITES implementation for tree species and trade/market transparency (TMT)"—was launched in early 2012 after approval of the grant application. The target taxa in Phase II were *Pericopsis elata*; *Dalbergia* spp. and *Diospyros* spp. from Madagascar; *Prunus africana*; *Gonystylus* spp.; *Aquilaria* spp.; *Gyrinops* spp.; *Swietenia macrophylla*; *Dalbergia retusa* and *D. stevensonii* from Guatemala; and *Cedrela odorata*. The box on page 4 explains briefly the three CITES Appendices and shows tropical tree species currently contained in them.

ITTO developed a webpage (www.itto.int/cites_programme) for the ITTO–CITES Programme, on which all activity completion reports and other relevant information are posted. A quarterly Programme newsletter is emailed to all donors, participating countries and other stakeholders. Various outreach materials provide information on Programme outputs, including videos highlighting work in each tropical region, as well as brochures, posters and banners.

Impacts

The Programme's activities in the range States of targeted tree species have resulted in improved forest management and the regulation of trade in CITES-listed tree species, mainly through the work done by national CITES Scientific Authorities, but also jointly with Management Authorities. The Programme has increased awareness and cooperation in research, silviculture and CITES compliance, while increasing the integration of knowledge on sustainable forest management (ITTO's core mandate) and species conservation, management and international trade (CITES's core mandate), providing a coherent policy framework. In other countries that are party to CITES and which trade in the target species, the Programme has improved awareness and increased worldwide capacity to manage

and regulate international trade in CITES-listed tree species. Programme outputs have also supported bodies in importing countries and regions, such as the EC's Scientific Review Group, which frequently contacts the ITTO–CITES Programme team (see box this page) for information on specific cases.

Activities conducted under the Programme's two phases have included resource inventory design and implementation; silviculture research and implementation; the development and implementation of management plans; training on and undertaking NDFs; the implementation of forest product marking and tracking systems; facilitating meetings of regional working groups agreed at the CITES CoPs; convening national, regional and international fora; developing cost-effective regulatory systems; supporting CITES training workshops; and undertaking outreach. Many lessons have been learned, including the importance of: engaging with all stakeholders; improving the understanding of CITES regulations and their implementation; and clear communication between CITES authorities in countries and the private sector. The articles published in this edition of the *TFU* provide examples of these activities and indicate some of the benefits they have yielded for conservation and sustainable use and trade.

Participating countries have made enormous progress in the first two phases of the Programme in generating information and capacities to sustainably harvest and to control the trade in some of the most heavily traded CITES-listed tree species, but there is a need to consolidate and build on these initial steps. Moreover, new tree species continue to be listed in CITES (several new tree species from the tropics were listed at the most recent CITES CoP in 2013 and more are expected to be proposed at CoP 17 this year), partly because range States better appreciate the benefits of such listings given the support provided by the ITTO–CITES Programme. Moreover, the number of countries asking to participate in the Programme continues to grow. The ITTO–CITES Programme draws its strength from the continuity of the work, the outstanding quality of its results, and the long-term sustainability of its activities. The demand for support from range States continues to exceed the available financial resources.

Future work

The implementation of Phases I and II of the ITTO–CITES Programme allowed the identification of important gaps still requiring attention. Key activities or work areas to be addressed in the future are further strengthening NDFs, forensic work for the identification of traded specimens, marking and tracking, and supporting national, regional and global fora, prioritizing countries with broad CITES compliance needs. Consultations are underway to develop a proposal and seek donor support for future work that encompasses these and other relevant emerging issues.

A continuing partnership

The cooperation between ITTO and CITES fostered through the Programme constitutes a strategic alliance that can benefit many tree species in trade beyond those listed in the CITES Appendices. Both ITTO and CITES have been promoting the sustainable management of tropical forests for many years, which is why the partnership has been so successful.

This year marks the tenth anniversary of the ITTO–CITES Programme, which constitutes a high-added-value example of international cooperation promoting sustainable forest management worldwide. Although the main aim of the Programme is to ensure that international trade in CITES-listed tree species is consistent with their sustainable management and conservation, it also aims to help countries develop robust forest management systems that will also benefit other tropical forest products in trade. The two secretariats plan to continue working to strengthen their partnership and to enhance support for countries in responsibly managing tropical forests and forest products in international trade.

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The CITES Appendices

CITES publishes and regularly updates three lists of species requiring varying degrees of protection, and these are called "Appendices" to the Convention. Appendix I comprises species threatened with extinction, and trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction but for which trade must be controlled in order to avoid use that is incompatible with the species' survival. All exporters of Appendix I- and II-listed species must provide non-detriment findings and findings of legal acquisition carried out by the relevant national CITES authorities for exports to occur.

The Conference of the Parties (CoP), which is the supreme decision-making body of CITES and comprises all its 182 member States, has agreed on a set of biological and trade criteria to help determine whether a species should be included in Appendix I or Appendix II. Amendments to these two appendices are submitted for consideration at each CoP session and require super-majority approval by voting.

Appendix III contains species that are protected in at least one country that has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a procedure distinct from that for Appendix I and Appendix II; each Party is entitled to make unilateral amendments to Appendix III without any approval or voting by the CoP. Exports of Appendix III-listed species require export permits showing legal origin from the listing country and a simple certificate of origin from other exporters. The list below shows tropical timber species currently listed in Appendix I, II and III. When the inclusion in CITES applies only to a distinct population of the species, this is specified in the column showing main range state(s) (e.g. big-leaf mahogany, for which only populations in the neotropics are included in CITES). All listings in the three CITES Appendices are accompanied by "annotations" defining the products covered by the listing; for tropical trees, annotations mainly cover primary products (e.g. logs, sawnwood and veneer) but in some cases may also include finished products (e.g. furniture, oils and extracts).

Tropical tree species in the CITES Appendices, 2016

Scientific name	Common name(s)	Main range state(s)/area	Listing country (Appendix III)
Appendix I			
Abies guatemalensis	Guatemalan fir	Guatemala	
Dalbergia nigra	Brazilian rosewood	Brazil	
Appendix II			
Aniba rosaeodora	Rosewood tree	Amazon	
Aquilaria spp.	Agarwood	Asia (around 25 spp.)	
Balmea stormiae	Ayuque	Central America	
Bulnesia sarmientoi	Lignum vitae	South America	
Caesalpinia echinata	Pau Brasil/pernambuco	Brazil	
Dalbergia spp.	Rosewood	Populations of Madagascar (48 spp.)	
Dalbergia cochinchinensis	Siamese rosewood	Indochina	
Dalbergia granadillo	Cocobolo	Central America	
Dalbergia retusa	Nicaraguan rosewood	Central America	
Dalbergia stevensonii	Honduras rosewood	Central America	
Diospyros spp.	Ebonies	Populations of Madagascar (around 240 spp.)	
Gonystylus spp.	Ramin	Asia (around 30 spp.)	
Guaiacum spp.	Lignum vitae	South America (6 spp.)	
Gyrinops spp.	Agarwood	Asia (around 7 spp.)	
Oreomunnea pterocarpa	Gavilán	Central America	
Osyris lanceolata	African sandalwood	East Africa	
Pericopsis elata	Afrormosia	Central/West Africa	
Platymiscium pleiostachyum	Cachimbo	Central America	
Prunus africana	Pygeum	Africa	
Pterocarpus santalinus	Red sanders	India	
Senna meridionalis	Malagasy	Madagascar	
Swietenia humilis	Honduras mahogany	Central America	
Swietenia macrophylla	Big-leaf mahogany	Populations of the neotropics	
Swietenia mahagoni	West Indian mahogany	Caribbean	
Uncarina grandidieri	Mousetrap tree	Madagascar	
Appendix III			
Cedrela fissilis	Cedro blanco	Central/South America	Bolivia (Plurinational State of) and Brazil
Cedrela lilloi	Cedro bayo	Central/South America	Bolivia (Plurinational State of) and Brazil
Cedrela odorata	Spanish/Red cedar	Central/South America	Bolivia (Plurinational State of), Brazil, Colombia, Guatemala and Peru
Dalbergia darienensis	Indian rosewood	Colombia/Panama	Panama
Dipteryx panamensis	Almedro/tonka bean tree	Central America/Colombia	Costa Rica and Nicaragua
Pterocarpus erinaceus	Muninga	West Africa	Senegal

Source: www.cites.org

How sustainable is mahogany management?

Modelling indicates that the management of big-leaf mahogany in Guatemala's Maya Biosphere Reserve is on track, but changes are needed in Brazil

by James Grogan[1], Mark Schulze[2], Iran Paz Pires[3], Christopher M. Free[4], R. Matthew Landis[5], Gustavo Pinelo Morales[6] and Andrea Johnson[6]

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Mark Schulze (foreground) from Oregon State University and the Instituto Floresta Tropical's Miguel Alves de Jesus inspect *Swietenia macrophylla* (mahogany) trees at a field site in Marajoara, Pará, Brazil, as part of a project conducted under the ITTO–CITES Programme. *Photo: S. Hirakuri*

The ITTO–CITES[1] Programme for Implementing CITES Listings of Tropical Timber Species seeks to ensure that international trade in CITES-listed tropical timber species is consistent with their sustainable management and conservation. For Appendix II species such as big-leaf mahogany (*Swietenia macrophylla*, referred to in this article simply as mahogany), this means that exported volumes must be acquired legally and without detriment to natural populations. "Non-detriment" is generally equated to sustainable forest management (Smith et al. 2011). From a biological point of view, "sustainable" requires that current management practices do not imperil future harvests by reducing population densities during repeated harvests below levels that can be biologically sustained.

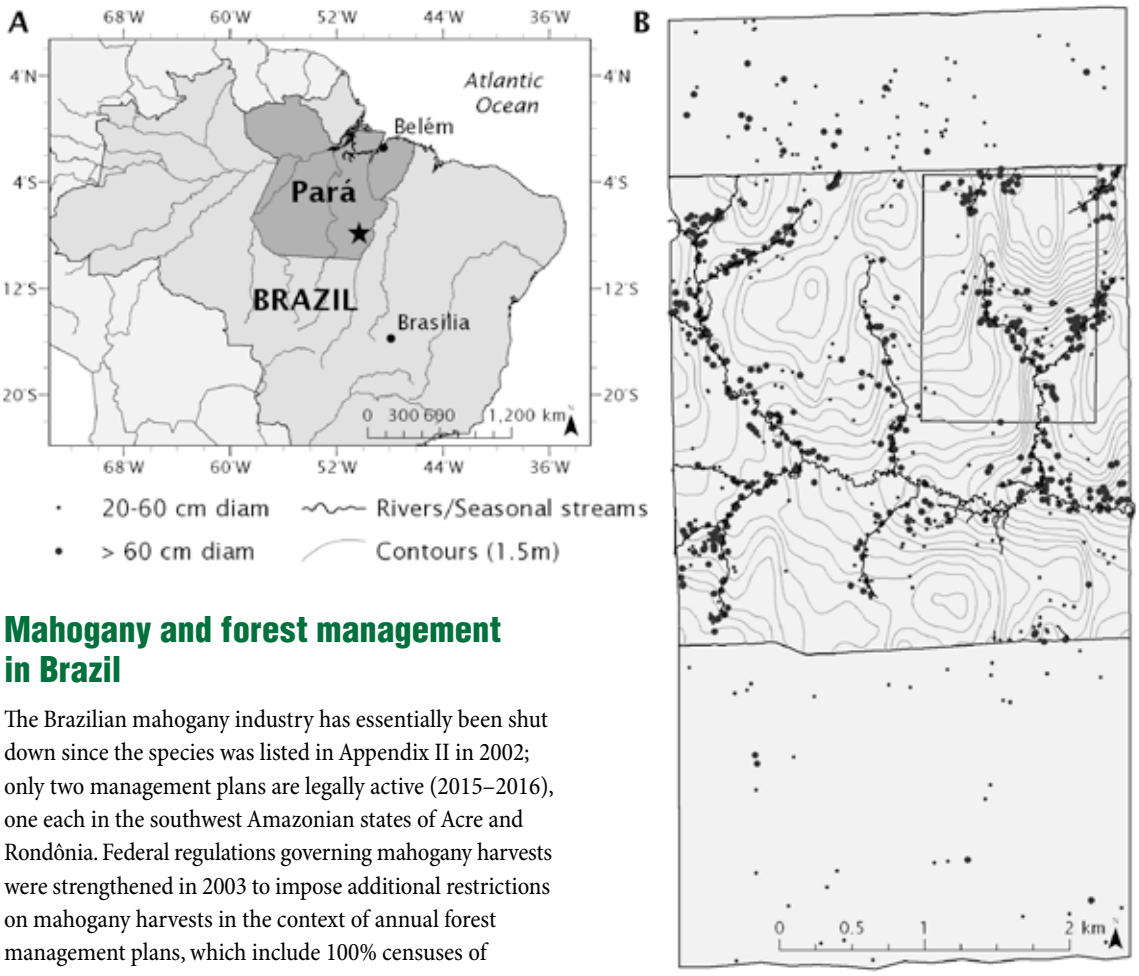
This article summarizes findings on the sustainability of management practices in Brazil and Guatemala generated by a project supported by the ITTO–CITES Programme called "Big-leaf mahogany in the Brazilian Amazon: long-term studies of population dynamics and regeneration ecology towards sustainable forest management". Starting in 2007 and continuing through 2015, this project is extending field research initiated in 1995 with support from the United States Forest Service's International Institute of Tropical Forestry. The goal is to establish a biological foundation for sustainable forest management systems for mahogany based on long-term studies of key demographic rates—growth, reproduction and regeneration—by natural populations in primary and logged forests. A detailed understanding of age- and size-related mortality, growth and reproductive rates is essential for evaluating management guidelines and adapting practices to changing environmental and socioeconomic contexts. This study's mahogany populations have been studied more intensively and for longer than any other mahogany populations in the Amazon.[2]

The impacts of harvesting practices on future timber yields can be evaluated if empirical data are available on demographic rates spanning a given species's life cycle. Demographic analysis may also need to account for other aspects of life history and landscape ecology, such as density-dependent mortality factors and gap formation rates, especially for light-demanding tree species like mahogany (Norghauer et al. 2016). We built an individual-based demographic model for mahogany parameterized from field data collected in 1995–2015 in the Brazilian Amazon. Research sites in southeastern Pará are visited annually during the dry season to re-census nearly 500 mahogany trees larger than 10 cm diameter mapped in 2700 hectares of forest. We also monitor several thousand mahogany seedlings, saplings and pole-sized juveniles in natural and artificial gaps in experiments initiated in 1996–1997. The demographic model is based on regression equations of stem diameter growth, mortality and fruit production estimated as functions of stem diameter and prior growth; it includes functions for germinating seeds, growing trees from seedlings to adult senescence, producing seeds, and creating disturbances at specified spatial scales and return intervals, including logging. The model also incorporates growth autocorrelation, which has been shown to strongly influence model predictions (Grogan and Landis 2009; Grogan et al. 2014; Free et al. 2015; see also www.swietking.org/model.html for model details).

1 CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora.

2 See *TFU* 22(1) for descriptions of recent scientific and technical publications resulting from this project (Grogan et al. 2013).

Figure 1: (A) Map of Pará, Brazil, with star symbol showing location of the field site at Marajoara; (B) the 2050-hectare principle research area at Marajoara



Note: Seasonal streams, topography and live + logged mahogany trees are mapped within 1035 hectares. The smaller rectangle outlines a 204-hectare permanent plot. Only live mahogany trees were located outside the core research area (top and bottom). Adapted from Grogan et al. 2014 (Figure 1).

Mahogany and forest management in Brazil

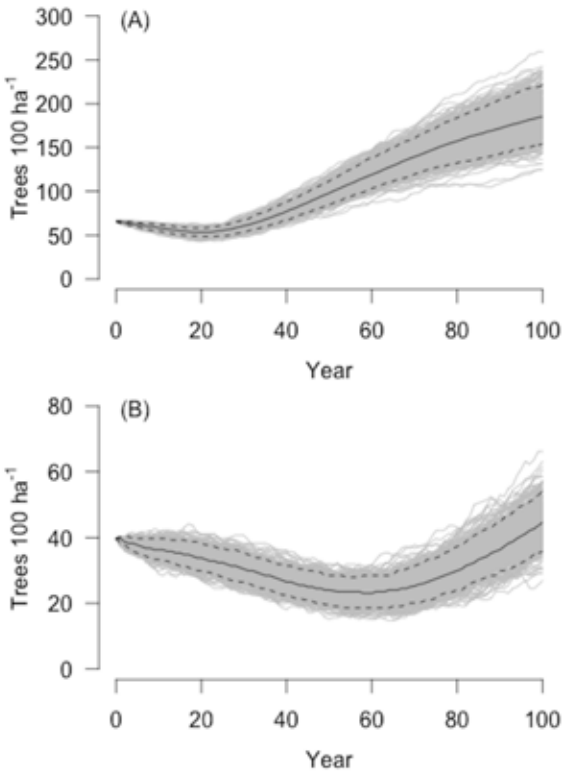
The Brazilian mahogany industry has essentially been shut down since the species was listed in Appendix II in 2002; only two management plans are legally active (2015–2016), one each in the southwest Amazonian states of Acre and Rondônia. Federal regulations governing mahogany harvests were strengthened in 2003 to impose additional restrictions on mahogany harvests in the context of annual forest management plans, which include 100% censuses of commercial-sized trees of all commercial species and cutting cycles of 25–30 years. Mahogany harvests are restricted to mahogany trees larger than 60 cm diameter; at least 20% of commercial-sized trees must be retained for seed and future timber production; and logging is prohibited where population densities are lower than five commercial-sized trees per 100 hectares. Rules based on stem quality are in place for determining which trees should be retained as seed trees and for future harvests. Moreover, a technical committee must approve any industrial or community management plan that includes mahogany after the field verification of plan details.

To evaluate whether these tightened rules for managing mahogany would yield sustained harvests, we used the project's demographic model to simulate harvests at 30-year intervals over three cutting cycles (harvests in years 0, 30, 60 and 90) based on mahogany's population structure and demographic behaviour at our principle research site of Marajoara in southeast Pará (Figure 1). Simulations were repeated 500 times to estimate median outcomes at each harvest.

When we simulated the Marajoara population without logging, the median density of trees larger than 20 cm diameter and of trees larger than commercial size (60 cm diameter) increased over time (Figure 2). This suggests, first, that one or more parameters in the model may overestimate long-term demographic rates on this landscape and, second, that outcomes for simulated harvests are more likely to overestimate recovery rates than the reverse. Under current harvesting regulations for mahogany in Brazil, simulations indicate that commercial densities at Marajoara would decline from 40 commercial-sized trees per 100 hectares at the time of the first harvest to only eleven trees per 100 hectares at the time of the fourth harvest in year 90, yielding an estimated 16% of the initial harvest volume in the fourth harvest (Figure 3). That is, current harvesting regulations designed specifically for mahogany in Brazil will lead to population decline and commercial depletion within 3–4 cutting cycles (60–90 years) at sites where populations lack subcommercial trees at densities sufficient for short-term replacement. Without strict adherence to the minimum density requirement of five commercial-sized trees per 100 hectares, few commercial-sized trees would survive after four harvests (Grogan et al. 2014).

These results indicate that current harvesting regulations in Brazil for mahogany and other high-value timber

Figure 2: Simulated mahogany population dynamics in southeast Pará, Brazil, in the absence of logging: (A) density of trees ≥ 20 cm diameter during 100-year simulations; (B) density of commercial-sized trees ≥ 60 cm diameter over the same period



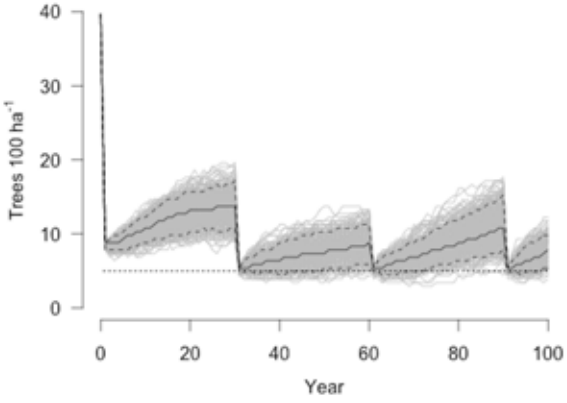
Note: Grey lines indicate 500 replicate simulations, the solid black line indicates the median value, black dashed lines indicate 5th and 95th percentiles. Adapted from Grogan et al. 2014 (Figure 3).

species with similar life histories will lead to commercial depletion over repeated cutting cycles. Sustainable harvesting will require, in combination, an increase in the retention rate, investment in artificial regeneration to boost population recovery, and the implementation of silvicultural practices designed to increase the growth rates of future crop trees. Moreover, these estimated outcomes are likely to overstate post-harvest recovery rates by surviving mahogany populations in Brazil, which are concentrated in the southwestern Amazon. Those populations are characterized by lower densities of subcommercial stems relative to commercial-sized trees compared with populations in southeastern Amazon, like Marajoara's (Grogan et al. 2008, 2010).

Mahogany and forest management practices in Guatemala

Forest concessions in the Maya Biosphere Reserve (MBR) in the department of Petén, Guatemala, have been harvesting mahogany and associated high-value timber species under multiple-use forest management systems since the late 1990s with the twin goals of conservation and socioeconomic development. In the MBR's Multiple Use Zone (MUZ), nine community organizations and two industrial firms manage timber and non-timber forest products in concessions

Figure 3: Simulations of mahogany population dynamics in southeast Pará, Brazil, under current legal harvest regulations with harvests in years 0, 30, 60 and 90



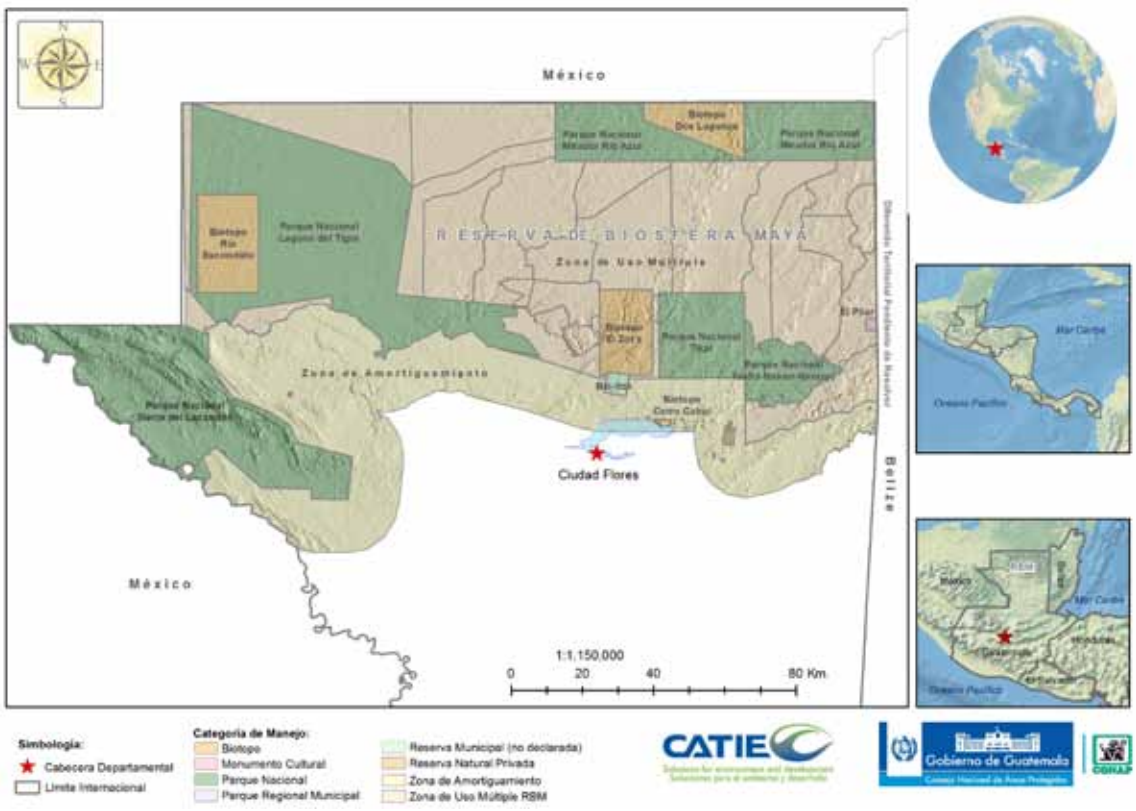
Note: There were 40 commercial-sized trees per 100 hectares in year 0. Median recovered population density in year 90 was 11 trees per 100 hectares. See Figure 2 for key. The horizontal dashed line indicates the minimum post-harvest commercial density of 5 trees per 100 hectares. Adapted from Grogan et al. 2014 (Figure 4).

representing nearly 25% of the MBR's total area of 2.1 million hectares (Figure 4). The regulatory entity for forest management in the MUZ is the National Council of Protected Areas (*Consejo Nacional de Áreas Protegidas*—CONAP), which has the power to adjust regulations in response to emerging concerns and needs.

Similar to Brazil, concessions must submit detailed plans for each annual harvest parcel, including 100% inventory data for commercial-sized and subcommercial-sized trees with spatial locations, excluding areas with steep slopes and other high-conservation-value areas. Concessions have flexibility in setting minimum diameter cutting limits (MDCLs) and cutting cycle lengths; the MDCL for mahogany is almost always 60 cm diameter (occasionally 55 cm), and cutting cycles range from 25 to 40 years (30 years being most common). The allowable harvesting or cutting intensity for a given timber species is determined by a formula that uses an assumed median diameter growth rate to estimate the amount of subcommercial basal area that will recruit to commercial size during the cutting cycle following harvest, based on the best understanding of species-level diameter growth rates. That is, the number of commercial-sized trees that can be harvested is determined by the number and size distribution of subcommercial trees in position in the forest to replace logged trees in the coming 25–40 years. In addition, all concessions must obtain and uphold Forest Stewardship Council certification; this requirement was established by CONAP in 1999 in response to social and political pressure to use best practices in protected areas such as the MBR.

To evaluate whether these management practices for mahogany and associated high-value species would yield sustainable harvests, we adapted the project's demographic model to the Guatemalan context. We used concession inventory data from annual operating plans from the

Figure 4: The Maya Biosphere Reserve in the Petén region, northern Guatemala



Adapted from Grogan et al. 2015 (Figure 1).

mid-2000s, supplemented by field data collected in 2014 estimating landscape-scale densities of seedlings, saplings and pole-sized juveniles in each harvest area. We simulated harvests over three cutting cycles that varied in length between concessions. Simulations were repeated 100 times to estimate median outcomes at each harvest. Although simulation outcomes for mahogany population dynamics in the MUZ were based on growth, mortality and reproductive rates obtained from Brazilian populations, the mahogany growth function from Brazil matched almost perfectly the available growth data from MUZ concessions. Indeed, the model used in this study provides the best-available interpretation of the current understanding of mahogany life history (Grogan et al. 2015).

Model simulations indicate that, on average, concession mahogany populations logged during the mid-2000s under forest management parameters described above will recover or exceed initial commercial densities and volumes during cutting cycles between successive harvests. The overall recovery trajectory of simulations spanning three cutting cycles (75–120 years) was positive or nearly so for 17 of the 22 annual harvest parcels evaluated in this study. Median commercial densities of simulated populations recovered to 109–156% of initial densities from the first to fourth harvests and to 83–142% of initial commercial volumes. Whether or not commercial density and timber volume recovered between harvests was a direct consequence of the distribution and densities of subcommercial trees, poles and saplings. Where these individuals occur at relatively high densities compared with commercial trees, future harvests can be comparable with initial harvests because subcommercial trees recruit to commercial size during the coming decades. By linking cutting intensity to assumed growth rates by subcommercial trees, forest managers in the MUZ restrict harvests to sustainable levels (Grogan et al. 2015).

Implications for CITES-listed timber species

For Appendix-II species such as mahogany, legal and non-detrimental or sustainable acquisition are prerequisites for international trade. With sufficient understanding of species' life histories, and especially of the demographic rates that underlie the distribution of juvenile and mature individuals on a landscape, we can model the future impacts of current management practices in much the same way that actuarial professionals analyze survival probabilities in human populations for health and life insurance purposes. "One-size-fits-all" management regulations like those for mahogany in Brazil are common across the tropics, but they fail to recognize that each tree species in a natural forest survives and functions differently from every other. Harvesting 80% of commercial-sized mahogany trees in Brazil will lead to commercial extirpation over repeated harvests because populations there tend to have few subcommercial trees relative to commercial trees, leading to the depletion of commercial size classes over time. Other commercial species with similar life histories to mahogany's,

such as red cedar (*Cedrela odorata*) and ipê (*Tabebuia* spp.), may be harvested at even higher intensities (90%) and to smaller diameters (50 cm) than mahogany in Brazil, meaning that commercial depletion of those species could occur in 1–2 cutting cycles (Schulze et al. 2008a,b).

Mahogany harvests in Guatemala's MBR appear to be sustainable because biological realities—growth, mortality, and the size-class frequency distribution of juvenile and mature trees—determine cutting intensity, not an arbitrary number. There, mahogany populations—and populations of four associated high-value commercial species—are (on average) expected to recover initial commercial densities and volumes during cutting cycles between successive harvests. Such a finding sets the MBR apart from most other commercial forestry operations in the tropics.

This conclusion is particularly notable given that most of the concession area in the MBR is under the management of local communities whose capacity to implement sustainable forestry has been and continues to be questioned, both in Guatemala and across the tropics. The finding that community-based enterprises, working with government and technical assistance agencies, are practising better forest management than highly capitalized industrial firms operating in other parts of the tropics is important. The model of sustainable species-level forest management in Guatemala's MBR deserves recognition and replication in other tropical countries. Considering the long history of mahogany's unsustainable exploitation across its neotropical range, forest management in the MBR represents a significant achievement and a CITES success story.

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Knowing red cedar

***A project funded under the ITTO–CITES Programme has prepared Guyana for a possible CITES listing of* Cedrela odorata**

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Growing up: A sapling of *Cedrela odorata* in Madre de Dios, Peru is assessed as part of a project conducted under the ITTO–CITES Programme. *C. odorata* is the second-most valuable tropical timber in the neotropics, and work reported here has added to information on the species's conservation status in Guyana. *Photo: S. Hirakuri*

Historically, the focus of Guyana's wood products sector has been on a few key primary species, principally greenheart (*Chlorocardium rodiei*) and purpleheart (*Peltogyne venosa*), because of their inherent physical properties of natural durability and strength and their suitability as structural- and appearance-grade timber. A narrow focus risks the sustainability of these species, however.

The ITTO–CITES[1] Programme for Implementing CITES Listings of Tropical Timber Species assists countries in the tropics to undertake forest inventories, design forest management plans, generate non-detriment findings for CITES-listed tree species, and develop and disseminate tools for timber identification, with the overall objective of ensuring that international trade in CITES-listed timber species is consistent with their sustainable management and conservation.[2] ITTO Project TMT-SPD 014/13 Rev. 1 (M): "Enhancing the sustainable management and commercial utilization of the CITES-listed species *Cedrela odorata* (red cedar) in Guyana" was implemented from August 2014 to February 2016 under the ITTO–CITES Programme. It focused on the assessment, development, marketing and promotion of *Cedrela odorata* (known locally as red cedar and more generally in the region as cedro), building on Guyana's efforts to develop and promote its lesser-used species[3] as part of a multipronged strategy for managing the country's commercial forest estate sustainably.

About red cedar

Red cedar is deciduous; it is also strongly light-demanding, behaving as a long-lived pioneer (Cintron 1990; Lemmens 2008), and often associated with other Meliaceae genera (e.g. *Swietenia* and *Guarea*) and leguminous trees (Pennington 1981). Red cedar timber is highly valued for its unique technical and physical properties and attractive visual appearance, which makes it ideal for use in fine furniture, interior joinery and interior structural building applications. It is also very durable and termite-resistant. The natural range of red cedar encompasses Latin America and the Caribbean, and it has been harvested for more than 500 years (Navarro-Cerrillo 2013). Red cedar is common in seasonally dry, semi-deciduous forests and less common in evergreen forest types (Cintron 1990; Lamb 1968), where it is found mainly in seasonally flooded lowlands along watercourses (Gentry undated; Pennington 2006, as seen in CITES 2007) and in the transitional zone between evergreen and savannah forests (Brown et al. 2003). In Guyana, the species is rare to locally occasional in *mora* forest along creeks, as well as in seasonal forests and poorer types of rainforest (Fanshawe 1961). According to Hohenkerk (1923), the species was scarce in Guyana's easily accessible forests by the early twentieth century, except in the North West District and locally in the Rupununi District, where it was more abundant.

As the second-most valuable tropical timber in the neotropics after big-leaf mahogany, *C. odorata* is threatened by over-exploitation and deforestation in much of its range. It is listed in CITES Appendix III[4] by the Plurinational State of Bolivia, Brazil, Colombia, Guatemala and Peru.

1 CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora.

2 www.itto.int/cites_programme.

3 An ITTO project supporting the promotion and development of lesser-used species in Guyana, PD 344/05 Rev.2 (I): "Utilization of lesser used wood species in Guyana", completed in 2008, laid the platform for this project.

4 CITES regulates international trade by means of trade measures, which include the listing of species in Appendix I, II or III, and the use of export/import permit requirements. Appendix III contains species that national authorities wish to list and for which they seek the assistance of other Parties to regulate trade.

The species has not been used commercially in Guyana to the same extent as in other range States, in part because of its relative scarcity. Although it has been logged in Guyana since the nineteenth century (Institute of Mines and Forests of British Guiana 1903), it has only ever accounted for a small fraction of total timber production. For example, average annual red cedar production was less than 250 m^3 per year in 1955–61 (Flemmich 1963) and not much higher in 2006–2014, at 280 m^3 per year (Guyana Forestry Commission production data). Most of the production in the latter period was intended for export, when sawnwood and log exports averaged 245 m^3 per year. Guyana's role in the red cedar trade—which amounted to a reported global average of approximately 24 000 m^3 per year in 2006–2014—is small.

The ITTO–CITES project

Project TMT-SPD 014/13 Rev.1 (M) enabled Guyana to undertake an assessment of its commercial forests to determine the status of red cedar. The outputs of this resource assessment were used to develop a management plan for the sustainable harvesting of red cedar and to increase the capacity of the industry to harvest, develop and market the species domestically and internationally, consistent with the objectives of a CITES Appendix III listing.

The project's development objective was to "enhance sustainable management of the forest sector of Guyana through improved market intelligence and trade of CITES-listed timber species". Its specific objective was to "strengthen forest planning and marketing of current and potential CITES-listed timber species from Guyana", and it had three main outputs:

- improved sustainable management of red cedar through enhanced forest management planning;
- enhance market intelligence on CITES and the timber trade related to the impacts on Guyana's forest sector; and
- increased capacity of the forest sector to trade and market CITES-listed timber species.

Outputs

Figure 1 shows baseline information obtained from a survey in Guyana conducted by the Food and Agriculture Organization of the United Nations (FAO), supplemented by forest concession inventories and primary data collected under the ITTO project. One of the main outputs of the ITTO project was the collation, for the first time in Guyana, of a range of forest inventory data on red cedar and the construction of a master database for the species. The project's main technical report includes a map of red cedar distribution based on these data; it also provides an overview of population size, distribution, stand density, size structure and regeneration dynamics and outlines a possible strategy for the sustainable management of red cedar in Guyana.

A second technical report by the project focuses on the domestic and international markets of the species and a reporting framework for CITES. Sections of the report address:

- the forest management and monitoring systems employed by the Guyana Forestry Commission (this section concludes with a protocol framework for the international trade of red cedar products);
- red cedar production in Guyana in 2007–14 and export volumes of red cedar from Guyana, by product type, in 2009–14;
- the prospects of further developing domestic and international markets for red cedar; and
- a production and marketing strategy and reporting framework to ensure the consistent implementation of the trade regulation requirements of a CITES Appendix III listing.

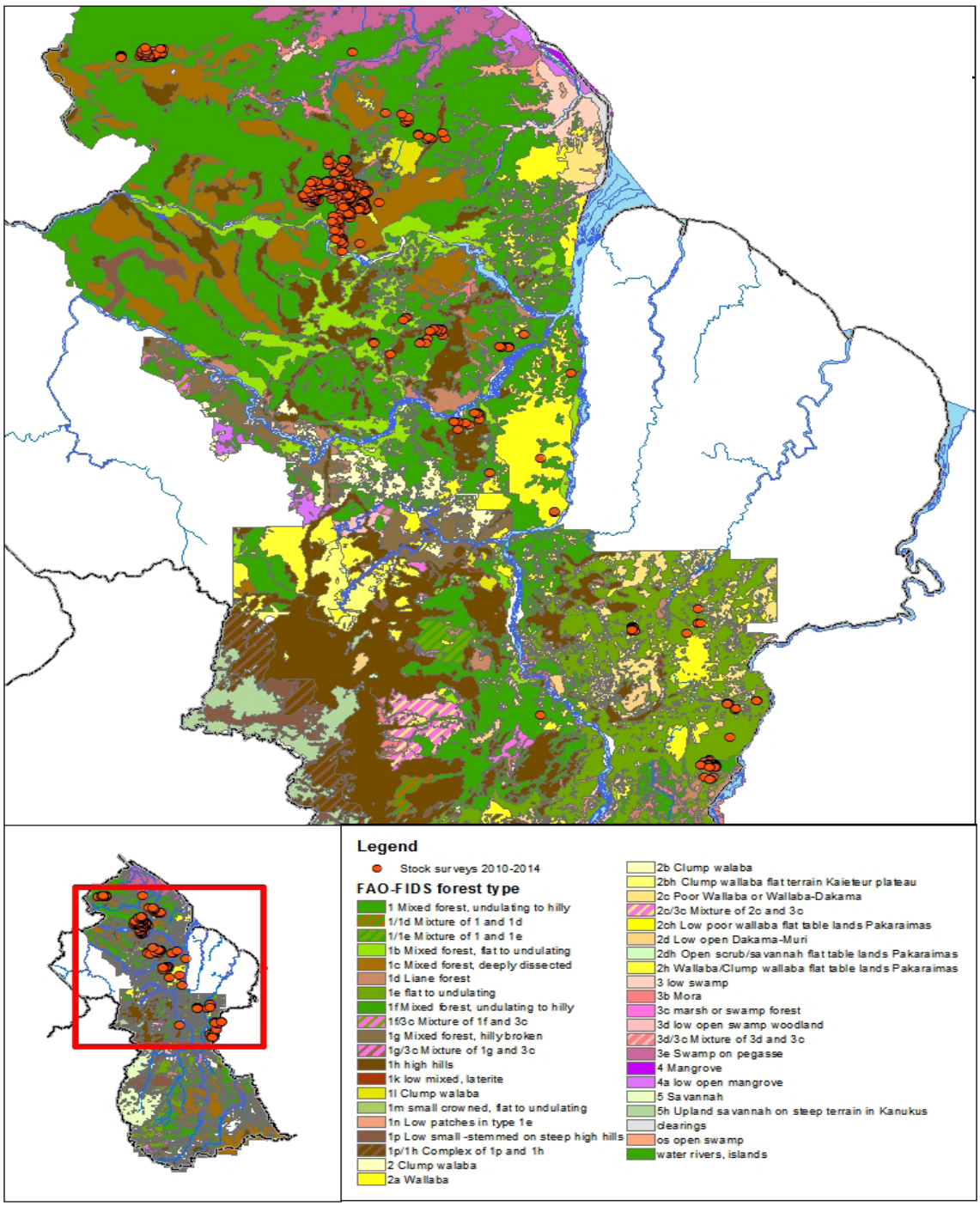
Forest monitoring and reporting system

A diagnostic of the reporting framework concluded that the Guyana Forestry Commission (GFC) has a strong system of forest permitting and monitoring that includes most elements of an effective chain-of-custody management system for forest products, from the point of harvest to the point of export, enabling the verification of legal origin. Monitoring tools include the permitting system, the national log-tracking system, codes of practice, and concession-level and range-level monitoring. Support for the computerized national log-tracking system was boosted by ITTO Project PD 440/07 (M,I): "Improving the detection and prevention of illegal logging and illegality in shipment and trade of wood products in Guyana", implemented in 2008–2009. Guyana also received support from ITTO in the development of the Code of Practice for Wood Processing through ITTO Project PD 513/08 Rev.1 (I): "Enhancing the capacity of the wood processing sector to improve efficiency and add value in Guyana", implemented in 2010–2011.

Monitoring occurs at four main stages: 1) the forest concession; 2) the transportation network; 3) sawmills and lumber yards; and 4) ports of export.

- The GFC's log-tracking system traces forest products using tags, which are assigned to all concessionaires and private forest owners involved in commercial logging operations. The system requires that each harvested tree is measured and tagged. Each operator is assigned a unique sequence of numbers, and tags are issued in sequences to be used in particular blocks (in the case of large concessions). The GFC sets the log quota for small concessionaires, depending on the size of the concession and previous harvesting records.
- All timber must be tagged, including logs, lumber, piles, poles and posts. In cases where logs are converted in-forest (using chainsaws or mobile mills), the removal and transport of lumber must be accompanied by a removal permit, and tags must be attached to batches of lumber originating from the source logs.
- Transportation of logs and lumber outside the boundaries of a forest concession must be accompanied by a GFC-approved removal document; this document must declare the species and volume of timber, log tag numbers, and permit number or licence number.

Figure 1: Guyana forest types according to the FAO–Forest Industries Development Survey, and occurrence of red cedar according to stock surveys under the ITTO project



- The block and log quota system applied to large concessionaires ensures that concessionaires adhere to the allowable harvest intensity and the cutting cycle, because harvesting outside those blocks is not permitted. The GFC conducts post-harvest audits in all timber sales agreement areas, including reconciliations of samples of stump tag numbers with declarations and log tag numbers on removal permits. Small concessionaires are subject to similar post-harvest audits.

The project made recommendations for strengthening and improving the management of the supply and production chain.

Listing of *Cedrela odorata*, and next steps

Under the current CITES listing of *Cedrela odorata*:

- Exports from States that have included the species in Appendix III (i.e. the Plurinational State of Bolivia, Brazil, Colombia, Guatemala and Peru) require the prior granting and presentation of CITES export permits issued by the Management Authority of the State of export.
- Exports from all other range States (e.g. Guyana) originating in those States require CITES certificates of origin issued by the Management Authority of the range State.

If, based on the outcomes of this project, Guyana decides that the national population of red cedar should be included in Appendix III, exports of red cedar logs, sawnwood and veneer sheets from the country will require CITES export permits issued by its Management Authority. The project helped Guyana prepare for this possibility, as well as for potential listings of other species on CITES appendices.

In sum, Project TMT-SPD 014/13 Rev.1 (M) enabled a resource assessment of red cedar in Guyana's forest estate to establish the status of the species; increased understanding of the conservation status of red cedar; increased capacity in Guyana for managing red cedar and for CITES reporting; and helped create a strategy for commercializing CITES-listed species in Guyana and developing value-added markets for red cedar, both locally and internationally.

ITTO–CITES Programme creating synergies in Guyana

Synergies have been created between the project and other initiatives in Guyana. For example, ongoing work towards a voluntary partnership agreement (VPA) as part of the European Union's Forest Law Enforcement, Governance and Trade (EU FLEGT) initiative benefited considerably from the diagnostic assessment of forest monitoring systems conducted under the project, enabling the streamlining of several links in the chain of custody under the legality assurance system created for the EU FLEGT VPA.

A core aspect of Guyana's REDD+ programme and the cooperation agreement between Guyana and Norway is the monitoring, reporting and verification system (MRVS). This includes indicators for forest management and the monitoring of illegal logging. Reporting on these areas under the MRVS has improved following the work done on reporting structures through TMT-SPD 014/13 Rev. 1 (M).

Guyana's ongoing collaboration with the UK in an effort to promote the trade of Guyana's timbers has also benefited from the project. The justification report now being prepared by Guyana on greenheart use in UK public procurement projects has fully integrated the results of the assessment done under the ITTO–CITES project.

Note: The main reports produced under TMT-SPD 014/13 Rev.1 (M) will be available in due course at www.forestry.gov.gy and will also be available at www.itto.int.

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Arresting the decline of agarwood

A project under the ITTO–CITES Programme has developed a conservation action plan for* Aquilaria malaccensis *in Malaysia

by Lillian Swee Lian Chua[1], Soon Leong Lee[2], Kah Hoo Lau[1], Zakaria Nurul-Farhana[2], Lee Hong Tnah[2], Chai Ting Lee[2], Chin Hong Ng[2] and Kevin Kit Siong Ng[2]

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Standing agarwood: The trunk of an *Aquilaria malaccensis* tree. Photo: K.H. Lau

Aquilaria, a genus in the family Thymelaeaceae, is known worldwide as agarwood. It comprises 15 species and is confined to the Indo-Malayan region of Asia, from Assam in northeastern India, to southeastern China, to Southeast Asia and New Guinea (Ding Hou 1960). Malaysia has five species of *Aquilaria*, of which *A. malaccensis* is the most widespread. *A malaccensis* occurs on both well-drained and waterlogged soils at altitudes of up to 750 m above sea level (Ding Hou 1960). It does not form dominant stands in the habitats it occupies; being an intermittent food source, it is unlikely to be a keystone or guild species.

Aquilaria produces a highly valuable fragrant wood used as incense and in traditional medicines and the perfume industry (Chung and Purwaningsih 1999). In the past, only heartwood infected with a certain fungus and thereby containing oleoresin was harvested; with skyrocketing demand for the fragrance, however, many more parts and derivatives of the plant—roots, fruits, seeds and seedlings—are now traded. The main species in South and Southeast Asia that produce agarwood are *A. malaccensis, A. crassna* and *A. sinensis*.

The lucrative demand for agarwood in the late twentieth century decimated a significant number of trees beyond functionality. Because of this, and in line with the aims of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), *Aquilaria* was listed in CITES Appendix II in 2005 as a means to regulate its international trade. *Aquilaria* is not a dominant tree in Malaysia's tropical rainforests and, given the complex interactions of biotic and abiotic factors in such forests, its ecological role is not clearly understood; therefore, the effects on ecosystem processes of its removal through harvesting are unknown. An even more critical question is whether the species itself is resilient to harvesting pressures.

Project overview

To discover whether the species is resilient to harvesting, Malaysia undertook a research activity titled "Reproductive and genetic studies towards the conservation and management of *Aquilaria malaccensis* in Peninsular Malaysia" between June 2013 and September 2015 as part of the ITTO–CITES Programme for Implementing CITES Listings of Tropical Tree Species. The project strengthened and provided continuity for two research studies conducted in 2007–2008 and 2011–2012, both of which were funded by the Government of Malaysia.

The main objective of the project was to develop a conservation action plan (CAP) to reduce harvesting pressures on wild populations of agarwood in Peninsular Malaysia. The specific objectives were to document the flowering phenology and reproductive behaviour of *A. malaccensis* in Peninsular Malaysia and to develop DNA profiling databases.

Findings

Ecological data for a site in Peninsular Malaysia spanning 25 years indicate a downward trend in the *A. malaccensis* population, caused by an annual mortality rate that is consistently higher than the recruitment rate; high floral abortion rates; and, possibly, supra-annual flowering behaviour. In combination, these factors exert pressure on the regeneration potential of populations; a decline in abundance has been observed nationwide since the late 1980s.

Notwithstanding this, *A. malaccensis* in Peninsular Malaysia has high genetic diversity and moderate population differentiation. Two major genetic clusters were identified on the Peninsula corresponding to two geographical regions, one comprising states in the north and west and the other comprising the central, southern and eastern states. Detailed

genetic information has determined the optimum population size and identified populations that should be conserved to capture the majority of the genetic diversity of *A. malaccensis*. Such information is crucial for the identification and development of *in situ* conservation areas, genetic resource areas and gene banks, all of which are necessary prerequisites for a successful agarwood plantation sector.

The DNA profile databases—that is, population and individual identification databases—developed by the project allow rapid, accurate species authentication and product certification, which are critical for forensic and marketing purposes, respectively. These databases will be made available to enforcement agencies.

There is now sufficient evidence to indicate that populations of *A. malaccensis* in Peninsular Malaysia are declining in size. Contributing to this decline is the species's inherent reproductive, regeneration and mortality traits.

Demographic information on growth, recruitment, mortality and reproduction indicates that, given the prevailing circumstances, *A. malaccensis* will continue to decline. Bearing in mind the species's reproductive traits, it is unclear whether a ban on harvesting would reverse this trend.

The availability of population and individual identification databases enhances the capacity of forest law enforcement and Malaysia's timber tracking and tracing system. The rapid and accurate methodology for species authentication allows no uncertainties on the origin of logs and woodchips. The use of these databases for certification can provide assurance that finished products were obtained from sustainable sources.

A partial non-detriment finding (NDF) was produced by the project for *A. malaccensis*, describing biological and harvest characteristics and population status. Biological characteristics—distribution, habitat, abundance reproduction, regeneration and dispersal mechanisms—and harvesting characteristics will be published in a technical report in mid-2016.

Conservation action plan

The CAP draws on the results of the project, dialogues with stakeholders, and existing and past related projects.

A draft CAP was developed under the project with the ultimate aim of preventing a catastrophic decline in population viability. The recommendations made in the plan are based on demographic, reproductive and genetic results. Many of the identified actions are already in place but require enhancement, including by channelling increased efforts by stakeholders. Actions relate to *in situ* and *ex situ* conservation; the management of the resource; artificial propagation; enforcement; research and development; and strengthening cross-sectoral enabling factors. Crucial to the success of the CAP in achieving its ultimate aim will be the continued and enhanced collaboration of stakeholders.

Conclusion

A. malaccensis has low resilience to harvesting pressure; unless strictly regulated, its wild populations are likely to be strongly impacted by harvesting. The proposed CAP, if implemented, could ameliorate the decline in population viability, but its success will rely heavily on collaboration among stakeholders. The CAP provides a holistic list of actions that project beneficiaries—primarily the Forestry Department of Peninsular Malaysia and the various state forestry departments—can review, refine and implement.

Other project stakeholders, such as plantation managers and smallholders, will find the information generated by the project on the reproductive ecology and genetics of *A. malaccensis* useful. The Ministry of Natural Resources and Environment and the Malaysian Timber Industry Board (the Malaysian CITES Management Authority) will benefit from the *A. malaccensis* DNA profile database for timber tracking and forensic purposes. The most immediate use of the information generated by the project will be in determining the annual export quota, which for the past several years has been capped at 200 000 kg annually. The project has also enabled the Forest Research Institute of Malaysia to increase the evidence-based support it provides to stakeholders in light of its improved understanding of population demographics and genetic changes.

Future phases of the ITTO–CITES Programme should support activities outlined in the CAP, in particular research and development on breeding and artificial propagation.

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Barking up the right tree

A pilot study of* Prunus africana *shows that DNA tracking technology can help safeguard supply chains from illegality

by Darren Thomas

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Bark mat: *Prunus africana* bark chips are spread for drying. Photo: G. Yene Yene/DoubleHelix

Significant progress continues to be made in the practical application of DNA technology to safeguard global timber supply chains, the area of focus for Double Helix Tracking Technologies ("DoubleHelix"). This article describes the recent completion of a traceability project carried out under the ITTO–CITES[1] Programme for Implementing CITES Listings of Tropical Timber Species.

Securing supply chains of CITES-listed *Pericopsis elata* and *Prunus africana*

ITTO engaged DoubleHelix in 2014 to support the ITTO–CITES Programme with two activities: the pilot implementation of a DNA traceability system for *Pericopsis elata* in forest concessions and sawmills in Cameroon and the Republic of the Congo, and a similar pilot implementation for *Prunus africana* in Cameroon and the Democratic Republic of the Congo (DRC).

These two activities are the latest in a series supported by ITTO focusing on the development of DNA techniques for timber traceability. A DNA-based timber traceability system was first applied in the Indonesian forest sector in 2007 to verify chain-of-custody documentation for merbau (*Intsia* spp.) processed for export to Australia, New Zealand and Europe through ITTO Activity PP-A/43-194. The results were published in *Silvae Genetica* (Lowe et al. 2010) and as an ITTO technical paper (Seidel 2012). Another ITTO-funded DNA project was PD 620/11 Rev. 1 (M): "Development and implementation of a species identification and timber tracking system in Africa with DNA fingerprints and stable isotopes", which involved the development of both genetic and isotope reference data for multiple tree species across seven countries in West and Central Africa (Degen and Bouda 2015).

In the case reported here, the task assigned by the ITTO–CITES Programme coordinator was to design and implement DNA-based traceability systems to help control trade in two CITES-listed tree species: *Pericopsis elata* (timber) and *Prunus africana* (bark). The objective was to address gaps in the CITES permit process that allow timber and bark from non-authorized sources to enter supply chains controlled under the ITTO–CITES programme. The desired output was a system that could detect attempts to substitute timber and bark from non-authorized harvest zones, using DNA testing to independently and scientifically verify claims of origin associated with CITES permit applications and the permits themselves.

The *Pericopsis elata* activity was conducted in Cameroon and the Republic of the Congo, with scientific work carried out at the University of Adelaide. The *Prunus africana* activity was carried out in Cameroon and DRC, with scientific work conducted at the Thünen Institute in Germany. A number of government agencies were closely involved in both activities (see "acknowledgements" at the end of this article). The final results of the *Pericopsis elata* activity are still in preparation, but the *Prunus africana* activity has been completed—marking a key milestone in the application of DNA technology to safeguard the supply chains of tropical timber products.

The remainder of this article describes the implementation and outcome of the *Prunus africana* project. Two technical approaches were trialled: The first would enable the matching of *Prunus africana* bark with individual trees in controlled harvest zones to verify systems of tree tagging and detailed harvest documentation (such as in the Mount Cameroon area). The second would allow the traceability of bark back to distinct *Prunus africana* populations for which sustainable harvest plans have been drawn up and approved. (These are known as "*Prunus* allocation units" in Cameroon and "harvest zones" in DRC.)

1 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Figure 1: Locations of *Prunus africana* population samples, Cameroon

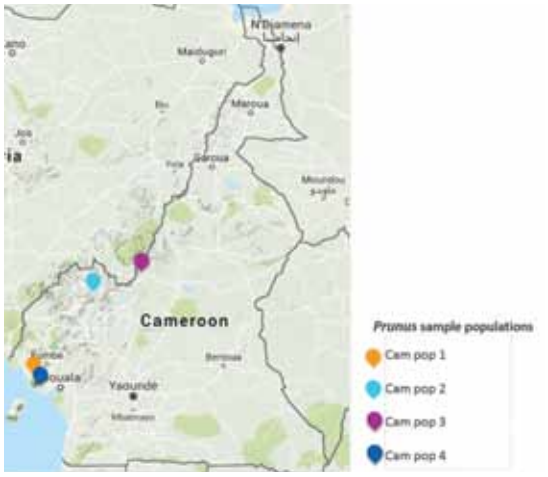
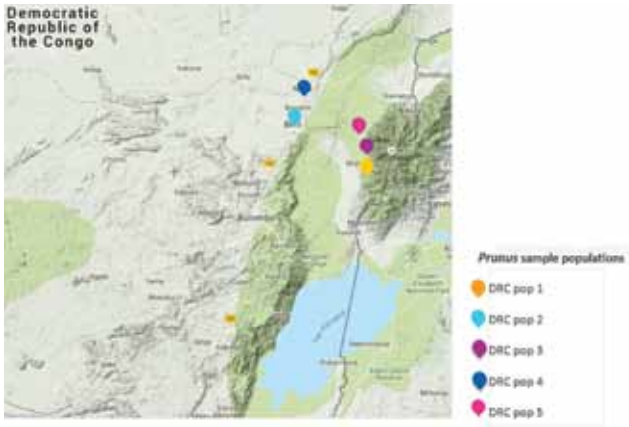


Figure 2: Locations of *Prunus africana* population samples, Democratic Republic of the Congo



By developing both approaches, it is possible to identify and verify that bark has been harvested from authorized harvest zones. As more advanced inventory and chain-of-custody systems are implemented (such as in the case of Mount Cameroon, with the assistance of GIZ), it is also possible to independently verify claims of harvest from individual trees. Irrespective of the approach, these capabilities enable the independent scientific verification of CITES document claims.

Implementation strategy

The implementation strategy of the activity had two components, described below.

1) Preparation and development of DNA reference data

Preliminary work was done to confirm the ability to extract DNA of sufficient quality and quantity from *Prunus* bark that has been dried and processed. This is not a trivial task, requiring advanced laboratory facilities and skilled technicians. A successful trial DNA extraction was undertaken in the early stages of the activity.

Training in procedures for the collection, recording, storage and shipment of bark samples was carried out for field sampling teams in both Cameroon and DRC. The trained teams then completed an initial round of sampling of *Prunus africana* bark from standing trees in five populations in Cameroon and DRC. Three more populations were added later; Figure 1 and Figure 2 show the locations of the sampled populations in the two countries.

The samples were sent to the Thünen Institute for analysis and the development of genetic markers. A genetic marker is a sequence of DNA with a known location in the chromosome that can be used to identify individuals or species. The identification of sufficient genetic markers enables reliable discrimination between individual trees of the same species, and between trees of different geographic origin.

2) Field implementation

Discussions were held with government officials, communities and industry stakeholders to better understand the harvesting, transportation and processing activities associated with *Prunus africana* to inform the development of the DNA-based verification system. The field implementation stage was conducted with the cooperation of the key *Prunus africana* processors in Cameroon and DRC to determine how samples could be taken with minimal disruption during actual harvesting and processing operations.

Results

Genetic reference data enabling the matching of bark with specific harvest zones

Thirty-six *Prunus* genetic markers were developed, 16 of which were used in the final analysis. These markers can be used for both individual assignment (matching bark with individual trees) and population assignment (matching bark with a geographic area). Genetic profiles have been created for eight distinct geographic areas of *Prunus africana* trees.

Table 1: Accuracy of assignment of individuals to their correct populations

Accurate assignment back to specific population (%)									
	Cameroon pop. 1	Cameroon pop. 2	Cameroon pop. 3	Cameroon pop. 4	DRC pop. 2	DRC pop. 3	DRC pop. 4	DRC pop. 5	Kenya
Cameroon pop. 1	95			5					
Cameroon pop. 2		100							
Cameroon pop. 3			100						
Cameroon pop. 4	3			97					
DRC pop. 2					94	2	2		2
DRC pop. 3		2				90	3	3	2
DRC pop. 4						7	87		6
DRC pop. 5						5		95	
Kenya									100

Note: Percentages add to 100 on the horizontal plane (but not vertically); "pop." = "population".

Box 1: DNA verification systems

The ITTO–CITES Programme pilot activity has built capacity to verify the origin of *Prunus africana* bark to eight authorized harvest zones in Cameroon and DRC. The intention is to implement a DNA verification system aimed at supporting and strengthening CITES supply-chain controls while minimizing disruption to trade. Properly applied, the system will provide unprecedented supply-chain transparency and a material chain of custody for CITES-listed species, where such control is essential for ensuring the sustainability of the species and for providing local communities with a sustainable source of income.

Selection of sampling and testing points

Sampling control points will ultimately be located where stakeholders determine the highest risk of substitution to be. Based on the findings of the activity, DoubleHelix recommends that samples are collected for testing at two points in the supply chain, the first on the delivery of bark from harvest zones to central processing and distribution warehouses, and the second at the point of import. If DNA tests indicate false declarations of origin, having multiple testing points will make it possible to narrow down where the non-controlled *Prunus africana* was introduced—either between the point of harvest and delivery to the distribution warehouse, or between the packing of the product into containers at the warehouse and the loading of the containers onto the shipping vessel at port.

Sampling and testing

Once set up, routine sampling could be conducted by the national CITES Authority or an independent third party. Much like any product quality control process, the DNA testing of a predetermined number of samples randomly pulled from product shipments over time will make possible statistical estimates of the level of confidence in claims of origin. In other words, the number of negative test results that identify false claims enables the determination of the probability of false claims associated with all other shipments in the supply chain.

For example, consider the implementation of a system in which 75 bark samples are randomly selected and tested in a supply chain over the course of six months. If DNA testing reveals one false claim of origin in the 75 tests, statistical calculations predict that up to 7.3% of the total volume of bark handled through this supply chain during the period might also have had falsely declared origins. These calculations are made with a 95% level of confidence.

The following table provides a similar calculation for higher numbers of negative tests.

Observed frequency of false claims (75 samples tested)	Confidence interval (% of potential false claims in population)
2	Up to 9.5%
5	Up to 15%
10	3.2–23.5%
20	Between 14.9–38.4%

The advantage of this claims verification approach is that the number of samples taken and tested can be adapted according to the level of risk associated with the supply chain. Risk may be a function of supply chain complexity, location and previous testing history.

To validate the accuracy of the genetic reference data, an application test was carried out to determine if samples could be assigned to specific populations through DNA testing. Table 1 shows that the level of assignment of test samples to the correct population was very high, with an average success rate of 96%, even though some populations are only 15–20 km apart.

Because the data are based on genetic information encoded in the species, they have a very long lifetime and will be useful for traceability purposes for decades to come. The raw sequence data generated through this project also has many other potential research applications, such as for landscape reconstruction and climate-change adaptation.

A system to support the verification of CITES applications, export and import permits

DoubleHelix has proposed a DNA verification system that verifies the accuracy of CITES export permit applications, and the export/import permits themselves, at key control points in the supply chain. Box 1 provides an example of such a system.

Conclusions and recommendations

This pilot activity has demonstrated that, using DNA testing, it is possible to assign bark samples back to specific harvest zones where genetic reference data have been established to a high level of confidence. Some of the harvest zones included in the pilot were only 15–20 km apart, but even for these, the samples were correctly assigned in 96% of cases (on average).

Statistical process control enables the detection of bark substitution and associated document fraud to a high level of confidence, leading to better enforcement of CITES controls. Even in cases of unintentional error, a breakdown in traceability can be identified at an early stage and rectified before the problem escalates.

It is hoped that this transparency brings confidence that CITES controls are effective in managing the harvest and trade of sustainable *Prunus africana*. The ability to accurately measure compliance with harvest and export quotas should enable the use of more sources of *Prunus africana* for which non-detriment findings have been made, perhaps including in countries currently banned from export.

Traceability back to population (rather than to specific trees) is the recommended approach when the bark of different trees is mixed during harvest and where harvest practices do not allow segregation, such as in DRC. However, as forest management practices develop in harvest zones under the ITTO–CITES Programme, the DNA verification system can be adapted to monitor improvements in chain-of-custody systems so that bark can be traced to specific trees, if necessary. Box 2 presents two examples of the use of DNA verification, one of which includes traceability to trees and stumps.

This project has generated findings that can be applied more broadly, such as the following:

- The scientific verification of controlled origin is an effective mechanism for detecting illegally harvested bark in the supply chain, closing off channels to market for illegally harvested forest products and subsequently deterring illegal harvesting.
- DNA traceability works on top of existing document controls, verifying the accuracy of documents and records required under a simple but otherwise vulnerable control system, thereby supporting existing supply-chain control systems. No additional document or information technology-based systems are required. The same principle can be applied to other legal or sustainable forest management and chain-of-custody systems.
- Now that the initial investment in DNA reference data for the species has been made, the cost of rolling out the traceability system to other areas where the species is harvested is marginal (at about US$25 000 per harvest zone). Ongoing running costs (of sampling and testing) are estimated at around 1% of the export value of the bark.
- Export markets gain access to a wider range of controlled timber sources, and responsible exporters gain better access to overseas markets based on sustainable and controlled volumes of product.

To expand on this work and create a viable platform on which to begin comprehensive *Prunus africana* bark verification, the next stage of activities should include:

- the expansion of the genetic reference data to include all harvest zones in countries with export quotas;
- additional genetic marker development to increase the likelihood of successful DNA extraction and analysis across a greater number of populations and to reduce the cost of routine testing;
- consultation and agreement on the mode of implementation of a DNA verification system with the CITES Secretariat, local CITES Authorities and the ITTO–CITES Programme coordinator; and
- the application of activity outputs and insights to improve the management of other CITES-listed plant species worldwide and other voluntary and mandatory timber traceability systems.

Box 2: Examples of other deployments of DNA technology

Big-leaf maple law enforcement

DoubleHelix was engaged to help address the illegal logging of big-leaf maple (*Acer macrophyllum*) on United States public lands. Funded by the World Resources Institute and in partnership with the University of Adelaide, the task was to develop a system to match suspected illegal timber with individual stumps of trees that had been felled illegally. To do this, genetic reference data for big-leaf maple across its natural range in the North American Pacific coast were developed. The resulting DNA markers enabled the matching of timber samples back to individual trees or stumps across the natural range to a very high level of confidence (Jardine et al. 2015). The success of the project led to a significant milestone: the first time plant DNA has been used as part of a criminal illegal logging prosecution (under the Lacey Act) in the United States.[1]

In addition to supporting law enforcement, efforts are underway to establish a voluntary system that will enable buyers of big-leaf maple timber to confirm its legal harvest through the DNA verification of the associated harvest permits, which are granted for individual trees.

Oak market screening

With support from the World Resources Institute, the Forest Stewardship Council and participating organizations, DoubleHelix conducted a project to test the validity of documented claims of origin and species associated with white oak products in the UK market. The purpose was to generate scientific data that would shed light on the extent of species substitution in typical oak supply chains. For example, how often are wood products claiming to be American oak (*Quercus alba*) actually Asian oak (*Q. mongolica*)? The project applied a combination of wood anatomy and DNA analysis (provided by the Thünen Institute) and stable isotope testing (provided by Agroisolab Gmbh) on a variety of oak products that were either purchased or submitted voluntarily by members of the UK timber trade. The study indicated significant levels of incorrect species claims across a broad range of products. The results have been submitted to the World Resources Institute for review and publication.

1 news.mongabay.com/2016/03/dna-evidence-just-helped-convict-illegal-loggers-in-the-us-pacific-northwest.

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Conservation status of bubinga in Cameroon

A study conducted as part of the ITTO–CITES Programme suggests there is sufficient cause to include* Guibourtia *timber species in CITES Appendix III

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Ready for listing: A child's cot in Yaoundé, Cameroon, made with timber from *Guibourtia demeusei*. There is a case for adding this and other *Guibourtia* species to CITES Appendix III. *Photo: J.L. Betti*

The vulnerability of a given plant species in a forest is determined by both internal and external constraints (Betti 2001, 2002). Internal constraints are those linked to the characteristics of the species, such as its morphology, habitat, seed distribution strategy, and abundance or density. External constraints are those linked to the environment and to human disturbances such as deforestation and the management system employed. To determine the likelihood that a given level of trade will be non-detrimental to the survival of a plant species, the International Union for Conservation of Nature (IUCN) has developed a checklist encompassing parameters such as the type and level of harvest, the demographic segment removed from a population, the economic drivers of the harvest, the biological characteristics and status of the taxon in question, harvest management measures, and incentives for conservation (Rosser & Haywood 2002).

Guibourtia, a genus commonly known as "bubinga", is of considerable sociocultural and economic importance; it includes morphologically very similar multipurpose species found in various habitats with differing climatic and soil conditions (Tasso et al. 2015). Bubinga wood is hard and red; it is highly appreciated in the marketplace and is used in Europe and Asia in the manufacture of furniture and musical instruments. Three *Guibourtia* species are on the IUCN Red List, only one of which (*G. ehie*, listed as "least concern") is known to occur in Cameroon; to date, a lack of data has limited assessments of the conservation status of other *Guibourtia* species.

Data presented in this article were gathered in a literature review and a web search as part of the ITTO–CITES[1] Programme for Implementing CITES Listings of Tropical Tree Species. The data were first presented at a regional workshop on bubinga and wengé (*Millettia laurentii*) held in Douala, Cameroon, in June 2012, sponsored by the Germany Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) through ITTO and hosted by the Government of Cameroon through its Ministry of Forest and Wildlife (MINFOF). The overall goal of the workshop was to assess the state of knowledge of bubinga and wengé in Africa, analyze their vulnerability, and establish their conservation status in each country.[2] This article reports on the status of bubinga species in Cameroon as determined using the IUCN checklist, specifically its Table 2, focusing on national distribution, national abundance and population trends.

Data on the distribution of bubinga species are based on the important work of Vivien and Faure on African trees (Vivien and Faure, 1985, 2011) and on forest inventories conducted in various forest management units (FMUs). Logging volumes were generated from the Forest Management Information System (*Système Informatique de Gestion de l'Information Forestière*—SIGIF), a database held by MINFOF.

Identification and population trends

The genus *Guibourtia* comprises 13 species in Africa (Tasso et al. 2015; Figure 1), of which Cameroon hosts five (Onana 2011): *G. demeusei* (Harms) J.Léonard (trade name = red bubinga); *G. tessmannii* (pink bubinga); *G. ehie* (A.Chev.) J.Léonard (ovangkol); *G. pellegriniana* J.Léonard (bubinga); and *G. arnoldiana* (mutenye). Two of these species—*G. tessmannii* and *G. demeusei*—are known for their timber. *G. demeusei* grows in closed forest, commonly in periodically

1 CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora.

2 A report of the workshop is available at: www.itto.int/files/user/cites/cameroon/Report%20of%20the%20Douala%20workshop.pdf.

Table 1: Density of two bubinga species (diameter at breast height ≥ 20 cm) in forest management units in Cameroon, and minimum harvesting densities

Tree species	FMU	Density (stems/ha)	Minimum density (stems/ha)*
Guibourtia tessmannii (pink bubinga)	FMU09006	0.0025	0.01
	FMU09016	0.004	0.05
	FMU09017-018	0.03	0.05
	FMU09021	0.01	0.01
	FMU09023	0.006	0.05
	FMU09024	0.06	0.01
	FMU09025	0.01	0.02
	FMU09004B	0.0018	0.05
	FMU09019	0.002	0.05
	FMU11005	0.01	0.05
	FMU10064	0.003	0.05
Guibourtia demeusei (red bubinga)	FMU09006	0.01	0.01
	FMU090017-0018	0.03	0.05
	FMU09021	0.004	0.01
	FMU09004B	0.0018	0.05
	FMU09020	0.005	0.05
	FMU11001	0.0023	0.05
	FMU11005	0.00	0.05

Note: Data obtained from forest management plans. *As set by the timber company, below which species should not be harvested.

inundated forest and swamp forest, and *G. tessmannii* occurs in evergreen Atlantic forest (Vivien & Faure 1985; Souane Thikakul 1985).

One way to determine population trends for a given tree species is to compare data collected with similar methods in two different periods. Vivien and Faure revised their 1985 book in 2011 (Vivien & Faure 2011), adding three *Guibourtia* species— *G. ehie*, *G. pelligriniana* and *G. tessmannii*. The updated version does not indicate the presence of *G. demeusei*, however (although it was present in the 1985 version), raising a number of questions about the distribution of *Guibourtia* species in Cameroon that remain to be answered.[3]

There are dissimilarities in the distribution of *Guibourtia* species between the maps generated by Vivien and Faure (1985) and data contained in the management plans of FMUs. For example, Vivien and Faure limit the presence of *G. tessmannii* to the Northwest, Littoral and South regions, while inventory data from FMUs indicate that the species does not occur in the Littoral Region but is found in the Southeast Region. To illustrate these dissimilarities clearly, we superposed the maps of *G. demeusei* generated from FMU inventory data with those of Vivien and Faure (1985) (Figure 2). The latter indicate that *G. demeusei* occurred only in the northwest of the South Region, while FMU data extend the range to almost all of the South Region and also to the Southeast Region.

It is difficult to conclude, therefore, whether the distribution of bubinga species is increasing or decreasing. Further investigation is required to determine whether the inconsistency is a case of species misidentification or illustrative of a real change in distribution and abundance. Regardless of the reason, the IUCN guidelines (Rosser & Haywood 2002) indicate that a lack of accurate information on distribution should be viewed as problematic for the conservation of a species.

Density and distribution of stems

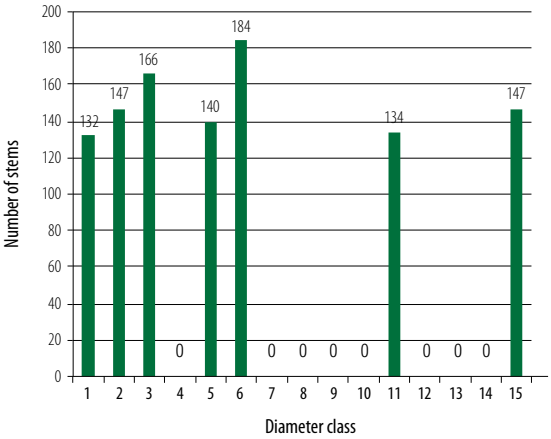
According to the Pilot Integrated Management (API) Project, which has been working in Cameroon's East Region since 1992, a tree species should be excluded from harvesting when its average density is less than 0.05 stems per hectare (Forni 1997, API 1995). Some timber companies have fixed their own minimum densities of exploitability (logging) in their management plans, often at a lower level than the 0.05 stems per hectare proposed by the API Project. Table 1 shows the densities of two bubinga species reported in forest management plans for various FMUs, and the minimum densities set by companies. Both species occur at densities below 0.05 stems per hectare in all FMUs for diameter classes ≥ 20 cm and should therefore be subject to special silvicultural and conservation measures.

Knowledge of the distribution of stems by diameter class is important for the effective management of a given tree species because it shows the structure of the population and helps in identifying deficiencies in regeneration capacity. Diameter class distributions provide a basis for the adaptation of silvicultural interventions.

Figures 1 and 2 show the distribution of stems of the two bubinga species commonly logged in Cameroon, by diameter class. For both species, a number of diameter classes are poorly represented, perhaps as a result of overlogging, raising questions about the sustainability of the management regimes.

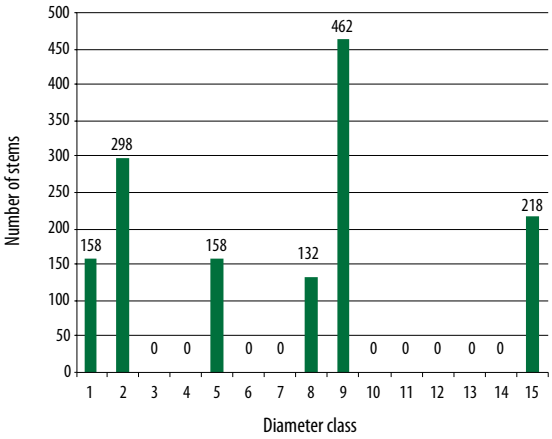
3 For example, does the exclusion of *G. demeusei* in the updated version mean that Viven and Faure consider that it has become extinct in Cameroon?

Figure 1: Number of stems of *Guibourtia tessmannii* (pink bubinga), by diameter class, various forest management units combined



Note: Diameter class 1 = <25 cm, class 2 = 26–35 cm, etc. (class 14 = 145–155 cm). Total number of stems = 1050.

Figure 2: Number of stems of *Guibourtia demeusei* (red bubinga), by diameter class, various forest management units combined



Note: Diameter class 1 = <25 cm, class 2 = 26–35 cm, etc. (class 14 = 145–155 cm). Total number of stems = 1426.

Distribution of requested logging volume

Concessionaires requested permission to harvest a total of 31 226 m^3 of bubinga species in Cameroon between 2008 and 2012 (Table 2), led by *G. demeusei* at about 28 961 m^3. It is paradoxical that some FMUs requested permission to harvest bubinga, even though their management plans indicate that those species are at very low densities and therefore should be excluded from harvesting. In FMU 09021, for example, *G. demeusei* was assessed at a density of 0.004 stems per hectare, which is 12.5 times lower than the 0.05 limit fixed by API and 2.5 times below the 0.01 limit fixed by the company (Table 1); nevertheless, permission was requested to log 7 056 m^3 of that species in FMU 09021. This demonstrates a universal problem in Cameroon—in general, management plans are well prepared, but timber companies do not always adhere to them in their implementation.

Actions undertaken to ensure bubinga conservation in the Congo Basin

A total of 40 participants from producer countries (Cameroon, the Central African Republic, the Republic of the Congo, the Democratic Republic of the Congo, Côte d'Ivoire, Equatorial Guinea and Gabon), a consumer/buyer country, an international organization, a logging company, research and teaching institutions, and a bilateral development agency attended the 2012 workshop in Douala on bubinga and wengé. At its conclusion, participants agreed on the following declaration:

> "Yes, we have preoccupations in the pressure exercised on bubinga and wengé in Cameroon, and presumptions of pressure in other countries. However, we acknowledge the fact that there is lack of concrete information to propose a direct registration of these species in to CITES

Table 2: Logging volume of two *Guibourtia* species requested in forest management units, 2008–2012

FMU	Logging volume (m^3)		
	G. demeusei	*G. tessmannii*	Total
9012	225		225
00-001	1214		1214
00-002	2895		2895
00-004	1605		1605
09-003			0
09-008	2105		2105
09-009	207		207
09-012	1167		1167
09-015	1286	369	1655
09-016			0
09-017	7056		7056
09-019	5017		5017
09-020	1720		1720
09-022	79	515	594
09-023	1121		1121
09-024	70	711	781
09-026	2766		2766
09-028	187		187
09-04b			0
10-007			0
10-020			0
2E-RF	241	670	911
Total	**28 961**	**2 265**	**31 226**

Appendixes II or III. This information concerns the biology, ecology, distribution area and current potentials in particular. Meanwhile, these studies could be extended to other species like longhi blanc (*Gambeya lacourtiana*) for the case of the Congo, essessang (*Ricinodendron heudelotii*) and akossika (*Scohelllia klaineana*) for Côte d'Ivoire. All these studies require financing which could come from several sources notably the concerned states and development partners".[4]

In the months following the workshop, various countries sent letters to the CITES Secretariat requesting the inclusion in CITES Appendix III of bubinga and wengé (Cameroon, the Central African Republic, the Republic of the Congo and the Democratic Republic of the Congo); iroko (the Democratic Republic of the Congo); and longhi blanc and moabi (the Republic of the Congo).[5] The CITES Secretariat reacted by inviting the requesting countries to comply with the requirements of CITES Resolution Conf. 9.25 (Rev. CoP 15) concerning the inclusion of species in Appendix III.

At an international meeting on sustainable forest management organized by ITTO and CITES in Bali, Indonesia, on 8–10 January 2013, range countries invited ITTO to assist them in gathering relevant data and preparing the application for listing key tree species in CITES Appendix II or Appendix III. ITTO subsequently prepared a project document aiming to respond to that call, with the overall objective of ensuring that any decision to list tree species in CITES Appendix III is consistent with the real situation in the forest and in international trade.

Conclusions and recommendations

In Cameroon, the distribution of bubinga species is restricted largely to the South and Littoral regions, with some stands in the Centre and East regions. A lack of reliable information, however, makes it difficult to discern trends in the distribution of *G. demeusei* and *G. tessmannii*, and this lack of information constitutes, in itself, an indicator of vulnerability. Data presented in FMU management plans tend to show that bubinga species occur at low densities (less than 0.05 stems per hectare) and with irregular diameter class distributions, but timber companies continue to harvest them, a further indicator of their vulnerability in Cameroon.

ITTO should assist range States (Cameroon, Côte d'Ivoire, the Republic of the Congo, the Democratic Republic of the Congo, the Central African Republic and Equatorial Guinea) to propose the inclusion of bubinga species in Appendix III of CITES so that it might be considered a species of concern in the ITTO–CITES Programme. The Programme has previously assisted Cameroon, the Republic of the Congo and the Democratic Republic of the Congo to develop a sustainable trade in *Pericopsis elata* (assamela) and *Prunus africana* (pygeum or African cherry), two CITES-listed tree species.

An increasing number of timber species are being listed in the CITES Appendices with the aim of better regulating their trade and ensuring the survival of the species in the wild. In practice, the survival of CITES-listed tree species in their natural ranges cannot be separated from broader forest management. In this context, ITTO has an important role to play, given its 30 years of experience in supporting sustainable forest management in the tropics and its well-established working relationships with forest authorities in its member countries.

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4 www.itto.int/country_activities.

5 Species are included in Appendix III at the request of a party that already regulates trade in the species and which needs the cooperation of other countries to prevent unsustainable or illegal exploitation. International trade in specimens of species listed in Appendix III is allowed only on presentation of the appropriate permits or certificates.

Fellowship report

An ITTO Fellow makes the case for listing the entire* Dalbergia *genus in CITES Appendix II

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Valuable samples: The very-high-value woods of *Dalbergia calycina, D. retusa* and *D. stevensonii* are similar to each other in anatomy, colour and grain. *Photo: V. Vaglica*

The very-high-value wood of *Dalbergia* species, known as "rosewood", is renowned for its fragrances and colours. *Dalbergia* species are the most demanded species occurring naturally in Central and South America and are at considerable risk of overexploitation.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has been used for over 40 years as a tool to help in the conservation of wild species traded internationally. The aims of this study were to:

- verify whether *Dalbergia* species occurring in Guatemala meet the criteria for listing in CITES Appendix I or II, and, in the affirmative case, to draft a proposal for such a listing for consideration at the next CITES Conference of the Parties (CoP17); and
- provide assistance and guidance to range States on the biology, ecology and management of *Dalbergia* species and the impacts of their harvesting and international trade.

Methods

The study required investigations into the taxonomy, biology and trade of *Dalbergia* species and relevant laws at the national and global levels. Data and information were obtained from a literature review, consultations with experts, and a web search. The CITES listing criteria were applied to selected tree species to assess whether those taxa meet the criteria for inclusion in the CITES Appendices on the basis of the information collected (as specified in Resolution Conf. 9.24 [Rev. CoP16]).

Rosewoods and rosul

Dalbergia is a large genus in the family Fabaceae; it has a global distribution concentrated in the tropics and subtropics (Rout et al. 2003). The wood, which is traded in Central America as "rosul", is used in musical instruments such as marimbas (Guatemala's national musical instrument) and guitars and in expensive furniture and joinery (Rasolomampianina et al. 2005).

Guatemala and *Dalbergia*

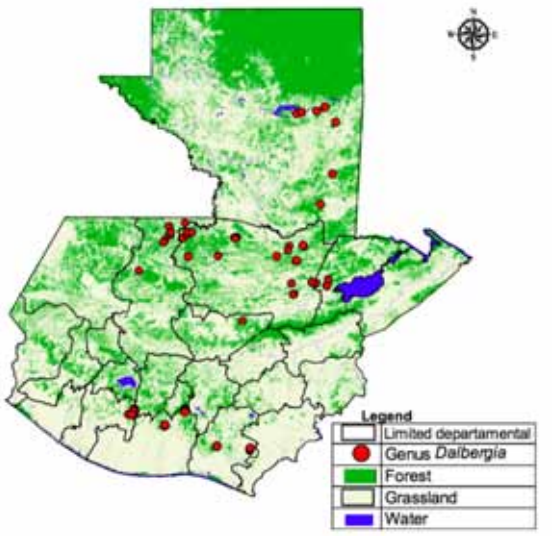
The distribution of *Dalbergia* is highly fragmented in Guatemala and restricted to specific regions, such as Alta Verapaz, Baja Verapaz, Izabal, Huehuetenango, Quiché and Petén (Figure 1). Fourteen *Dalbergia* species occur in Guatemala, seven of which are known to be used for their timber.

The distribution of *Dalbergia* species such as *D. calycina*, *D. retusa*, *D. stevensonii* and *D. tucurensis* is affected by illegal logging (INAB, CONAP, UVG & URL 2012), agricultural expansion, cattle ranching, oil-palm plantations and population growth (FAUSAC-FPNV 2015). According to FAUSAC-FPNV (2015), only trees of *Dalbergia* species in the diameter class 20–60 cm can be found in the wild, mainly in Alta Verapaz and Petén. The overcutting of exploitable individuals in the wild is the main cause of the absence of certain diameter classes and the low density of populations. Inside protected areas (especially in the department of Petén), activities such as drug trafficking, the illegal trade in timber products, and road construction all represent threats to the survival of the genus in the wild (INAB & IARNA 2012).

Morphological characteristics

The wood of *Dalbergia* is either red (*D. tucurensis* and *D. glabra*), dark brown (*D. calycina*) or brown to dark brown with reddish stripes (*D. stevensonii*) (FAUSAC–FNPV 2015). Many *Dalbergia* species have the same wood anatomy, and the hardness of the wood makes it difficult to prepare thin

Figure 1: Distribution of *Dalbergia* in Guatemala



sections for microscopic analysis (McLure et al. 2015). There are look-alike issues among *Dalbergia* species: *D. tucurensis* and *D. stevensonii* cannot be separated by their wood anatomy, and *D. tiralana* can be confused with *D. stevensonii*. The wood of *D. granadillo* is indistinguishable from that of *D. retusa*, and the woods of *D. calycina, D. retusa* and *D. stevensonii* are similar in colour and grain, especially immediately after cutting.

Parts and derivatives in trade

Logs and sawnwood are the main *Dalbergia* products in international trade (especially in illegal trade), but wooden furniture, woodfuel, manufactured items (e.g. tables, doors, frames and boards) and handicrafts are also traded nationally and internationally (CONAP 2015; INAB 2015; CTD 2015). In 2014, the national trade of *Dalbergia* timber in Guatemala amounted to 669.53 m^3 (INAB 2015), comprising five species—"*Dalbergia* spp."[1], *D. calycina*, *D. cubilquitzensis*, *D. stevensonii* and *D. tucurensis*. *D. stevensonii* (444.41 m^3) was the main species traded.

Legal trade

A total of 177.1 m^3 of logs, tables, sawnwood and furniture of *D. calycina, D. cubilquitzensis, D. stevensonii* and *Dalbergia* spp. were exported legally in 2014 (INAB 2015). Ninety-three CITES export permits were issued for sawnwood in 2008–2014, accounting for a total volume of 59.33 m^3 of *D. retusa* (at an estimated value of US$374 066) and 808.48 m^3 of *D. stevensonii* (at an estimated value of US$1 850 371) (CONAP 2015). The main countries importing *D. stevensonii* in 2008–2014 were China (317.04 m^3), the United States (233.71 m^3), Germany (159.32 m^3) and Japan (46.95 m^3) (Figure 2).

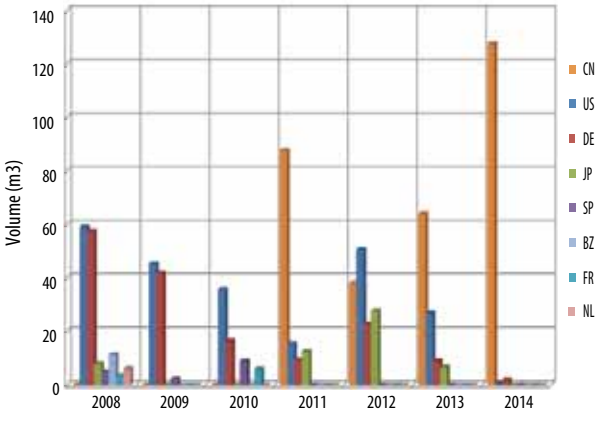
According to the CITES Trade Database (CTD), Germany was the main importer of "*Dalbergia* spp." in 2007–2009, with a total import volume of 110 m^3 of sawnwood, and the other main importers in that period were the United States, Japan and Spain. Little information is available on the international trade of *D. retusa*. Regarding *D. stevensonii*, the CTD recorded the export of 23 batches of sawnwood from Guatemala in 2008–2013, of which the main importing countries were (according to importer-reported quantities) Germany, China, the United States and Japan. Small quantities of *D. stevensonii* were exported from Guatemala to Spain in 2008 and to France in 2010.

Illegal trade

Extensive illegal trade in rosewood has been reported, and concerns have been raised that this trade has accelerated in recent years (Jenkins et al. 2012). In Guatemala, illegal logging is estimated to comprise 95% of all traded timber (IARNA 2009). According to Kiuru (2003), 50% of timber traded in the markets at Quetzaltenango and Huehuetenango (year unspecified) was illegal; IARNA (2006) reported that, from 1999 to 2004, 66.1% and 77% of timber products traded in the Chimaltenango and San Juan Sacatepéquez regions, respectively, were of illegal origin.

In 2011–2014, officers from the National Forest Institute (*Instituto Nacional de Bosques*—INAB) and the National Council of Protected Areas (*Consejo Nacional de Áreas Protegidas*—CONAP) confiscated 38 shipments and vehicles carrying a total volume of 906.244 m^3 of timber (logs trunks, flitches and tables) of *D. stevensonii*, *D. retusa* and "*Dalbergia* spp." (reported collectively as "rosul") of illegal origin in roadside checks and export inspections at the country's main ports (Puerto Quetzal, Santo Tomás de Castilla and Puerto Barrios). With the exception of two shipments destined for Honduras and El Salvador, all shipments were headed to China. In February and March 2015, two containers of *D. stevensonii* (18.9 m^3) and "*Dalbergia* spp." (22.13 m^3) were seized by CONAP inspectors at Puerto Quetzal; the destination country was China. Often, the documents accompanying such shipments state that they comprise recycling material (e.g. cardboard, junk or scrap metal) or other timber species, such as *Cupressus*, *Dialium* or *Miroxylum*.

Figure 2: Importer countries of *Dalbergia stevensonii* from Guatemala, 2008–2014



Note: CN = China; BZ =Belize; DE = Germany; FR = France; JP = Japan; NL = the Netherlands; SP = Spain; US = United States of America. Source: CONAP (2015).

1 Note that sources report a category called "*Dalbergia* spp." in which the actual species is not specified.

Actual or potential trade impact

Rosewood timber products are traded more internationally than locally. In the forest, *Dalbergia* species have a relatively low regeneration rate, and the absence of certain diameter classes (70–100 cm) and the low density of populations of certain diameter classes (20–30 cm, 40–50 cm) further affects regeneration. The international trade has promoted the cutting of *Dalbergia* in Latin America, including Guatemala, leading to the decline of populations, both outside and within protected areas.

Conclusion and recommendations

A complete evaluation is needed of *Dalbergia* populations in the main regions in Guatemala affected by illegal logging and deforestation, particularly in undisturbed forests, to enable informed decisions on their conservation and management. Nevertheless, it is clear that the unsustainable and illegal logging of *Dalbergia* species in Guatemala threatens those species and is likely to constitute a threat to natural forests more generally. The *Dalbergia* genus meets the criteria for listing in CITES Appendix II on the basis of its biology and trade data, and also for look-alike reasons between species. The inclusion of the entire *Dalbergia* genus in CITES Appendix II would bring legal restrictions to the harvesting, sale and international trade of wild *Dalbergia* species.

There is a need to raise awareness about the trade in the main range States that are producing and exporting significant volumes of *Dalbergia* species and among other CITES Parties to ensure that international trade is consistent with the sustainable management and conservation of *Dalbergia* species. Stakeholders should be incentivized to support *Dalbergia* planting and restoration programmes to counter overexploitation.

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Market trends

Japan's changing demographics have changed the furniture trade

Compiled from reports prepared for ITTO's Market Information Service

Next time you are in Japan, walk into any furniture store and check the origin of the items for sale there. You will be in for a surprise if you expect to see "Made in Japan", because many of the furniture items sold in Japan today are imported. A closer look will reveal other changes: for example, cabinets and tables are smaller than before, reflecting the changing lifestyles of the younger generation. There is also a much wider selection of beds because it is no longer common to sleep on tatami mats.

Japanese people are marrying at an older age than previously, and the urban population of young people is growing. These two trends have created new demands on furniture-makers. Success in the furniture business now depends on delivering affordable, stylish and generally smaller-sized items.

Many small and medium-sized craft/specialist furniture-makers in Japan, who once made beautiful solid-wood items by hand using woods such as oak, kayak, kiri and mahogany, have been overwhelmed by imported products made mainly from reconstituted panels. Although these lack the same quality, the price is right and "will do just fine".

Furniture import trends

Production and sales have been shrinking in Japan's domestic wooden furniture manufacturing sector for more than a decade. Most of the decline is due to competition from imports and the inability of local manufacturers to upgrade their processing methods and raise productivity.

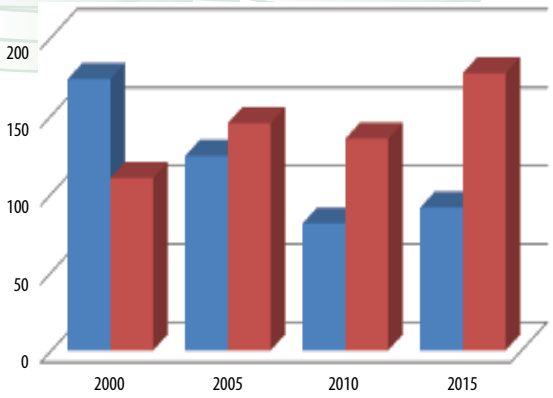
Wooden furniture imports continue to gain market share; it has been estimated that imports of bedroom, kitchen and dining-room furniture accounted for around 60% of the market in 2015. The growth in imports from China and Southeast Asian countries continues to hollow out domestic wooden furniture manufacturing.

Figure 1 shows trends in housing starts and imports of wooden office, kitchen and bedroom furniture. At first sight there appears to be a contradictory inverse relationship between trends in housing (falling) and imports (rising). Rather than a statistical anomaly, however, this reflects the rapid growth in the market share captured by imports. The Japanese furniture market was worth around ¥900 billion in 2005, and imports of wooden office, kitchen and bedroom furniture accounted for about 16% of all domestic sales. By 2015, the size of the market had fallen to around ¥700 billion, and imports accounted for over 25% of the market.

Data from Japan's Ministry of Internal Affairs and Communications show that purchases of wooden chests of drawers, a main item in the traditional "bridal furniture set", have dropped dramatically in the last 15 years. On the other hand, household spending on dining-room furniture has been fairly stable—although relatively low compared with spending on bedroom items.

In the past, the bridal market was a main driver of growth in Japan's furniture sector. It was usual for the bride's family to buy a three-piece furniture set consisting of a wardrobe, a Japanese-style chest of drawers, and a dressing table. Over time, the dressing-table component has been replaced by western-style chests of drawers and, because many newly built houses and apartment have built-in closets, demand for free-standing wardrobes has faded. This, combined with the decline in the number of marriages, has upended the established demand patterns for wooden furniture in Japan.

Figure 1: Housing starts and furniture imports, Japan, 2000–2015



Data sources: Ministry of Land, Infrastructure, Transport and Tourism and Ministry of Finance, Japan.

Bedroom furniture

China's exports of bedroom furniture to Japan accounted for 57% (by value) of all wooden bedroom furniture imports in 2015. The second-ranked supplier last year was Viet Nam, with 28% of all imports, and other Southeast Asian countries made up around 8%. The combined market share of these three suppliers in 2015 was over 90%, the balance coming mainly from Europe and North America.

Kitchen furniture

Fitted kitchens are now a standard feature of newly constructed houses and apartments, and the replacement kitchen market is growing strongly as owners of existing homes embrace renovation to avoid the cost of demolition and rebuilding (once a feature of the Japanese housing sector).

In the early days of kitchen modernization, European and North American makers of kitchen units and cabinets found a ready market in Japan. It took suppliers in Asia only a short time to grasp the opportunity, however, and they began growing their market share. Manufacturers of kitchen furniture in Viet Nam have secured a significant part of the market (41% in 2015), as have shippers in Indonesia, Malaysia and Thailand. Demand for European kitchen furniture tends to focus on German and Italian lines in the up-market housing sector.

Hollowing out the manufacturing base

Japan's domestic furniture manufacturing sector has declined as Japanese companies—even small and medium-sized companies—have shifted production outside Japan (Figure 2) to countries where production costs are lower, populations are growing and there is good infrastructure

and communications. In Japan's wooden furniture market, relocated Japanese companies are responsible for much of the export trade from China and Southeast Asia to Japan.

China was once the preferred destination for relocating Japanese companies—it is close to Japan and has good shipping connections. Moreover, wages and energy costs have been much lower than in Japan, and domestic demand has grown rapidly. This has changed now, however: rising wages, labour disputes, and the re-emergence of bitter historical issues are causing many Japanese companies to look elsewhere for their investments.

Viet Nam has attracted Japanese companies, and the trade relationship between the two countries is close. Viet Nam's overall exports to Japan are now almost 10% of all its exports, ranking second after North America. The main products exported to Japan are garments, seafood, wood products and electronics. In 2015, around 1000 Japanese companies had production capacity in Viet Nam.

Expansion of single-person homes creates opportunities

Trends in Japan's housing sector are central to the future of the furniture manufacturing sector (whether domestic or off-shore). Japan's population is aging and shrinking due to a low birth rate. The population peaked in 2005; the number of households is increasing for now but is projected to decline after 2019. The number of people aged over 65 years is expected to level off in 2025 and decline from 2040.

Superimposed on these trends is the expectation that the population of greater Tokyo, which is rising, will begin to fall in about ten years, when the number of households will also begin to fall.

The other major force to influence furniture demand is the current upward trend in one-person households, driven by changes in culture and lifestyles, which should peak in 2030. Young professionals are shying away from early marriage to focus on their careers. Since 1973 there has been a 33% decline in the number of people getting married; moreover, the divorce rate is rising fast.

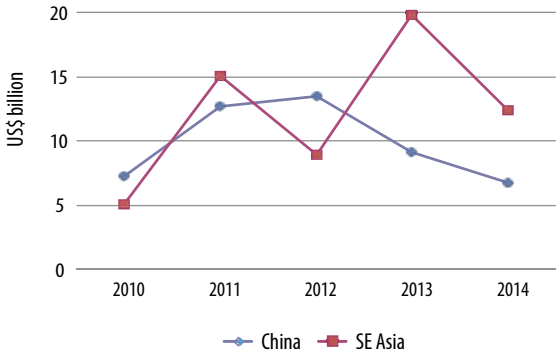
As the numbers of divorcees and never-married adults increase, single-person households are the fastest-growing household group and will eventually become the largest such group in Japan. Singles need less space and can therefore save on rent and house-building costs.

When space is limited, furniture needs to be both pleasing and practical. Storage cabinets are popular among singles in small homes, and many guides to living in small spaces—with a focus on storage techniques—are available.

Demolish and rebuild or renovate

Typically in Japan, detached wood-frame homes around 30 years old are considered worthless by lenders and by those looking to buy. This rapid depreciation is more a reflection of tradition than the soundness of residences, however—

Figure 2: Japan's outward investment, all sectors, 2010–2014



Data source: JETRO.

homeowners in Japan were raised to believe that wood-frame homes do not last and must be demolished and replaced. Understanding the extravagant waste of resources such a tradition has created, the Japanese government has introduced measures to encourage lenders to place a value on renovated homes and apartments and extend the depreciation of homes to around 50 years. The house and apartment renovation market is booming as small, medium-sized and even major developers are realizing its potential.

Room for innovation and creativity

There is potential for segments of the Japanese furniture market to grow, especially for competitively priced items designed for singles in small spaces, such as drawers, cabinets, fold-away dining tables and dining chairs. Manufacturers offering a range of styles—from traditional Japanese to Scandinavian—will find an ideal market base if the focus is on the tasteful use of colour and simple designs at reasonable prices.

The market is becoming more polarized between high-value-added products and low-priced products as the divide between consumers favouring fine interiors and those preferring low-priced furniture in the stagnant economy becomes more defined.

Japanese consumers have long been considered predictable; unlike consumers in North America and Europe, they have looked on low-priced goods with disdain, preferring to shop in recognized national-brand stores and outlets and prepared to pay for quality. Now, however, Japanese consumers have started behaving like their overseas counterparts, who for years have flocked to discount stores (including, in recent years, online stores) seeking lower-priced, serviceable items that will last until individual tastes or fashion dictate replacement.

This fundamental shift in the attitudes and behaviour of Japanese consumers has been reinforced by the current state of the national economy and the impact this is having on incomes and job security. It is likely to continue, even when the country's economic prospects eventually improve.

ITTO vacancy announcement

ITTO VACANCY ANNOUNCEMENT No. 75

(DEADLINE FOR APPLICATION: 30 APRIL 2016)

Position/title	Level (grade)	Duty station	Date for entry on duty	Duration of assignment
EXECUTIVE DIRECTOR	ASG	YOKOHAMA, JAPAN	LATE 2016/EARLY 2017	FIXED TERM: FOUR YEARS (RENEWABLE)

The International Tropical Timber Organization (ITTO), a commodity organization headquartered in Yokohama, Japan, is in the process of appointing a new Executive Director. The ITTO mission is to promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forests and the sustainable management of tropical timber-producing forests. The Executive Director is the chief administrative officer of the Organization and responsible to the International Tropical Timber Council for the administration and operation of the International Tropical Timber Agreement, 2006, in accordance with decisions of the Council.

ITTO explicitly encourages applications from qualified female candidates.

Candidates who are citizens of ITTO member countries[1] with the following qualifications may apply:

1. COMPETENCIES

Demonstrates:

(i) Professionalism: professional competence and mastery of subject matter, and conscientiousness and efficiency in meeting commitments, observing deadlines and achieving results.

(ii) Accountability: ability to operate in compliance with organizational rules and regulations and to deliver outputs within a prescribed time, cost and quality standards.

(iii) Communication: ability to communicate effectively orally and in writing. Listens to others, correctly interprets messages from others, and responds appropriately. Openness in sharing information and keeping people informed.

(iv) Networking: ability to create and maintain a network of external contacts and coalitions with other relevant organizations in a manner that enables ITTO to play a leadership role internationally on matters relevant to its mandate.

(v) Leadership: experienced in proactively developing goals and strategies to accomplish the Organization's objectives.

(vi) Vision and innovation: creates an environment that fosters innovation and innovative thinking. Empowers others to translate vision into results.

(vii) Managing performance: delegates the appropriate responsibility, accountability and decision-making authority. Makes sure that roles, responsibilities and reporting lines are clear to each staff member. Monitors progress against milestones.

(viii) Ethical standards: committed to the highest ethical standards in furtherance of his/her mission and the objectives of the ITTO.

(ix) Gender balance: committed to promoting equal opportunities.

(x) Diplomatic and negotiation skills, including experience in working with high-ranking government and industry representatives.

2. PROFESSIONAL EXPERIENCE

(i) Managerial experience: a proven track record and at least 15 years of experience in managing programmes, staff and finances in matters relevant to forestry, trade, environment or other equivalent field with proven experience in strategic planning.

(ii) Specific experience: demonstrated experience in the field of sustainable forest management and timber trade would be a distinct advantage.

(iii) International experience: previous work at the international level and experience in dealing with international organizations.

(iv) Partnership building and fundraising experience: demonstrated experience in creating strategic partnerships/networks and promoting initiatives with partner organizations. Demonstrated experience in mobilization of financial resources would be a distinct advantage.

3. EDUCATION

Master's or PhD degree in forestry, natural resource management and conservation, economics, business administration, or other relevant field.

4. LANGUAGES

Proven ability in both oral and written communication in one of the official languages of ITTO (English, French and Spanish), and preferably a working knowledge of the other two official languages. Good command of English would be a distinct advantage.

5. SALARY AND EMOLUMENTS

Salary is equivalent to that of an Assistant Secretary General in the scale of the United Nations, including benefits such as removal expenses, home leave travel every 24 months, children's education grant, rental subsidies, etc.

6. CONFLICT OF INTEREST

Candidates should have no vested financial interest in the timber industry or timber trade and related activities.

7. APPLICATIONS

Written applications including a cover letter explaining how the candidate meets the required qualifications, a completed United Nations Personal History form (form P.11), a curriculum vitae and additional supporting materials related to the job qualifications and a recent photo should be received at ITTO headquarters by 30 April 2016 at 17:00 hours (Japan time). Applications may be submitted electronically or by mail or fax and should be sent to:

Officer-in-Charge
International Tropical Timber Organization
International Organizations Center, 5th Floor
Pacifico-Yokohama, 1-1-1, Minato-Mirai
Nishi-ku, Yokohama, Japan 220-0012

Tel: +81-45 223-1110
Fax: +81-45 223-1111
Email: vacancy_ed@itto.int

All applications will be acknowledged within two working days of receipt. If applicants do not receive acknowledgement of receipt of their application, it is their responsibility to contact the ITTO Secretariat.

1 www.itto.int/itto_members

Tropical and topical

Compiled by Ken Sato

Hottest year on record

According to analyses released recently by the United States National Aeronautics and Space Administration (NASA), 2015 was the warmest year ever recorded on Earth. A NASA team found that globally averaged temperatures from January through December 2015 were 0.87 °C above the norm (based on temperatures based for 1951–1980). The analyses found that 2015 was more than 1 °C warmer than in 1880, when consistent record-keeping began.

Working independently, researchers at the National Oceanic and Atmospheric Administration (another United States government institution) found 2015 to be 0.90 °C (1.62 °F) above the 1901–2000 average. According to their analysis, 2015 was the second-warmest year on record for the continental United States and for Africa and Europe and the warmest year for Asia and South America. Globally, new monthly temperature records were set in every month except January and April.

Read the articles at http://earthobservatory.nasa.gov/IOTD/view.php?id=87359&src=eoa-iotd; www.ncdc.noaa.gov/sotc/summary-info/global/201512.

Certification aims achieved as Congo Basin Program ends

Concession-holders participating in IDH's Congo Basin Program (CBP) have obtained Forest Stewardship Council (FSC) certification covering, in total, more than 4 million hectares. The aim of the CBP, which began in 2011 as a large-scale public–private partnership and ended in December 2015, was to increase the responsible production and trade of tropical timber. It assisted and guided concession-holders to obtain FSC certification and improve their market position by co-funding a number of activities. Forest companies were invited to become partners in the CBP, and only official partner companies could benefit from the financial support provided under the Program.

More information is available at: www.congobasinprogram.com/en/home.

Ghana harvests first FSC teak

The reforestation company Form Ghana recently achieved a milestone in plantation forestry in Ghana with the first harvest (of 3000 m^3) of high-quality teak from its FSC-certified plantations in Akumadan. Form Ghana has more than 3000 hectares of FSC-certified teak plantations.

More information is available at: www.formghana.com/bullets/first-fsc-teak-from-form-ghana-reforestation-company.

Interactive global map for combating illegal logging

As part of its Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, the European Union has produced an interactive map that allows users to obtain information on over 100 projects worldwide designed to combat illegal logging and strengthen forest governance. Featuring easy-to-use search tools, the map links to project-related stories, photos and videos.

The EU-FLEGT interactive map can be viewed at http://flegt.org/map-of-projects.

New report bolsters mangroves as key defence against floods

A new World Bank report shows the economic value of mangroves and coral reefs as economically and ecologically viable defences against flooding. *Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs uses* an approach called Expected Damage Function, which compares expected flood damage when mangroves and coral reefs are in place with the damage that would occur if those defences were lost. The report demonstrates that mangroves and reefs not only have ecological value but also social and economic significance. It constitutes one of the first rigorous valuations of the regulating environmental services of mangroves and coral reefs at the national and global scales.

Read the report at http://goo.gl/dI5pdz.

Project calls on used cell phones to combat illegal logging and poaching

A new, privately funded venture known as the Rainforest Connection aims to turn old cell phones into autonomous, solar-powered listening devices for monitoring and pinpointing chainsaw activity at distances of up to one kilometre. The real-time logging detection system is to be installed high in tree canopies where it is virtually invisible; the aim is to identify illegal logging as it occurs, triggered by the sound of chainsaws. Data will be transmitted openly, freely and immediately worldwide and allow local authorities to investigate disturbance. The project was initially funded by a kickstarter campaign, which gained enough funding for the successful testing of the technology in Africa (Cameroon) and the Amazon (Brazil) in 2015.

Read more at: https://rfcx.org.

Recent editions

Compiled by Ken Sato

Qinglin, H., Jingcheng, H & Zhibo, M. 2015. ***Study on investigation and assessment techniques of tropical forest ecotourism resources in Diaoluoshan National Forest Park.*** **Research Institute of Forest Resource Information Techniques, Chinese Academy of Forestry, Beijing, China.**

Available at: http://goo.gl/s3MP1R

This report is an output of ITTO Project RED-SPD 075/12 Rev. 1 (F): "Demonstration on investigation and assessment of tropical forest ecotourism resources in Hainan Province, China". It explores the importance of forest ecotourism in the construction of the Hainan International Tourism Island and the need for it to boost both environmental services and local livelihoods in Hainan Province.

Andrade, A. 2015. ***Pisos de madeira: características de espécies brasileiras. Woodflooring: Brazilian species characteristics.*** **Associação Nacional dos Produtores de Pisos de Madeira [National Hardwood Flooring Association], Piracicaba, Brazil.**

ISBN: 978-85-65161-05-3

Available at: http://goo.gl/Ty1d9Y

This publication (in both Portuguese and English) is based on an activity of ITTO Project PD433/06 Rev.3 (I): "Sustainable model for the Brazilian wood flooring production chain", which focused on the industrial production chain for woodflooring. The report contributes to the availability of information on woods already used in woodflooring and on lesser-known woods with potential for use as woodflooring.

OSINFOR 2016. ***Resultados de las supervisiones y fiscalizaciones efectuadas por el OSINFOR en el marco del Operativo Internacional "Operación Amazonas 2014" [Results of supervision and audits made by the OSINFOR under the International Task "Operation Amazon 2014"].*** **Organismo de Supervisión de los Recursos Forestales y de Fauna Silvestre (OSINFOR).**

ISBN: 978-612-47060-0-4

Available at: www.osinfor.gob.pe/osinfor/wp-content/uploads/2015/10/Operación-Amazonas-19-octubre.pdf

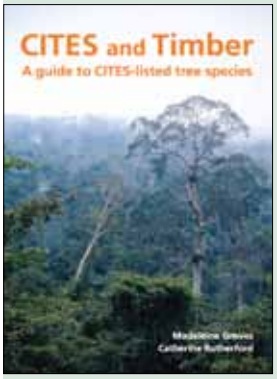
This report (available only in Spanish) is an output of "Operation Amazonas 2014", which was an operation led by the Peruvian Revenue and Customs Agency (SUNAT) aimed at addressing illegal logging in Peru and facilitating coordination among government agencies responsible for overseeing and controlling forest-product supply chains. In addition to SUNAT, Operation Amazonas 2014 involved the International Customs Organization, INTERPOL, and national-level custom agencies in various countries. In Peru, SUNAT worked with the Forest Resources and Wildlife Oversight Organization (OSINFOR), which is an independent Peruvian government agency responsible for supervising and auditing Peru's forest resources and wildlife.

Recent CITES-related publications

Environmental Investigation Agency 2016. ***The hongmu challenge: a briefing for the 66th meeting of the CITES Standing Committee, January 2016.*** **Environmental Investigation Agency, London, UK.**

Available at: http://eia-global.org/news-media/the-hongmu-challenge-an-eia-briefing-for-66th-cites-standing-committee

This briefing outlines the growing threat to increasingly rare rosewood species sought on a global scale for the lucrative hongmu furniture industry. Among other things, the briefing calls for greater acknowledgement of the severity and source of the problem and offers support for proposals to protect tree species affected by the hongmu industry.



Groves, M. & Rutherford, C. 2015. ***CITES and timber: a guide to CITES-listed tree species.*** **Kew Publishing/Royal Botanic Gardens, Surrey, UK.**

ISBN: 978-1-84246-592-9
ISBNe: 978-1-84246-593-6

Available at: www.daba.gov.lv/upload/File/Publikacijas/NOT_CITES_koki_EN.pdf

This book introduces tree species regulated under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and provides guidance on key issues in the implementation of CITES with respect to those species. It focuses on woody and tree species for which there is significant trade in their timber and parts and derivatives or that are newly listed in CITES. Subjects covered in the guide include where to find information on CITES listings; which parts and derivatives are in trade and whether they are regulated; identification techniques; and where to find more assistance and information.

Meetings

23–25 March 2016
Regional Conference on Biodiversity Conservation in Tropical Forests of Greater Mekong Subregion
Siem Reap, Cambodia
Contact: Hwan-ok Ma at ma@itto.int

4–6 April 2016
Dubai WoodShow 2016
Dubai World Trade Center, United Arab Emirates
Contact: info@dubaiwoodshow.com; www.dubaiwoodshow.com

4–8 April 2016
Capacity-building Workshop for Latin America on the Restoration of Forests and Other Ecosystems to Support Achievement of the Aichi Biodiversity Targets
Bogotá, Colombia
Contact: www.cbd.int/meetings

6–8 April 2016
World of Wood Convention 2016
Austin, Texas, USA
Contact: www.iwpawood.org

11–15 April 2016
AUSTimber 2016
Traralgon, Australia
Contact: austimber.org.au

12–14 April 2016
Caribbean Workshop on Forest Products Statistics
Jointly organized by ITTO, FAO and CABI. St Augustine, Trinidad and Tobago
Contact: Jean-Christophe Claudon, ITTO, itto-stats@itto.int; www.itto.int/workshop_detail/id=4671

21–23 April 2016
PERCEPTION–PREDICTION–ACTION: Managing Risk in Uncertain Times
Istanbul, Turkey
Contact: www.iufro.org/science/divisions/division-4/40000/40400/40407/

25–27 April 2016
First meeting of the Open-ended Intergovernmental Ad Hoc Expert Group of the United Nations Forum on Forests
New York, USA
Contact: unff@un.org; www.un.org/esa/forests

25 April–7 May 2016
20th Meeting of the Convention on Biological Diversity Subsidiary Body on Scientific, Technical and Technological Advice
Montreal, Canada
Contact: www.cbd.int/sbstta

9–20 May 2016
Permanent Forum on Indigenous Issues
New York, USA
Contact: www.un.org/esa/forests/events/permanent-forum-on-indigenous-issues/index.html

10–13 May 2016
Second Council Session and Second Board Meeting of APFNet
Siem Reap, Cambodia
Contact: apfnet@apfnet.cn; www.apfnet.cn

16–17 May 2016
Central America Timberland Investment and Wood Trade
Panama City, Panama
Contact: mferrari@danapanama2016.com

16–19 May 2016
Gene Conservation of Tree Species—Banking on the Future
Chicago, USA
Contact: www.fs.fed.us/aboutagency/gene-conservationworkshop

20–21 May 2016
4th Forest Science Forum: International Conference of Forest Multifunctional Management
Nanjing, China
Contact: www.gfsf2010.org/dct/page/70002

23–27 May 2016
UN Environment Assembly
Nairobi, Kenya
Contact: www.un.org/esa/forests/events/un-environment-assembly/index.html

30 May–3 June 2016
Genomics and Forest Tree Genetics Conference
Arcachon, France
Contact: colloque.inra.fr/iufro2016

1–3 June 2016
Carrefour International du Bois
Nantes, France
Contact: www.timbershow.com

2–4 June 2016
1st International Symposium of Forest Engineering and Technologies: Forest Harvesting and Roading in Environmentally Sensitive Areas
Bursa, Turkey
Contact: www.timbershow.com

6–9 June 2016
50th Global Environment Facility Council Meeting
Washington, DC, USA
Contact: www.thegef.org/gef/node/10940

14–16 June 2016
Third Meeting of the UNECE/FAO Team of Specialists on Wood Energy
Zagreb, Croatia
Contact: www.unece.org/index.php?id=41814#/

14–15 June 2016
2016 Oslo REDD Exchange
Oslo, Norway
Contact: http://goo.gl/5MRgp1

19–23 June 2016
IUFRO 53rd ATBC 2016: Annual Meeting of the Association for Tropical Biology and Conservation
Montpellier, France
Contact: plinio.sist@cirad.fr; www.atbc2016.org

21–23 June 2016
RISI Asian Conference
Shanghai, China
Contact: events.risiinfo.com/asian-conference

11–15 July 2016
4th International Conference on Soil Bio- and Eco-engineering: the Use of Vegetation to Improve Slope Stability
Sydney, Australia
Contact: http://sydney.edu.au/science/geosciences/soil/index.shtml

11–20 July 2016
High-Level Political Forum on Sustainable Development
New York, USA
Contact: https:/sustainabledevelopment.un.org/hlpf/2016

18–22 July 2016
ECOSOC High-level Segment: Implementing the Post-2015 Development Agenda: Moving from Commitments to Results
New York, USA
Contact: www.un.org/ecosoc/en/events/2016/ecosoc-high-level-segment-theme-implementing-post-2015-development-agenda-moving

18–22 July 2016
23rd Session of the FAO Committee on Forestry
Rome, Italy
Contact: Peter.Csoka@fao.org

3–5 August 2016
Asia-Pacific Rainforest Summit
Brunei Darussalam
Contact: asiapacific.rainforestsummit@gmail.com

15–19 August 2016
Conference Secretariat of 15th IPS International Peat Congress
Kuching, Malaysia
Contact: peat2016@gmail.com; www.ipc2016.com

27–28 August 2016
TICAD VI
Nairobi, Kenya
Contact: MaduekeL@africa-union.org

29 August–1 September 2016
EcoSummit 2016—Ecological Sustainability: Engineering Change
Montpellier, France
Contact: www.ecosummit2016.org

1–10 September 2016
IUCN World Conservation Congress
Honolulu, Hawaii
Contact: iucncongressregistration@spargoinc.com; www.iucnworldconservationcongress.org

7–9 September 2016
UNFF Ad-Hoc Expert Group
New York, USA
Contact: www.un.org/esa/forests/events/unff-aheg-2/index.html

21–22 September 2016
1.5 Degrees: Meeting the Challenges of the Paris Agreement
Oxford, UK
Contact: www.1point5degrees.org.uk

24 September–5 October 2016
17th Meeting of the Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora
Johannesburg, South Africa
Contact: www.cites.org

27–30 September 2016
World Congress on Silvo-Pastoral Systems
Evora, Portugal
Contact: www.silvopastoral2016.uevora.pt

12–14 October 2016
Mexico's Forestry Expo
Guadalajara, Mexico
Contact: expoforestal@conafor.gob.mx; www.expoforestal.gob.mx

17–20 October 2016
73rd Session of the UNECE Committee on Forests and the Forest Industry
Geneva, Switzerland
Contact: info.ece-faoforests@unece.org; www.unece.org/forests

17–22 October 2016
BELUM Rainforest Summit 2016: International Conference on Conservation and Sustainable Use of Tropical Rainforests
Pulau Banding, Gerik, Perak, Malaysia
Contact: info@belumrainforestsummit2016.com; www.belumrainforestsummit2016.com

24–27 October 2016
IUFRO Regional Congress for Asia and Oceania 2016
Beijing, China
Contact: www.iufro-ao2016.org

7–12 November 2016
52nd Session of the International Tropical Timber Council and Associated Sessions of the Committees
Yokohama, Japan
Contact: www.itto.int; itto@itto.int

7–18 November 2016
22nd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change
Marrakesh, Morocco
Contact: secretariat@unfccc.int

4–17 December 2016
13th Meeting of the Conference of the Parties to the Convention on Biological Diversity
Cancun, Mexico
Contact: secretariat@cbd.int; www.cbd.int/meetings