Working groups

Working group	Co-chair	CS Presenter	Keynote Speaker	Expert	Rapporteaur	Attendance
Trees						
James Grogan	✔	✔				YES
Rafael M. Navarro Cerrillo	✔	✔				YES
Alejandra GarciaNaranjo					✔	YES
Alejandro Jaques					✔	YES
Cuauhtemoc Tejeda						YES
David L.N. Hafashimana						NO
Dora Ingrid						YES
Jean Lagarde Betti		✔				NO
Ken Farr		✔				YES
Lillian Swee Lian Chua		✔				YES
Leonel López		✔				YES
Mayra de la Torre						YES
Marielos Peña Claros		✔				YES
Milena Sosa Schmidt						YES
Margarita Clemente				✔		YES
Ricardo Ríos						YES
Sofia R. Hirakuri				✔		YES
Steven Johnson				✔		NO
Tukirin Partomihardjo				✔		YES
Uwe Schippmann				✔		YES
Ximena Buitron		✔				YES

Total Participants : 21

International Expert Workshop on CITES Non-Detriment Findings

Cancun, Mexico, November 2008

Working Group 1

Trees

Working Group Summary

The Trees Working Group elaborated essential **principles**, **procedures**, and **elements** that Scientific Authorities should consider when making non-detriment findings (NDF) for the taxa.

Principles can be summarized as follows: Since an Appendix II listing recognizes that international trade at current rates or patterns has placed the species at risk of harm, the Scientific Authority is charged with verifying that traded volumes or products do not cause harm to the species within the range State. The central issue that must be addressed is whether the anticipated impact of current or proposed harvests on species' population status will be non-detrimental to the species in its role in the ecosystem. The extent to which species population status has been described and is understood determines the scale, quality and certainty at which NDFs can be made. Sufficient biological information for Appendix II tree species exists to propose harvest and management systems where population status is known. Risk associated with a negative outcome from the NDF declines as the level of understanding of population status and management systems increases.

The initial **procedure** for NDF should consider the source of specimens to be harvested, whether they originate from plantations or from wild populations. NDF for plantation-grown specimens should be straightforward. Harvests from wild sources should be distinguished between those having non-lethal vs. lethal outcomes. Each of these outcomes implies a different approach to evaluating impacts on wild populations.

The Trees Working Group considered that the NDF process should consider five basic **elements**, and offered a description of issues, tools, and resources relating to each (see 'TreeWG_NDF.doc'). These elements and the specific objective that each addresses are as follows:

1 SPECIES DISTRIBUTION AREA (RANGE) AT RELEVANT SCALES

Characterize the species' distribution at different spatial and jurisdictional scales so that production and conservation areas can be identified.

2 POPULATION PARAMETERS AS INDICATORS OF SUSTAINABLE MANAGEMENT

Characterize species population status (standing stocks & dynamics) to provide standards for evaluating harvest impacts.

3 MANAGEMENT SYSTEMS & HARVEST RATES

With sufficient knowledge of distribution and population parameters, determine whether management systems are appropriate to species populations subject to harvest AND whether harvest levels are sustainable.

4 MONITORING & VERIFYING HARVESTS

Determine whether adequate monitoring & verification systems are in place to ensure the sustainability of harvest and to reduce illegal activities & illegal trade**.**

5 CONSERVATION & THE PRECAUTIONARY PRINCIPLE

Determine whether safeguards are in place to ensure that representative natural populations and phenotypic & genetic diversity represented in harvested populations are conserved.

The Trees Working Group report includes Annexes indicating further resources available for this taxa, including outputs from species-specific Workshops, a Glossary, tools and expertise, and considerations for a proposed Trees Working Group website as an extension tool.

International Expert Workshop on CITES Non-Detriment Findings

Working Group 1

Trees

FINAL REPORT

Trees Working Group Guidelines

First document of the Working Group

Principles for Non-Detriment Findings (NDF) for TREES

1. A species' listing on Appendix II indicates that, based on the available trade and scientific information and in the view of the Parties, international trade at current rates or patterns has placed it at risk of harm in its environment on a range-wide basis.

2. The non-detriment finding (NDF) required from CITES Scientific Authorities for Appendix II (and Appendix I) species verifies that traded volumes or products do not cause harm to the species or look-alike species within the range State.

3. Because species and products derived from them are the relevant units of trade, the NDF must consider biological and environmental parameters relevant to the population status of the Appendix II species. For trees, anticipated impact of current or proposed harvests on species' population status (structure & dynamics) is the central question that must be addressed during the NDF process.

4. The extent to which species population status has been described and is understood determines the scale, quality and certainty at which NDFs can be made. Comprehensive knowledge of nation-wide population structures (stocks) and dynamics (recovery capacity) would allow annual export quotas to be set at the national level in confidence that these would be non-detrimental to the species' survival. Lacking comprehensive knowledge at the national level, and considering the precautionary principle, NDF should be undertaken at the scale at which sufficient knowledge exists to verify non-detriment. In most cases at present, this scale will be the management unit within which complete or statistically inferred knowledge of population status is sufficient to assess harvest impacts on species survival.

5. Sufficient biological information for Appendix II tree species exists to propose harvest and management systems where population status is known. Management systems should represent best current practices for the type of species (product)

involved, and should be adaptive over time, incorporating new understanding of harvest impacts on species' population dynamics as revealed through practice (production) and research.

6. Risk associated with a negative outcome from the NDF process – that is, NDF allowing exports produced unsustainably – declines as the level of understanding of population status and management systems designed to mitigate negative impacts increases.

Making NDF for tree species

As explained in the draft Working Groups´ guidelines, *The main objective of the workshop, as indicated in Decision 14.49, is to enhance CITES Scientific Authorities´ capacities, particularly those related to the methodologies, tools, information, expertise and other resources…*

The Trees Working Group has agreed that these four elements can be addressed as follows:

- First, the Scientific Authority should consider the harvest regime and determine whether specimens are taken from a plantation or from the wild. If taken from a plantation, the NDF can be made relatively quickly since it considers that the plantation has been verified by the Management Authority and that the removal of the specimens does not affect populations in the wild (therefore this should imply a low risk of the operation).

- If specimens come from the wild, the Scientific Authority should take a more cautious approach and consider whether the harvest implies removal of the whole tree or not.

- If removal of the specimen does not result in the death of the tree (as in the case of some medicinal trees and agarwood-producing species), the guideline of maintaining the resource in the population over time and through a recovery period between harvests should be followed, with the objective of minimizing the impact of harvesting on species populations in the wild.

- If removal of the specimen results in the death of the tree, then adherence to comprehensive guidelines (encompassing information available, possible methodologies, etc.) is required. The essential elements of such guidelines are here proposed by this Working Group.

- General guidelines to help making an NDF are presented in this document and its Annexes, which include examples of species-specific guidelines for mahogany and agarwood.

Essential elements of NDF (guidelines) for tree species

ELEMENT 1: SPECIES DISTRIBUTION AREA (RANGE) AT RELEVANT SCALES

OBJECTIVE: Characterize the species' distribution at different spatial and jurisdictional scales so that production and conservation areas can be identified.

ELEMENT 2: POPULATION PARAMETERS AS INDICATORS OF SUSTAINABLE MANAGEMENT

OBJECTIVE: Characterize species population status (standing stocks & dynamics) to provide standards for evaluating harvest impacts.

ELEMENT 3: MANAGEMENT SYSTEMS & HARVEST RATES

OBJECTIVE: With sufficient knowledge of distribution and population parameters, determine whether management systems are appropriate to species populations subject to harvest AND whether harvest levels are sustainable.

ELEMENT 4: MONITORING & VERIFYING HARVESTS

OBJECTIVE: Determine whether adequate monitoring & verification systems are in place to ensure the sustainability of harvest and to reduce illegal activities & illegal trade.

ELEMENT 5: CONSERVATION & THE PRECAUTIONARY PRINCIPLE

OBJECTIVE: Determine whether safeguards are in place to ensure that representative natural populations and phenotypic & genetic diversity represented in harvested populations are conserved.

NDF guidelines for tree species

Having established the purpose of the NDF, the Trees Working Group concluded that the basic elements to be considered for making NDF for timber and non-timber tree species have been elaborated by recent working groups focused on Appendix II species (bigleaf mahogany, agarwood). These elements have been generalized and adapted to be applied to the taxa as follows:

ELEMENT 1: SPECIES DISTRIBUTION AREA (RANGE) AT RELEVANT SCALES

OBJECTIVE: Characterize the species' distribution at different spatial and jurisdictional scales so that production and conservation areas can be identified. Suggested scales & tools that may be available include:

NATIONAL (HISTORICAL, CURRENT) DISTRIBUTION

- Vegetation & forest cover maps
- Ecosystem or eco-zoning maps
- National forest inventories
- Herbarium collection data (georeferenced)
- Existing & potential conservation areas

SUB-NATIONAL (E.G. REGIONS, STATES, WATERSHEDS) DISTRIBUTION

- National databases, including management units
- Sub-national forest inventories
- Sub-national mapping from various sources

LOCAL (FOREST MANAGEMENT UNIT) DISTRIBUTION

- Statistical samples from inventories for forest management plans
- GIS representation of harvest areas
- Commercial censuses, ideally based on georeferenced data
- Local, specialist & industry knowledge

ELEMENT 2: POPULATION PARAMETERS AS INDICATORS OF SUSTAINABLE MANAGEMENT

OBJECTIVE: Characterize species population status (standing stocks & dynamics) to provide standards for evaluating harvest impacts. Suggested parameters & tools that may be available include:

POPULATION STRUCTURE: NUMBER OF INDIVIDUALS, AGE AND/OR SIZE DISTRIBUTION, DENSITY, VOLUME/QUANTITY

- Field inventories applying appropriate statistical methods
- Published studies
- Reliable proxy data (e.g. local knowledge, historical data)

POPULATION DYNAMICS: RATES OF MORTALITY, GROWTH, REPRODUCTION, REGENERATION & RECRUITMENT

- Long-term studies using appropriate methods
- Modeling approaches (e.g. matrix)
- Published studies

- Reliable proxy data (e.g. local knowledge, historical data)
- Information on other factors affecting populations (e.g. microsite preferences, pests, disturbances)

ELEMENT 3: MANAGEMENT SYSTEMS & HARVEST RATES

OBJECTIVE: With sufficient knowledge of distribution and population parameters, determine whether management systems are appropriate to species populations subject to harvest AND whether harvest levels are sustainable. Suggested aspects to review & issues to consider include:

Inventory (or description) of commercial & non-commercial trees, ideally with mapping / spatial referencing

Harvest operations

- Identification of material to be harvested, understanding that differing harvest systems can be implemented
- Equipment / tools & methods to be used (appropriate or not)
- Measures for reducing damages during harvests (direct & environmental)
- Identification & protection of reserved areas / seed trees / future crop trees

Silvicultural practices

- Pre- & post-harvest
- Examples: liana cutting, liberation thinning, seed tree selection

Restoration / alleviation measures/ reduction of harvest impacts

- Seed tree retention
- Enrichment planting, with adequate seed selection (e.g. vigor, genetic diversity)
- Cutting cycle (rotation) or fallow period
- Post-harvest measures for reducing damages (direct & environmental)

Harvest rate evaluation

- Standards: intensity (retention %), minimum diameter cutting limit
- Quantitative knowledge of population status through appropriate statistical methods
- Expected (current) production & recovery rates (future production)
- Appropriate scaling methods

ELEMENT 4: MONITORING & VERIFYING HARVESTS

Objective: Determine whether adequate monitoring & verification systems are in place to ensure the sustainability of harvest and to reduce illegal activities & illegal trade. These may consist of or include:

Monitoring & verification systems

- Pre- & post-harvest review mechanisms to verify management practices
- Permanent plots to assess harvest impacts on populations
- Chain-of-custody from harvest to export
- Transparent practices that improve control of trade in harvested products
- Where export quotas have been set, assessment of the extent to which they indicate sustainable harvests

Optimization of timber / non timber use & processing

- Conversion / correction factors for translating raw material (e.g. standing volume, pre-processed weights) into processed product (e.g. sawnwood, extracts, etc.)

ELEMENT 5: CONSERVATION & THE PRECAUTIONARY PRINCIPLE

Objective: Determine whether safeguards are in place to ensure that representative natural populations and phenotypic & genetic diversity represented in harvested populations and the role of the species in the ecosystem are conserved. Precautionary measures may consist of:

- Conserving different populations throughout the natural range to ensure phenotypic & genetic diversity
- Conserving the existing range of age/ size classes and distribution of the species while considering processes of natural succession and recruitment.
- Avoiding negative impacts of harvest on other species and the ecosystem
- Establishing reserve areas to protect unharvested populations
- Establishing seed banks & other mechanisms for conservation of germplasm
- Accounting for the effects of legal & illegal harvesting on species conservation status
- Giving due consideration to incentives & benefits from harvests (e.g. species / habitat conservation).

Annex 1 Case studies matrix

	Timber species					Non-Timber species		
	A.	*B.*	*C.*	*D.*	*E.*	*F.*	*G.*	*H/*
Estimation of species range area								
National level								
Subnational level								
Management units					No applicable			
Population parameters								
Periodic measurements								
Indicators of sustainable management								
Local reference values								
Management principles, methods & indicators								
Silvicultural system								
Silvicultural treatments			No applicable					
Harvest systems								
Regeneration								
Conservation								
Commercial plantations ¿domestication?			No applicable					
Monitoring & verifying harvests, processing & conservation								
Determination of annual production quotas					No applicable			
Optimization of product processing								
Monitoring & verification								
Level of knowledge	High		Middle		Low			

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

Seventeenth meeting of the Plants Committee
Geneva (Switzerland), 15-19 April 2008

Timber issues

Bigleaf mahogany

INTERNATIONAL WORKSHOP OF EXPERTS ON NON-DETRIMENT FINDINGS ON BIGLEAF MAHOGANY (CANCUN, APRIL 2007): ENDORSEMENT AND ADOPTION OF GUIDELINES FOR MAKING NDFS FOR MAHOGANY

1. This document has been prepared by Mexico, as Chairman of the Bigleaf Mahogany Working Group of the Plants Committee.

2. The document comprises two Annexes, described below, and has been drafted in order for the Committee to review and endorse at the present meeting the results of the International Workshop of Experts on Non-Detriment Findings on Bigleaf Mahogany (*Swietenia macrophylla*), held in Cancun, Quintana Roo, Mexico, from 10 to 13 April 2007.

   Annex 1: Results of the International Workshop of Experts on Non-Detriment Findings on Bigleaf Mahogany (*Swietenia macrophylla*); and

   Annex 2: Working group's interpretation of the term 'planes de ordenación de la caoba' (mahogany management plans).

Background

3. At its 16th meeting (Lima, July 2006), and further to Decision 13.58, the Plants Committee decided *inter alia* (see the PC16 summary record):

   i) to encourage the issuance of new recommendations to exporting countries regarding necessary elements for the formulation of non-detriment findings for timber species, and

   ii) to organize a course on non-detriment findings for timber species that will focus on how to identify the information necessary for evaluating and documenting non-detriment findings.

4. Mexico, as Chairman of the Mahogany Working Group, organized the International Workshop on Non-Detriment Findings on Bigleaf mahogany. The main purpose of this workshop was to define a feasible methodological approach that could be used to formulate non-detriment findings (NDFs) for the bigleaf mahogany, in order to improve the implementation of the provisions of CITES Appendix II and to ensure the sustainability of the harvesting of and international trade in the species.

5. Mexico, as Chairman of the Mahogany Working Group, submitted the results of the workshop as information document CoP14 Inf. 24 at the 14th meeting of the Conference of the Parties (The Hague, 2007).

6. At that meeting, the Conference adopted Decision 14.145 which states: "The Conference of the Parties adopted the 'Action plan for the control of international trade in bigleaf mahogany (*Swietenia macrophylla*)', attached as Annex 3 to these Decisions."

7. The *Action plan* states the following:

   1) All range States of the bigleaf mahogany should:

   e) facilitate the making of non-detriment findings by:

   i) preparing, adopting and implementing, as a priority, forest management plans at a national and/or local levels that include specific requirements for the bigleaf mahogany, as outlined in the results of the International Workshop of Experts on Non-Detriment Findings on Bigleaf Mahogany held in Cancun (April 2007) (see document CoP14 Inf. 24) ***after its endorsement and adoption by the Plants Committee;***

   ii) developing and conducting forest inventories that enable specific identification and data analysis of the bigleaf mahogany, as well as programmes to monitor the distribution, population size and conservation status of the bigleaf mahogany, based on the results of the International Workshop on Non-Detriment Findings on Bigleaf Mahogany, ***after its endorsement and adoption by the Plants Committee****, and incorporating the three basic requirements for non-detriment findings highlighted in document MWG2 Doc. 7, paragraphs 44 a) to c).*

Recommendation

8. In order to comply with the request made to the range States in the *Action plan*, in particular with the making of non-detriment findings, the Plants Committee is invited to review and adopt the recommendations that resulted from the workshop and which are included in Annex 1 of the present document.

RESULTS OF THE INTERNATIONAL WORKSHOP OF EXPERTS ON NON-DETRIMENT FINDINGS ON BIGLEAF MAHOGANY (*SWIETENIA MACROPHYLLA*)*

Cancun, Quintana Roo, Mexico (10-13 April 2007)

I. PROGRESS OF THE MEETING

The Workshop was held in Cancun, Quintana Roo, Mexico, April 10 – 13, 2007.

The workshop was attended by 46 participants, representing 12 range states (Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama and Peru); the European Union in its capacity as importers (Belgium and Spain); the Chair of the CITES Plants Committee; a representative of the CITES Secretariat; a representative of the International Tropical Timber Organization (ITTO); two representatives of non-governmental organizations and a representative of the International Importers Association (Annex 4).

The event took place as described in the workshop agenda (Annex 3). The workshop was inaugurated by Mr. Francisco Javier Díaz Carvajal, Minister of Urban Development and the Environment of the Government of the State of Quintana Roo. The following officials were present: Dr. Steve Johnson (Associate Director of ITTO), Mr. José Cibrián Tovar (Director General of the National Forestry Commission - CONAFOR), Mr. Martín Vargas Prieto (Director General of Wildlife of the Ministry of the Environment and Natural Resources - SEMARNAT, CITES Administrative Authority in Mexico), Professor Ana Luisa Guzmán (Executive Secretary of the National Commission for the Knowledge and Use of Biodiversity - CONABIO, CITES Scientific Authority in Mexico), Dr. Francisco García García (Director General of Forestry and Soil Management - SEMARNAT and President of the Mahogany Working Group - MWG), Mr. Manuel Mercado Béjar (Director General of Contamination Source Scrutiny of the Federal Environmental Protection Agency - PROFEPA, representative of the CITES Law Enforcement Authority in Mexico).

In the first session, Dr. Margarita Clemente (Chair of the Plants Committee) gave the following presentation; "Mahogany in CITES and the Mahogany Working Group". Dr. Rafael Navarro (Spain) completed this presentation with a preliminary proposal on the use of remote sensors for the formulation of non-detriment findings (NDFs) on mahogany, based on acquired experience with *Prunus africana*. Mrs. Milena Sosa Schmidt (CITES Secretariat), gave a presentation on "Non-Detriment Findings", followed by Dr. Steve Johnson's presentation: "ITTO and CITES" and Dr. Patrick Van Damme's (Belgium) presentation on "Relevant Information for the Formulation of Non-Detriment Findings". The session concluded with Dr. Patricia Dávila's overview of the summarized outcomes of the Mahogany Comprehensive Report (CoP14 Doc. 64) and an explanation by biologist Hesiquio Benítez of the workshop logistics and desired outcome.

Based on the conclusions of the Mahogany Working Group's (MWG) comprehensive report, four thematic sessions took place. Each thematic session was structured as follows: 1) Presentation by the moderator of the main conclusions of the MWG comprehensive report; 2) Presentation by the experts of the proposals on methodology and analysis of the necessary actions; 3) Discussion of the experts' proposals and 4) Feedback from the audience regarding the experts' proposals and drafting of conclusions.

The panel comprised five mahogany experts: Dr. Laura Snook (Bioversity International), Dr. Carlos Manuel Navarro Pereira (Costa Rica), Dr. James Grogan (United States of America), Mr. Luis Alfonso Argüelles Suárez (Mexico) and Dr. Roberto Kometter Mogrovejo (Peru), who held discussions and issued recommendations thus fulfilling the goals of the workshop. Four more specialists contributed to the guidance and development of the workshop: Dr. Patrick Van Damme (Belgium), Dr. Kenneth Farr (Canada), Dr. Rafael Mª. Navarro Cerrillo (Spain) and Dr. Alfonso García-Ferrer Porras (Spain).

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* *Text from document CoP14 Inf. 24.*

The moderators for each session were: Theme 1.- Classification Plans (Marina Rosales, Peru); Theme 2.- Range Area (Patricia Dávila, Mexico); Theme 3.- Population and Environmental Parameters (Kenneth Farr, Canada) and Theme 4.- Management principles, criteria and indicators (Rafael Navarro, Spain).

A field trip to the Noh-Bec forest community, located in the Felipe Carrillo Puerto Municipality in the State of Quintana Roo, was organized in order to demonstrate community-based forest management activities for mahogany.

The following is a list of the basic elements for the formulation of Non-Detriment Findings on Mahogany (Section III) which were suggested, based on the results of the theme sessions.

1. Estimation of Mahogany range areas,

2. Population parameters,

3. Management principles, methods and indicators

The workshop also analyzed the cost of silviculture as well as the tools necessary to monitor and verify conservation and processing activities (Sections IV and V of Annex I). In addition, the workshop analyzed the working group's interpretation of the term "planes de ordenación de la caoba" (mahogany management plans), as a problem with the translation of this term has been identified which has affected the response of Countries of origin regarding compliance with Decision 13.58 (Annex 2).

The workshop ended with a presentation by Dr. Patricia Dávila on conclusions reached, followed by the Closing Ceremony with the participation of Dr. Francisco García García, Dr. Margarita Clemente Muñoz and Mr. José Luis Funes, representative of the Government of the State of Quintana Roo.

II. ESSENTIAL ELEMENTS FOR THE FORMULATION OF NON-DETRIMENT FINDINGS (NDFS) ON BIGLEAF MAHOGANY (*SWIETENIA MACROPHYLLA*)

II.1. ESTIMATION OF MAHOGANY RANGE AREAS

Based on territorial classification at the country level, it is appropriate to identify the range area of mahogany at the national (potential), sub-national (departments, states, provinces, water basins) and local (management unit) levels. Some of the available tools for each of the three levels are:

1. National level

a. National ecologic forest mapping (such as, Holdridge Life Zones map)

b. National forest maps

c. National forest inventories

d. Available imagery (such as NOAHH, MODIS, Landsat, ASTER).

2. Sub-national (optional) level

a. GIS resulting from national level analysis.

b. National databases (management units)

c. Sub-national forest inventories

c. Sub-regional mapping derived from projects or other available sources

d. Available imagery (such as Landsat, ASTER, SPOT)

3. Management plan comprising two levels:

a. Forest management unit

- GIS of the areas under management
- Statistical sampling (exploratory inventories from Forest Management Plans)
- High or medium resolution images (e.g. ASTER, IKONOS, QuickBird)

b. Harvesting plots (areas)

- GISs of harvesting areas
- Commercial censuses at 100% (geo-referenced databases)

The information obtained and analyzed at these three levels should make it possible to obtain potential and present distribution maps of the species throughout the country as well as to define its commercial harvesting areas.

II.2. POPULATION PARAMETERS

In order to assess Bigleaf mahogany populations (and related species) as well as the environmental conditions under which mahogany grows, periodical documentation of certain biological parameters and indicators of sustainable management is essential, as is incorporation of reference values.

1. Periodic measurement parameters

1.1 Characterization of the structure of mahogany populations:

a. Direct

- Diameter [measuring trees with a Standard Diameter (SD)/DBH >10 cm, based on an appropriate sampling method for a population with an irregular spatial distribution].
- Total and commercial height, measured or estimated (optional).
- Eco-physiographic situation [information on the populations (distribution), as well as geomorphologic, edaphic and climatic data at the location of said populations].

b. Subsequent

- Density (trees/ha; trees/100 ha), by size classification
- Volume (m^3)
- Base area (optional and additional to density)

1.2. Estimation of seed production based on annual stratified sampling of a statistically appropriate number of trees, according to a range of diameter classes, preferably before and after harvesting. In order to evaluate the regularity of seed production and to observe changes over time, it is advisable to have sampling trees located in areas that are not subjected to harvesting.

1.3. Estimation of standing trees to be harvested in the subsequent cycle (reserve trees, future harvest): trees that will be incorporated to the commercial size classification (<Minimum diameter cutting limit MDC).

2. Sustainable management indicators

These indicators make it possible to identify the level of success of forest treatments (bearing in mind that an equivalent population of mahogany trees must be established for regeneration and maintenance purposes, so as to replace the ones that were harvested), by monitoring the following elements:

a. Potential seed-bearing trees

b. Regeneration rate / recruitment (natural or through enrichment planting)

c. Replacement rate in number of trees across the range of size classifications.

d. Number of trees available for future harvest.

3. Local reference values

These values allow monitoring of the population parameters of Bigleaf mahogany under management (in a given region) over time, providing information for adjusting future harvesting levels.

a. Testimonial information derived from compliance with the Management Plan and the annual cutting Plans. Said local references are useful to monitor harvested trees and their relationship with geo-referenced inventories.

b. Growth rate, which is obtained from permanent sampling plots or from individual mahogany trees measured regularly (preferably annual measurement~~s~~). This specific type of monitoring may be simultaneously used to follow-up on other harvested species.

II.3. Management principles, methods and indicators

II.3.1. PRINCIPLES

a. There is sufficient knowledge about the ecology and forest parameters of the species to establish a basic silviculture. However, more detailed information on some aspects of the species' ecology (i.e., reproductive ecology) and on some forest parameters (i.e., growth, seed tree selection criteria, MDC or target diameter, etc.) is still needed.

b. The available information suggests that mahogany, within its range, follows certain relatively homogeneous growth and/or development patterns. This, together with the relevant precautions, allows the establishment of some common reference values for silviculture of the species throughout its range area.

c. An adaptive mahogany silviculture is essential. It must be based on current knowledge, but must be subject to modification based on the results of regeneration and growth sampling practices carried out in the management areas (as per the abovementioned guidelines). Likewise, it must be founded on relevant auto-ecologic data (reproductive physiology and ecology, etc.) and must be implemented through silvicultural management parameters (rotation, cutting diameters, growth, etc.). This adaptive silvicultural principle is based on the assessment of the results obtained in management activities and must be incorporated to the species management plans.

d. Management plans constitute the foundation for the biological and/or silvicultural arguments necessary to establish the minimum diameter cutting limit and, where appropriate, the maximum diameter cutting limit, taking into consideration the seed bearing age, the annual diametric growth (available information indicates that annual growth varies between 0.4 and 0.7 cm) and the timber quality of the trees.

e. Despite the fact that this species is the primary harvesting objective, it is essential that mahogany silviculture incorporate harvesting of additional species. Doing so results in increased harvesting profitability and healthier silvicultural practices (i.e., regeneration of forest stands based on the creation of appropriately sized openings).

f. Although multiple species harvest planning may initially represent an additional cost, it provides financial support to harvest areas (by making additional resources available) and promotes comprehensive and sustainable forest management.

g. Management entails different intensity levels, ranging from intensive silviculture in plantations, semi-intensive silviculture in managed secondary forests, up to extensive silviculture in low-mahogany-density primary forests. Community and industrial forest management are two–additional possibilities. However, similar minimum management guidelines and principles may be applied in both cases.

h. The outcomes of successful management programs, such as the Noh-Bec Community Forest (Mexico), must be broadly disseminated in order to enhance silvicultural knowledge of the species and improve management programs in other areas.

II.3.2. METHODS THAT GUARANTEE THE SUSTAINABILITY OF MAHOGANY POPULATIONS.

a. Logging planning strategies

- To define the type of logging to be undertaken according to the terrain and the populations.
- Depending on the type of logging, to define the type of silviculture that will be implemented based on the distribution of the desired initial and final diametric classifications.

b. Logging: Based on the terrain and mahogany populations, different types of logging may be carried out:

- Thinning / Selection-cutting Method
- Uniform shelterwood cutting / Protective cutting
- One- or two-step clearance cutting / One- or two-step clearcutting / Cutting down to a stump
- Thinning / Clearing

c. Regeneration. Given the low natural regeneration levels of mahogany, it is necessary to define and implement the following:

- Protection of the trees to be retained for future harvests (those that will be cut during the subsequent cycle), based on inventories and silvicultural measurements.
- Opening of clearings or forest product concentration yards in the cutting area (known as "bacadillas" in Mexico). These should ideally be areas of more than 2,000 m², although their size can vary and therefore should be defined in each processing area.
- Enrichment of clearings through planting.
- Encouraging retention and protection of seed trees, bearing in mind available information indicates that trees with a DBH of >75cm and a broad crown bear significantly more seeds than do smaller trees. However, this value may vary and therefore would need to be defined for each harvesting area.
- Establishing the maximum distance between seed trees (taking into account requirements for successful pollination).
- Development of other silvicultural treatments such as: liana cutting, directed cutting and log removal optimization (planning log removal work).

d. Conservation

- To protect the different populations found throughout the mahogany range in order to ensure that the variety and diversity of the populations will be preserved.

- Establishing reserve areas (possibly areas of low density, or areas having healthy or inadequate diametric structures).

- Adequate seed selection for enrichment plantings.

- Sowing selected seeds or planting seedlings grown in nurseries, according to the ecological and productive conditions of the area.

- Coordinating a mahogany seed collection and management program between national and regional seed banks and accurately documenting seed collection locations; protecting seed trees and stands, creating seed orchards.

e. Commercial Planting

- Establishing pure and mixed plantings and plantings in agro-forestry systems as a medium-term alternative for mahogany harvesting in natural populations.

Note 1: The drafting of a document that includes basic silvicultural guidelines for this species was suggested. Said document could be used as the basis for establishing the most important silvicultural parameters for mahogany management under CITES.

Note 2: It is important to promote and encourage training and the exchange of experience and information among the mahogany range states, so as to harmonize the knowledge of management criteria and indicators, silvicultural techniques and regeneration programs. Likewise, countries must share their experiences on subjects such as logging regulations, regulations on domestic transport control and exports. This proposal had already been made at previous Working Group meetings.

II.3.3 LOGGING AND PROCESSING

a. Determining quotas

Establishing quotas necessarily implies an accurate knowledge of populations. Therefore, when quotas are established without knowledge of populations and based solely on commercial and pre-commercial stocks, it is impossible to ensure the impact that exports will have on the populations. Likewise, establishment of quotas must be done at the management unit level, since the characteristics of the populations may vary.

- Implementation of minimum viable population models, so as to supplement the calculation of the maximum volume (number of trees) subject to harvesting. It is advisable to include growth and regeneration/recruitment data to determine harvesting volumes.

- Analysis of harvesting/export quotas based on the available yield studies (i.e., methodology proposed by Dr. James Grogan), so as to reflect losses inherent to processing round wood into sawn timber; export quality percentage; stem/bole quality (holes or poor condition) in order to identify physical and pathologic defects, and elements such as bark thickness, stem shape and others relating to size and age. Failure to take these values into consideration will probably result in an overestimation of export quotas.

- Establishing quotas one year in advance whenever possible in order to ensure verification capability.

b. Timber use and processing optimization

- A continuous training program for the staff involved in logging activities is required.

- In the course of census-taking activities, drafting of geo-referenced maps of harvestable and future crop trees is recommended.

c. Monitoring and verification

- Whenever possible, establishment of permanent plots is advisable in order to gain a detailed and long-term understanding of the impact of logging in mahogany forests.

Note: The establishment of databases and electronic exchange systems is recommended: (a) establishing a domestic and international database network on the existing plots for information exchange purposes; and (b) establishing a database that incorporates existing scientific information (CITES Web).

III COST OF SILVICULTURE

Various research studies indicate that the correct implementation of silvicultural management activities for mahogany and associated tropical species will guarantee harvesting sustainability as well as increase mahogany regeneration and establishment in range areas. However, appropriate silviculture does imply additional costs necessary to meet requirements such as promoting regeneration, low-impact harvesting, timber traceability, maintenance of conservation areas, certification processes or maintenance of logging roads.

- Implementing non-detriment harvesting plans for mahogany requires external financial support. Each country should estimate the cost, according to its situation and needs. In order to determine the actual cost of harvesting plans, the creation of a cost and activity matrix has been proposed.

- Funding of a National Management Plan for mahogany should be one of a series of actions aimed at the sustainable harvesting of forest timber species, strengthening the Administrative Authority's power to control said harvesting activities.

- It is necessary to evaluate the role that the various institutions play in the creation and implementation of a national management plan, so as to define responsibilities and make efficient and transparent use of resources.

- The experience of the BOLFOR project in Bolivia may be regarded as an exemplary international forest enhancement project at the national level.

- The high cost of sustainable harvesting plans may reduce the competitiveness of timber on the international market. Therefore, it is important to revise the marketing chain so that both costs and benefits may be shared by import and export intermediaries, logging companies and end users.

IV MONITORING AND VERIFICATION TOOLS FOR CONSERVATION AND HARVESTING ACTIVITIES

It is necessary to follow up conservation and harvesting activities in order to reduce illicit activities that could encourage illegal mahogany logging. Therefore, the following measures were suggested by the Group:

- Establish a timber marking and traceability system (thus strengthening the chain of custody), from harvesting to export. The model implemented by Brazil is suggested, along with prior validation of the methodology through different technical alternatives.

- Establish a verification system based on forest inventories (quality of inventories), on-site inspection of forest management plans and annual plans, as well as monitoring systems utilizing remote sensors.

- On-site verification in large mahogany harvesting areas, using a statistical sampling that guarantees compliance with the approved management and logging measures. To supplement field inventories through the use of images derived from high spatial resolution sensors (such as IKONOS or QuickBird).

- Strengthen the implementation of management plans by means of control systems combined with severe penalties in case of noncompliance, reinforced by the timber traceability systems.

- Strengthen the chain of custody of forest certification and of traceability systems as a means of intensifying the control on legally and illegally logged timber.

WORKING GROUP'S INTERPRETATION OF THE TERM "PLANES DE ORDENACIÓN DE LA CAOBA" (MAHOGANY MANAGEMENT PLANS)

Decision 13.58, subparagraph a), states that:

The range states of *Swietenia macrophylla* (Mahogany) should:

a) Prepare and officially adopt, as a priority, forest management plans for mahogany at a national and sub-regional level.

On this subject, a semantic problem was identified. The English version of Decision 13.58, the PC14 WG7.1 working documents and those derived from CoP13: E13-COM1.04 and S13/COM1.04, refer to Management Plans for mahogany. The Spanish version of Decision 13.58 uses the term "Planes de ordenación de caoba". It was concluded that the correct reference is "Planes de manejo de caoba". This explains why, throughout the compilation exercise of the national reports on mahogany, most of the countries stated that they did not have specific management ("ordenación") plans for the species, since the term was mistaken for "ordenamiento" (classification), which refers to an instrument of higher hierarchical status (at the national or sub-national level) that surpasses the implementation scope of the NDFs. Therefore, it was acknowledged that the appropriate domain for the formulation of the NDFs is at the Management Plan level.

The Working Group's interpretation of Classification Plans is as follows:

1. Territorial classification at two levels:

National: Land classification based on its increased use capacity (forest, agricultural, livestock, urban, protection, conservation, etc.). At this level, it is necessary to chart a basic national map that includes coverage of the various types of plants and life zones (1:250,000), for identification of potential harvesting (production forests) and conservation areas. This is a necessary undertaking which is within the capabilities of all range states. Virtually all range states have such maps and it would be advisable to up-date them regularly.

Tools:

- Mapping of plant types and life zones
- National forest maps
- National forest inventories
- Use of 250m images (such as Modis, at no cost), or 30m images (such as Landsat)

Sub-national.- Classification of forest types at the level of states, provinces, departments, water basins or other smaller units at country scale. At this level, it is necessary to have larger scale maps to identify of the types (maturity level, sucesional stages) and current state of forests (plant communities that contain the species), whose information will be subject to on-site verification. The human resources (universities, research centers, government agencies, corporations, etc.) that are necessary to carry out this activity are available in the range states.

Tools:

- Mapping of plant types
- 30m and 15m images (such as Landsat and Aster, respectively)

Note: Teleidentification requires training plots and on-site verification.

PC17 Inf. 4
(English only / Únicamente en inglés / Seulement en anglais)

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

Seventeenth meeting of the Plants Committee
Geneva (Switzerland), 15-19 April 2008

DEVELOPING A NON-DETRIMENT FINDING METHODOLOGY FOR AGARWOOD-PRODUCING TAXA

Compiled by TRAFFIC, the wildlife trade monitoring network, for the CITES Secretariat

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SECTION 1 – INTRODUCTION

1.1 Background on Agarwood-producing taxa

Agarwood is a non-timber forest product valued for its aromatic, medicinal and cultural uses, and is also known as eaglewood, aloeswood, *gaharu* (Malay), *chen xiang* (Chinese), *jin-koh* (Japanese), *oudh* (Arabic) *mai kritsana* (Thai), and *tram huong* (Vietnamese) among many other vernacular and trade names (Barden *et al.* , 2000). Primarily sourced from two tree genera, *Aquilaria* and *Gyrinops*, agarwood's aromatic and medicinal properties derive from resinous deposits in the tree's heartwood that probably are produced as a response to wounding or infection – but this will not occur in every tree. Wild populations of agarwood trees are found in the lowland and montane tropical forests, with habitat varying for different species. Agarwood-producing taxa are distributed from north-east India eastwards through continental Southeast Asia and the Indo-Malesian bio-geographic realm as far east as Papua New Guinea, and north to the south-east provinces of China. There are 14 known range States (Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Papua New Guinea, Singapore, Thailand and Viet Nam[1]). All range States (excepting Singapore, which does not allow export of its native species) share a common characteristic of declining wild tree populations due to persistent over-harvesting and increasing habitat conversion (TRAFFIC Southeast Asia, 2004).

Concern over the effect of international trade led to the genus *Aquilaria* (along with one other agarwood-producing genus, *Gyrinops)* being listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which came into effect in 2005, 10 years after a single agarwood-producing species, *Aquilaria malaccensis*, was first listed in CITES Appendix II[2]. In general, a CITES Appendix II listing aims to ensure that the international trade is conducted legally and maintained within sustainable levels – it is not a trade ban.

Agarwood-producing taxa are linked to several genera in the family Thymelaeaceae, with the genus *Aquilaria* being the most important (Hou, 1960). However, not all species within these genera are known to produce agarwood. Furthermore, no standard biochemical parameters have been determined to define agarwood, with the make-up of the substance's various constituent compounds varying between different specimens from the same tree.

For agarwood-producing taxa listed in CITES Appendix II: *Aquilaria* spp. and *Gyrinops* spp, the provisions of CITES apply to all parts and derivatives under Annotation #1.

1.2 Requirements of the Convention for exports of Appendix II specimens

CITES requires that the export by range States of Appendix II species is not detrimental to the survival of that species in the wild. To ensure this, the CITES Scientific Authority (SA) of the State of export is required to make what is commonly referred to as a 'non-detriment finding' (NDF) prior to the issuance of any export permits by the CITES Management Authority (MA). The text of the Convention states that: "An export permit shall only be granted when the following conditions have been met: (a) a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species; ..." (Article IV paragraph 2(a)). The CITES *Resolution Conf. 10.3* on the designation and role of the Scientific Authority recommends, *inter alia*, that NDFs and advice from the SA of the country of export be based on the scientific review of available information on the population status, distribution, population trend, harvest and other biological and ecological factors, as appropriate, and trade information relating to the species concerned (see Section 1.4 of this document for more detail on the relevance of *Resolution Conf. 10.3*).

The term 'export' for the purposes of CITES only applies to the trade of specimens originating in the country where harvest has taken place. 'Re-export' applies to the trade of specimens originating from a country other than the exporting country, in such instances specimens only require a Re-export Certificate. 'Country of origin' is defined as the country in which a specimen was taken from the wild or

[1] There is some uncertainty whether the Philippines is also a range State.

[2] The genus *Gonystylus*, better known for its Ramin timber but which also produces agarwood, has also been listed in Appendix II owing to concerns about the sustainability of the international trade in its timber.

artificially propagated. These definitions have been adapted from Resolution Conf. 12.3 (*Rev. CoP14*) on permits and certificates, Annex 2.

In practice, NDFs are often incorporated into an annual export quota system which can eliminate the need for a NDF to be conducted for each individual shipment of CITES specimens. This provides a basis for monitoring the trade and may facilitate the issuance of export permits (see *Resolution Conf. 14.7* on the management of nationally established export quotas).

The Convention also requires the CITES SA of the State of export to determine when to limit the granting of export permits for Appendix II species "in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs, and well above the level at which the species might become eligible for inclusion in Appendix I" (Article IV paragraph 3).

Although the primary responsibility for making NDFs rests with the CITES SA of the State of export, Article XIII vests authority with the CITES Secretariat to communicate with a Party when there are believed to be problems with implementation. Furthermore, the Conference of the Parties to CITES adopted *Resolution Conf. 12.8 (Rev. CoP13*) on the review of significant trade in specimens of Appendix II species that directs the Plants Committee to identify when Appendix II species are subject to unsustainable trade and recommend remedial actions through what is known as the "Review of Significant Trade". This can include, for example, the establishment of export quotas, development and implementation of management plans or, as a last resort, restrictions on exports for the species concerned[3].

1.3 Approaches to conducting NDFs for agarwood-producing taxa

Since a single agarwood-producing taxon, *Aquilaria malaccensis*, was first included in Appendix II in 1995, studies in agarwood range States, particularly Indonesia and more recently, Malaysia, have made efforts toward gathering information that would assist the formulation of NDFs for agarwood (Soehartono and Newton, 2000; Soehartono and Newton, 2001; Soehartono and Newton, 2002; Anon., 2003b; Walujo and Wiriadinata, 2006; FDPM, 2006). These efforts were made parallel to similar NDF initiatives for other CITES-listed tree species, particularly Big-leaf Mahogany (Oldfield and Newton, 2003; Magin, 2006; CoP14 Inf24) and Ramin (Anon., 2002; Anon., 2003a). However, these efforts have all been somewhat hampered by the fact that no standard methodology has been developed for making NDFs.

In a generic attempt to address the methodological gap, IUCN developed a *Checklist to assist in making Non-Detriment Findings for Appendix II exports* (Rosser and Haywood, 2002) ('the IUCN Checklist')[4]. This checklist approach is also known as a 'rapid vulnerability assessment' (RVA) (Wong *et al.*, 2001). Such a RVA helps to determine whether a species may be at risk from overexploitation. However, a RVA does not actually provide quantitative information to assist in determining harvest limits or export quotas, two mechanisms that have been used to maintain harvests and trade within sustainable levels by a number of CITES Parties.

The IUCN Checklist consists of two parts: 'Table 1' is an initial review at the national level on the types of harvest, the degree of control over the harvest, the segment of the population harvested, the level of total off-take (for domestic and international use), the reason for the harvest, and the end users of the harvest. There are also checks to distinguish between regulated and illegal or unmanaged harvesting. Concerns captured in Table 1 can then be dealt with in more detail in 'Table 2', which compiles information on management history and planning, harvest management, status of land on which harvesting takes place, capacity for monitoring the harvest, benefits and risks of harvest, and levels of strict protection (Rosser and Haywood, 2002). Scoring is done on a scale of 1-5, where 1 shows the lowest level of confidence for the category concerned.

IUCN stressed that while the Checklist itself does not constitute a finding of non-detriment, its use should inform non-detriment finding methodologies. However, if the majority of factors are scored closer to 1, indicating a high degree of uncertainty, a Scientific Authority may conclude that insufficient information

[3] A review of significant trade was conducted for one Agarwood-producing species, *Aquilaria malaccensis*, in 2003, which resulted in recommendations being made to key range States, namely India, Indonesia and Malaysia with regard to implementation of Article IV of the Convention.

[4] This IUCN Checklist has been presented to the CoP as CITES Inf. 11.3 but has not been formally adopted.

exists on which to base a finding of non-detriment. In such a case it is recommended that most Parties should choose not to allow commercial trade until information quality is improved (Rosser and Haywood, 2002).

While a useful starting point, the generic IUCN Checklist has limitations in terms of its applicability to certain tree species and countries. The case of agarwood is very different from other CITES-listed tree species harvested for their timber – the fact that it is traded a non-timber forest product which is found irregularly in only 10-20% of agarwood trees makes the development of a NDF methodology even more challenging.

A national workshop held in Malaysia in March 2006 sought to assess the extent to which this generic checklist met the needs of making a non-detriment finding for *Aquilaria*; concerns were raised with the definition and clarity of checklist terms as applied to a national setting (Anon., 2006)[5].

Recognising the need for greater clarity in carrying out NDFs for agarwood-producing taxa, the Conference of the Parties to CITES (CoP) has recommended that a standard method for determining the population status of CITES-listed agarwood-producing taxa be developed to assist CITES SAs in carrying out NDFs: "Such a standard method could be used to verify populations across all agarwood-producing areas, and not allow only the setting of appropriate quotas but also allow the verification of species being harvested" (CITES Decision 12.70; CITES Decision 13.65(d)).

More generally, the CoP has decided to "develop guidelines for Parties to establish, implement, monitor and report national export quotas for CITES-listed taxa" (CITES Decision 13.66). In pursuit of these objectives, the CITES Secretariat contracted TRAFFIC Southeast Asia to develop a NDF methodology for agarwood-producing taxa. The first draft of such a methodology was prepared for discussion and further development by an international CITES Agarwood Experts Group Meeting involving government, scientific and industry representatives from key agarwood-trading countries held in Malaysia from 14-17 November 2006. Feedback from workshop participants has been incorporated into the present draft.

The term "not be detrimental to the survival of that species" is interpreted in the context of the full text of Article IV which notes the need to "maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs, and well above the level at which the species might become eligible for inclusion in Appendix I".

This wording can be broken down into a number of components: (1) the range of the species; (2) the abundance of the species consistent with its ecological role; (3) eligibility for inclusion in Appendix I. Further details on these components are found in the Biological Criteria for Appendix I which were adopted by the 13th meeting of the Conference of the Parties in 2004 (*Resolution Conf. 9.24 (Rev. CoP14*) on criteria for amendment of Appendices I and II, Annex 1). However, *Res. Conf. 9.24* does not actually specify criteria for the threshold levels at which species become eligible for inclusion in Appendix I.

1.4 Contextual and institutional references for CITES non-detriment findings

It is important to consider any NDF methodology in the context of the local governance framework (i.e. national or sub-national), including both legislation and institutional responsibility. This will include the framework for the management of species and habitats as well as the framework for the management of international trade. In terms of CITES implementation, the NDF is placed in the context of a wide range of responsibilities designated to the CITES MAs and SAs of each CITES Party.

Resolution Conf. 10.3 on Designation and Role of Scientific Authorities is a key reference in this regard, and illustrates the importance of having a functional and interactive relationship between SA and MA institutions. Several paragraphs of this Resolution are particularly important when considering the implementation of NDFs, including a), c), g), h), j) With reference to the fact that several agarwood-producing taxa have transboundary populations between range States, paragraphs d) and e) encourage co-operation and sharing of resources towards provision of the scientific ridings required under the

[5] See Annex 1 of this document for examples of outputs from using the IUCN Checklist for agarwood trade in Indonesia and Malaysia.

Convention. Paragraph m) of the same Resolution is relevant for the exports of cultivated agarwood products under the CITES definition of 'artificial propagation'.

Before the MA requests the SA to make NDFs for specimens of agarwood-producing taxa, it should determine that all applications for CITES permits to export these specimens are in order (*Resolution Conf. 12.3* (Rev. CoP14) on Permits and Certificates, Annex 2). In particular, the MA should ensure that the exporter has indicated the species, type, source and quantity of specimens on the standard permit specified in Article VI paragraph 2.

Prior to requesting advice from the SA, the MA should be satisfied that each specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora (Article IV paragraph 2(b)). NDFs and any quotas resulting from NDFs should not be used to legitimise illegal harvest of agarwood. Legality is generally considered to be a pre-requisite for sustainability and therefore the assessment of legality should be made prior to any NDF (for individual exports), or in conjunction with the issuance of export permits within the limits of any existing national quota. The first part of the IUCN Checklist ('Table 1') encourages the SA to make an initial review, at the national level, of the degree to which harvest is regulated (or legal).

The export of certain specimens of agarwood may not require advice from the SA. Examples include specimens that were artificially propagated (often referred to as cultivated agarwood) (with valid certificates of artificial propagation or proof of cultivation), pre-Convention specimens (with valid pre-Convention certificate) and non-commercial trade between scientists and scientific institutions. Agarwood seedlings may come under the category of plants that are artificially propagated in accordance with *Resolution Conf. 11.11 (Rev. CoP14)* on regulation of trade in plants, paragraph a. Agarwood from cultivated sources (home gardens, plantations) could come under the category of parts and derivatives of plants that were artificially propagated (CITES Source Code 'A'). Such specimens may be exported under the provisions of Article VII, paragraph 5, of the text of the Convention.

Finally, it is important that the SA does not consider its role complete once NDFs have been made. The Convention requires SAs to monitor the exports of specimens of Appendix II species. In this regard, it is important that, in the spirit of adaptive management, SAs work closely with the relevant Management Authorities, Customs and other relevant law enforcement agencies to assist with species identification and control of the chain of custody. The role of the SA should also be to advise on a practical permanent monitoring system to ensure levels of international trade (and by extension the harvest levels to supply those exports), do not become detrimental to the survival of the species in the wild.

1.5 How to use this document

Section 2 details a methodology for going through a NDF process with stakeholders towards assessing the impact of international trade levels on the status of agarwood-producing taxa. It suggests relevant categories of information, and the possible sources of such information, to assess the status of the harvest and trade relative to wild populations, identify knowledge gaps, and to examine any resulting trends or uncertainties in lieu of exhaustive field studies to enable CITES Authorities in relevant range States to evaluate the likelihood of detriment posed by current levels of trade.

Section 3 outlines technical specifications in the wider management context that encompass a resource assessment at more precise resolutions. Collection of such information would ensure that subsequent NDF assessments would benefit from an increasing degree of accuracy.

It also emphasises that the monitoring and verification systems that should be set up (or strengthened) in parallel to the NDF assessment process. Such systems will form the basis of an adaptive management system. Without a framework to pick up any iterative advances in quality and category of information, the management system will not be sensitive to change.

This document is presented in line with CITES Decision 14.143, directed to the Plants Committee and the Secretariat regarding Agarwood-producing taxa, which specifies that:

On the basis of the work on non-detriment findings for agarwood-producing species, that has been developed by TRAFFIC Southeast Asia and the Secretariat, the Plants Committee, in consultation with range States and the Secretariat, shall develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing species.

As such, the Plants Committee is invited to provide comments on this draft, and to consider how to further develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing taxa.

SECTION 2 – SOME STEP-WISE APPROACHES TO DECISION MAKING FOR NON-DETRIMENT FINDINGS

2.1 Define the scope of the assessment

Determine the current taxonomic status of the agarwood-producing species to be included in the assessment. Decide whether the assessment is addressing one or more species. Define the location subject to NDF assessment in terms of agarwood-producing species composition, geographic coverage as well as political and administrative limits[6]. If any previous NDFs have been made for the species, at the national level or any smaller geographic frame of reference within the national boundary, reference to these existing NDFs should be made when estimating values for scientific and management criteria (see step **2.3**).

2.2 Check for existing quotas

Check whether any existing harvest and / or trade quotas have been set, and whether they were determined by any previous NDF assessment for the species defined in step **2.1.** Determine whether these quotas are current and valid for the particular population of the species, taking into consideration any new information regarding the species.

2.3 Estimate values for fundamental scientific and management criteria

The IUCN document *Guidance for CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports*, will provide a useful qualitative starting point for determining biological status, management history and planning, harvest management, status of land on which harvesting takes place, capacity for monitoring the harvest, benefits and risks of harvest, and levels of strict protection.

To assist with the accuracy of scoring the Checklist, and to assemble as much information about the status of the population being harvested, carry out a review of the existing literature[7]. In terms of quantitative information relevant to wild population status, the minimum, maximum and best estimates for the following factors will be relevant:

a) Total number of individuals (including seedlings, saplings, small trees, big trees)
b) Number of fruit-producing individuals
c) Level and pattern of recruitment
d) Number of sub-populations
e) Effective number of fruit-producing individuals in each sub-population
f) Level and pattern of exploitation, including for international trade
g) Area of natural distribution
h) Area of present occurrence
i) Quality of habitat
j) Integrity (fragmentation) of area of distribution

Further detail for structuring the resource assessment component of a NDF can be found in **Section 3.2** of this document.

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[6] Article IV paragraph 2(a) requires the assessment of the conservation status of the species at a global level, at a subspecies level or at the level of geographically separate populations.

[7] This should include all relevant 'baseline data' derived from existing forest inventories, field-based assessments, botanical and ecological studies, and yield studies.

2.4 Conduct interview-based surveys with industry participants

Once the existing information and data have been reviewed, and key harvesting areas have been identified, the most important source of up-to-date information is likely to be from individuals and groups involved in harvesting and trading of agarwood. These industry participants, or stakeholders, may be located around the harvesting area, at intermediate points of consolidation and trade, at processing centres, or at points of warehousing and export. Field-based forestry officers, as well as those involved in issuing permits for harvest and/or trade, are also likely to be an important source of information, particularly if revenue is being collected from agarwood harvest and trade. Interview-based research could focus on the following information:

a) Numbers of industry participants and scale of industry (formal and informal) – including connection to international investment and demand, and how this relates to international trade dynamics.
b) Location of present harvesting areas – to determine where present supply is sourced from.
c) Extent of cultivated agarwood investment and whether any agarwood is being produced from cultivated sources.
d) Levels of trade – are these rising, declining or stable in both volume (quantity) and grade (quality)?
e) What understanding exists in terms of the existing institutional and regulatory system for agarwood harvest and trade (laws, permits, regulations)? Is it clear to trade participants which government agency has responsibility for monitoring the agarwood industry?
f) Annual value – national revenue from sale/export, how many stakeholders involved in earning an income [fewer participants may equal trade declining].

2.5 Examine additional factors that may assist with NDF assessment

Comprehensive information is unlikely to be available on population status, particularly at the national level, at the initial stages of carrying out a NDF. Therefore, in addition to analysing published data collected in step **2.3**, and interview-based information collected under step **2.4**, several other contextual indicators may assist in assessing the ability of the population to withstand the impact of harvest.

a) Are wild harvesting areas getting increasingly further away from urban trade centres?
b) Has volume of agarwood gathered per harvesting trip ('catch-per-unit-effort') decreased in terms of quantity (volume)?
c) Has quality (grades of agarwood) of agarwood declined?
d) Is the international market price rising?
e) Is any existing harvest quota from certain geographical areas being met? Are any trade (export) quotas fulfilled to the maximum level?
f) What size (diameter at breast height – dbh) trees are available for harvest in the wild?
g) Is harvested product coming from wild or cultivated sources? Can these be distinguished from each other?
h) Do any stockpiles of harvested (wood chips, pieces) or processed (e.g. oil, powder) agarwood products exist, and if so, how are these monitored or managed?
i) Are 'outsiders' involved in harvesting activities, including foreign nationals?
j) Are current harvesting areas inside or outside protected areas?
k) What evidence exists for illegal harvest and trade, and how does this compare to legal activities?
l) Are threats other than exploitation for trade (e.g. habitat conversion, fire) getting more severe?

2.6 Calculate the international trade threshold

Depending on the outputs from steps **2.3-2.5**, an estimate of the maximum quantity of agarwood which can be exported from a range State without detriment to the survival of remaining populations can be calculated. This export trade threshold should be based upon a level of harvest that does not exceed the ability of the species to regenerate.

An allowance for illegal harvest and trade should be deducted from the export trade threshold to incorporate an additional precautionary element.

The calculation will need to determine the conversion factor between the quantity (and the form or product type) of specimens entering international trade and the number of trees removed from the wild population in order to produce this quantity. Any domestic or national use of agarwood should also be taken into account.

For wood chips, this would need to address the number of live individual trees harvested per kg of wood chips in trade – or the number of kg of wood chips in trade per live individual tree lost[8].

For agarwood oil, this would need to address the volume (mass in kg) of agarwood chips used to produce resultant oil volume (litres), including an established metric for conversion. Once the volume/mass of wood (chips) is determined, that would also have to be calculated in terms of trees lost.

Based on these conversion factors, calculate the maximum quantity of agarwood (major products being wood chips and oil) that may enter international trade per year for the next five years before a species satisfies at least one of the Biological Criteria for inclusion in CITES Appendix I (A to C)[9]. Cultivated agarwood, however, and products derived from these controlled production systems, should be treated separately from wild-harvested agarwood, and production from cultivated systems should be differentiated to ensure it is not mixed or confused with wild harvested product (see **Section 3.1.3d)** of this document for more detail).

7. Determine management interventions

There are likely to be several 'unknowns' or information gaps in the NDF assessment, so incorporating precautionary approaches is recommended. Depending on the reliability of available information, several management interventions may be deemed necessary.

These may include, for example: preparation of a management plan; zoning of agarwood habitat into separate delimited areas for harvesting and conservation; population surveys of ecologically representative agarwood harvesting areas; setting size limits (tree dbh) for harvest; specifying product types allowed for export, designation of processing centres and points (ports) of export; and strengthening monitoring of any existing management systems applied to agarwood-producing taxa. A more detailed technical list is given in **Section 3** of this document, outlining elements which Parties may consider to incorporate into an adaptive management system.

However, given agarwood's nature as a high-value, predominantly open access resource, harvest and trade is likely to continue alongside any management interventions. Therefore annual limits to harvest and trade – in the form of quotas – may need to be set.

A national quota may be composed of several subordinate quotas relative to available habitat, harvesting locations, and political administrations. In the case of agarwood, the quota should specify to which species and product types it applies and in what volumes. The total national quota should be well below the quantity identified as a threshold in step **2.6** and should be tied to a calendar year (1 January to 31 December) [10]. The period after which a re-evaluation of a NDF for the species should be carried out should also be specified.

[8] In the case of specimens of agarwood, the conversion factor will be a function of a number of variables including (1) the proportion of trees harvested which actually yield agarwood of the particular grade of the specimen; (2) the mortality rate of trees harvested; and (3) the conversion rate of processing activities, for example from trees to wood chips, and wood chips to agarwood oil (see **Annex 3** of this document for conversion rate examples). In 2006, Malaysia presented an explanation to the CITES Secretariat detailing the process of calculating a cautious harvest quota for *Aquilaria malaccensis* for the year 2007. This included considerations of a size limit for wild populations (trees above 30cm dbh), volume of potential annual harvest over a 50 year rotation, estimation of yield per tree for both wood and resinous deposits, while factoring the likelihood of agarwood formation at 10% of trees in the total wild population. Malaysia may wish to present the detail of this example to the Plants Committee for discussion with other range States.

[9] *Res. Conf. 9.24 (Annex I) (Rev. CoP14).*

[10] Ensure that the CITES Secretariat is informed of this annual export quota (in compliance with *Resolution Conf. 12.3 (Rev. CoP14)*, s VIII a).

8. Advise on whether proposed agarwood exports will be detrimental, or not, to the survival of the species

The Scientific Authority, having taken into account all available information, ultimately needs to advise the appropriate Management Authority whether the export of the proposed quantity of agarwood will or will not be detrimental to the survival of the species.

If information gleaned from steps **2.3-2.6** indicates a predominantly negative trend, i.e. towards detrimental impact on the survival of the species in the wild, then the management interventions under **step 2.7** may also consider the cessation of trade. This amounts to a (self-imposed) zero quota by the Party concerned, and will allow time for certain information gaps to be filled in order to consider whether managed wild harvest and export should resume. A comprehensive list of management criteria is outlined in **Section 3** of this document, which aims to present a list of options for CITES Authorities of range States to consider towards improving the sustainable management of wild agarwood populations.

SECTION 3 – SOME TECHNICAL SPECIFICATIONS TO INFORM ADAPTIVE MANAGMENT FOR AGARWOOD-PRODUCING TAXA (*Aquilaria/Gyrinops spp.*)[11]

3.1 – MANAGEMENT PRINCIPLES, METHODS AND INDICATORS

3.1.1 Management plans and principles

a) Establishment of management plans at national levels, accommodating State/province and smaller geographic units of management, will form the foundations of short, medium and long-term interventions towards a goal of legal and sustainable wild agarwood harvest and trade.

b) An adaptive management approach is essential, allowing for new information to be taken into account as it comes to hand and implementation of modifications as necessary. In addition to conducting a resource assessment (see **Section 3.2**) factors such as harvest area rotation, allowable dbh sizes, growth, regeneration, levels of legal and illegal harvest, levels of threat posed by logging and other land conversion of agarwood habitat, would need to be considered.

c) Management plans should incorporate considerations and needs of different production systems to acknowledge both populations in natural forests, as well as cultivated agarwood in plantations and home gardens, whether managed by private enterprise or local communities. Best-practice management guidelines and principles can be adapted for all agarwood production systems.

d) The outcomes of successful cultivated agarwood production systems (whether small-scale home gardens through to plantations with differing degrees of management inputs), such as those in place in Bangladesh, India, Lao PDR, Thailand and Viet Nam, should be studied. Where possible, information should be widely disseminated in order to enhance silvicultural knowledge of the species and allow for adaptation towards enhanced management of remaining wild populations.

e) In addition, any knowledge gleaned from the study of natural populations should be applied to *ex situ* cultivated agarwood production systems.

3.1.2 Factors that need to be considered for the sustainability of *in situ* agarwood populations

a) Harvest planning strategies:

- Define the type of harvest (destructive/non-destructive) to be undertaken according to age/size classes of agarwood tree populations and assessment of resin content in the tree;
- Depending on the type of harvest, to define the type of silviculture that will be implemented based on the distribution and proportion of seed-bearing mother trees, and harvestable agarwood-bearing trees.

[11] The structure of this section is adapted from a template developed by Mahogany range States regarding "Essential Elements for the Formulation of Non-Detriment Findings for Bigleaf Mahogany *Swietenia macrophylla*", presented to CITES CoP14 by Mexico as part of CoP14 Inf. 24, and presented again to the Plants Committee as Annex I of PC 17 Doc 16.1.2.

- Given the nature of wild agarwood populations as an 'open-access' resource, and the predominance of local harvesters, it is important to consider who will conduct harvest monitoring and verification measures (i.e. the local community, or an external government extension officer?).

b) *Harvesting Methods:* Based on the type of local/cultural approach to harvesting, and perceived economic viability, different harvesting methods may be carried out:

- Non-destructive:
  - Harvest of selected resin-bearing sections of tree, and/or stems where multiple stems exist or where coppicing has taken place, without killing the tree;
  - Harvest of whole trees, but leaving roots/stump for regeneration and coppicing (acknowledging uncertainty of future resin formation and fruit/seed production)[12].
- Destructive:
  - Harvest of whole tree, often including roots, which kills the organism.
  - If this is not properly managed, the felling of the tree may also kill surrounding wildlings and small trees.

c) *Regeneration:* Natural regeneration has been observed to be abundant when ecological conditions are optimal and mother trees are present in primary forest[13]. To sustain a viable population[14], it may be necessary to implement the following:

- Ensure retention and protection of seed trees, and recording their location to assist with monitoring;
- Ensure agarwood regeneration is considered in the management of an area, assuming multiple species are being harvested from that management area;
- Collection of viable seeds to establish nurseries to supply seedlings for enrichment planting;
- Establish the maximum distance between seed trees (taking into account requirements for successful pollination);
- Protection of agarwood trees to be retained for future harvests, based on likelihood of agarwood formation and oleoresin production (natural or induced);
- Enrichment of harvested areas through planting (e.g. can be implemented by local harvesters/traders as part of their licensing requirements).

d) *Conservation:* To protect the different species and their localised geographic populations found throughout each national agarwood range, and in order to ensure that the variety and diversity of the populations will be preserved, the following actions need to be considered:

- *In Situ*: Establishing strictly protected agarwood conservation stands in ecologically representative locations. This will ensure the maintenance of genetic variation, and aid with production of seeds and the establishment and monitoring of sample plots. Such zones could be linked to existing protected area systems.
- Coordinating an agarwood seed collection and management program, accurately documenting seed collection locations; and creating nurseries to supply seedlings from viable and carefully selected seed stock for enrichment planting in selected locations.

3.1.3 Agarwood supply chain management

a) *Monitoring and verification:* this is probably the most critical element of a working adaptive management system to support NDF for agarwood-producing taxa, and includes elements of law enforcement further detailed in **Section 3.3**.

- Compliance monitoring referenced to existing regulatory system for managing agarwood harvest and trade (including taxa-specific management plans if they exist).
- Annual allowable cut (tree harvest volume) should be monitored in conjunction with product stockpiles (e.g. wood chips/pieces, powder, oil) and associated conversion ratios (particularly trees → wood chips; and wood chips → agarwood oil), and cross-referenced with levels of export trade in various agarwood product types.

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[12] In many cases, non-lethal (non-destructive) harvesting may not be economically viable.

[13] As agarwood-producing species are an upper-understory tree, the more light available will increase the speed of seedling growth (Anders Jensen, *in litt.* to TRAFFIC).

[14] For conservation stands, or seed sources, a viable population should include 30 fruiting and flowering trees at least 100m apart (Anders Jensen, *in litt.* to TRAFFIC).

- Where possible, establishment of permanent monitoring plots (in both harvested and non-harvested areas) is advisable in order to gain a detailed and long-term understanding of the impact of harvesting from agarwood habitats.
- Establishment of information databases and an expert group list-server is essential to support domestic and international information exchange on management of agarwood harvest and trade, including any associated scientific advances.

b) *Training/expertise and field data collection:*
- Define minimum training criteria and standards for harvesters.
- Devise an ongoing training programme for personnel (experts to train novice harvesters, whether local or outsiders) involved in harvesting activities to minimise destructive harvesting, and the selection of appropriate size and age classes of trees.
- Training programme for regulatory staff to ensure understanding of relevant range State regulations including harvesting criteria and indicators.
- In the course of population assessments and monitoring, drafting of geo-referenced maps of harvesting areas is recommended.

c) *Determining quotas for harvest and trade for wild-harvested agarwood:* Accurate quota establishment depends on adequate knowledge of wild populations. If quotas are established without knowledge of wild populations and levels of harvest (current and historical), and instead referenced only to domestic stockpiles and previous export volumes, it is impossible to assess the impact that exports will have on wild populations. The following steps should therefore be considered:
- Select an ecologically representative array of agarwood harvesting areas to determine minimum viable populations, to assist with calculation of the maximum volume (number of trees) subject to harvesting. This could also be paired with data on tree growth and regeneration/recruitment data to determine harvesting volumes, as well as considerations of any non-destructive harvesting.
- Harvest quotas will ideally be established with reference to a specific geographic area (including a defined collection area), to acknowledge variance in population structures, while also acknowledging any political management unit and associated regulatory procedures. This information can then be used as a baseline for establishing export quotas.
- As the current status of knowledge indicates 10-20% of trees in naturally occurring wild populations contain resinous agarwood deposits of commercial value, the number of harvested trees (including those with no agarwood deposits) should be referenced to volume of yield of resinous agarwood to reflect losses inherent from processing trees into agarwood chips[15].
- Export quotas should take into consideration the diversity of major products in trade and any associated conversion factors. In particular, the conversions of trees to wood chips, and wood chips to essential oil will both be critical considerations when setting annual thresholds/limits for exports[16].
- Quotas should be established one year in advance whenever possible in order to enable monitoring and verification.

d) Separating cultivated agarwood production from wild-harvested sources: Differentiation between wild and cultivated agarwood production systems and products in trade is necessary both for efficient management and monitoring of the agarwood supply chain, and a component of NDFs. This may involve:
- Registers of cultivated agarwood plantations and home gardens.
- Conducting NDFs for cultivated agarwood production referenced to outputs from these registered locations, whether wood chips, oil or finished products.

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[15] In an intensively managed production system (e.g. cultivated plantations or home gardens), this may also enable information to be collected on the mix of quality/grades of agarwood harvested from age/size classes of trees.

[16] This should then be related back to harvest monitoring, and linked closely with the monitoring of agarwood industry members processing wood chips into oil.

- Upon application, verification of agarwood product source before issuance of CITES export permits with Source Code ‘A’, designating ‘artificial propagation’ or production from non-wild sources under controlled conditions[17].

3.2 – RESOURCE ASSESSMENT– to determine crucial baseline biological and ecological information

3.2.1Distribution

Determine range and distribution of agarwood-producing taxa at the national level. This is clearly dependent on agarwood-producing taxa being included at genus, if not species, level in national forest inventory specifications, or in production forest assessments of smaller geographic units. Some existing sources of information at the national level (which may be aggregated from smaller units of information such as State/province, or forest management area) are:

a) National forest inventories – which may give indications of agarwood-producing taxa at genus level;
b) Available satellite imagery – in the case of agarwood, this may only give indications of suitable habitat, but will not give more precise information for a typically widespread species which has clumped distribution;
c) Any existing mapping of production forest areas at sub-national (i.e. State or province) level, or smaller localised levels of forest management (including protected areas) where species composition has been assessed.
d) The most important source of information on agarwood presence/absence at the local level is likely to come from field-based forest rangers and individuals and/or groups involved in harvesting and trading of agarwood. These industry participants, or stakeholders, may be located around the harvesting area, at intermediate points of consolidation and trade, at processing centres, or at points of warehousing and export.
e) Over time, key harvesting areas can be identified and inventories can be conducted in an ecologically representative selection of agarwood habitat. Given the widespread but irregular (clumping) distribution, techniques such as distance sampling and adaptive cluster sampling may be most appropriate[18].
f) Reference set of herbarium specimens at national, regional and international herbaria and forestry research centres – useful only for determining some extent of natural (historical) distribution, and with understanding background ecological conditions

By analysing available information, some indication of the historical and current distribution of agarwood-producing taxa may be determined, and key areas identified for harvest management and conservation. Collated information may also allow for systematic comparison of current status to historical distribution of wild populations.

3.2.2 Population parameters

In order to assess populations of agarwood-producing taxa, regular monitoring of selected biological parameters and indicators of sustainable management must be carried out in representative harvesting areas within, for example, a monitoring interval of five years. Baseline figures are therefore essential to this process.

1. Monitoring parameters

a) Structure of agarwood populations:
- Diameter at breast height (dbh), based on an appropriate sampling method
- Height of trees, measured or estimated
- Density (# agarwood trees/ha; # agarwood trees/100 ha), by size classification
- Number of seed-bearing (mother) trees

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[17] noting that the CITES definitions for ‘artificial propagation’ of agarwood or other non-timber forest products need examination with reference to *Res. Conf. 11.11 (Rev. CoP13)*.

[18] Areas assigned as *in situ* conservation stands for seed collection would be additionally useful for detailed tree inventories, and monitoring of seed trees. These conservation stands should be located across a representative range of ecological zones within each national jurisdiction.

b) Assessment of whether seed stock is being replenished (to determine recruitment potential)
c) Natural regeneration – estimate number of seedlings, saplings, small trees[19];
d) Growth rate (of standing trees at dbh) – as agarwood is an upper-understorey species, growth would vary depending on degree of canopy closure.
e) Indicative probability of agarwood formation in localised wild tree populations, based on information obtained from communities surrounding harvesting areas (depending on location).

2. Sustainable management indicators for viable agarwood tree populations

These indicators make it possible to identify the relative population dynamics to ensure that an equivalent population of agarwood trees is established for regeneration and maintenance purposes, so as to replace the trees that were destructively harvested:

a) Identification of seed-bearing (mother) trees, and monitoring of their mortality rate, within managed harvest areas. This would allow comparison with monitoring of mother trees in any protected / conservation zoned areas.
b) Regeneration rate / recruitment (natural or through enrichment planting), including considerations of seedling mortality.
c) Felling rate.
d) Retention rate of large trees (>50cm dbh).
e) Number of trees available for future harvest.
f) Ability of non-destructively harvested trees to allow agarwood formation.

3. Information gaps

In order to establish a basic silviculture for wild populations of agarwood-producing taxa, the following parameters need to be further understood by range State resource managers:

- reproductive biology, including pollination and dispersal mechanism;
- life history of all agarwood-producing taxa, including age at which agarwood formation and oleoresin production is most likely to occur;
- annual growth, regeneration;
- habitat and ecology (including soils, elevation, terrain, drainage, climate), including considerations of spatial distribution of agarwood trees in natural forest;
- phenology;
- agarwood formation process (and possible application of inducement technology to improve the speed and quality of resin formation[20]);
- minimum / maximum dbh appropriate for harvesting;
- agarwood content and quality in trees;
- techniques or tools on how to detect presence of resinous agarwood deposits in the tree without felling, including indigenous ethnobotanical knowledge;
- long-term morbidity associated with non-lethal harvest (and considerations of economic viability of non-lethal harvesting).

3.3 – MONITORING AND VERIFICATION TOOLS FOR CONSERVATION, HARVEST AND TRADE ACTIVITIES

It is necessary to support conservation and legal harvesting activities with monitoring and law enforcement in order to ensure compliance and reduce illicit activities driving illegal agarwood harvesting. These recommendations take note of outputs from the CITES Agarwood Experts Group meeting (Malaysia, 2006) and the 2nd International Agarwood Conference (Thailand, 2007):

a) Ensure clear definitions for aspects of the agarwood industry, particularly the parameters of 'cultivated agarwood' or plantation-sourced materials, a rapidly emerging component of future

[19] Strictly protected conservation stands would likely be managed specifically for recruitment, collection and planting elsewhere (whether in plantations or theoretically enrichment planting in wild population stands).

[20] Application of inducement technologies to wild agarwood populations should be examined under protocols agreed with the SA of the range State concerned.

supply that would need to be separated from, but informed by, wild harvest regulations. Other definitions that need to be established are agarwood powder/dust, wood chips, logs, wood pieces, oil, non-timber forest product, incense (as this refers to raw agarwood in some cultures) and even 'agarwood' itself (separate from the tree). A glossary of terms should be developed that considers cultural aspects of the agarwood industry and trade in order to allow better understanding between producers, traders and consumers, including government regulators.

b) Strengthen the chain of custody from forest (point-of-harvest) to point(s) of processing and/or export as a means of intensifying the control on legally and illegally harvested agarwood.

- Investigate options for an agarwood marking and traceability system to strengthen the chain of custody for product tracking, and to differentiate between cultivated and wild-sourced agarwood. This could also be extended to verify agarwood imports, right through to final sale of certain products (e.g. agarwood oil).

c) Establish a verification system for harvesting and supply chain management from production areas (at various levels e.g. national, State/province, or harvest site), carried out by the MA with the participation of the SA and any licensed harvest/trade participants, which may include:

- On-site (annual) inspection of harvesting areas to measure compliance with the approved harvest management protocols (acknowledging that these will vary between range States). under forest management plans, as well as monitoring systems utilizing available technology.
- Control systems for supply chain management from harvest area to point of processing, sale or export, in compliance with relevant regulations and procedures in each range State.

d) Under national management plans, establish national registers of industry participants in an effort to formalise the agarwood trade structure[21]. Such a register could also be referenced to licensing systems for harvesters, collectors, processors, vendors and exporters, depending on the regulations of each range State.

- Establish a register of cultivated agarwood plantations (including inventory of trees and stocks) at national levels, to enable better separation of production systems for cultivated agarwood and wild harvested agarwood.

SECTION 4 – CONCLUSIONS

This paper considers a range of options for carrying out a non-detriment finding (NDF) assessment for agarwood-producing species in compliance with the provisions of CITES. The text of CITES does not provide detailed guidance in regards to NDF, however the numerous decisions, resolutions and information papers of the CITES Conference of Parties does lay a foundation upon which the recommendations of this paper are built.

In practice, the lack of comprehensive information will inevitably render NDF assessments subject to a degree of uncertainty. Furthermore, there are numerous practical difficulties with the regulation of the agarwood trade that have been recognised and have yet to be resolved. Nevertheless, the practical implementation of NDF by the Scientific Authorities of the various Parties will begin to bring the trade in agarwood closer in line with the criteria of legality and sustainability.

However, the effectiveness of implementing a NDF rests on the fundamental assumption that range States have a functional and objective Scientific Authority (as defined by *Resolution Conf 10.3*), and an interactive relationship between the SA and MA focused on monitoring the legality and sustainability of Appendix II exports.

Through a process of continual improvement of the quality of data specific to agarwood-producing taxa, Parties can implement an adaptive management system that will aim to safeguard remaining wild populations.

[21] Note that this has been done in some range States already (e.g. India, Indonesia, Thailand), to different degrees.

SECTION 5 – RECOMMENDATIONS

In line with CITES Decision 14.143, it is recommended that the Plants Committee consider this draft and examine how to further develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing taxa.

It is recognised that for robust implementation of a NDF, prescriptive management interventions may be needed to support harvesting sustainability. For agarwood-producing taxa, meeting goals of promoting regeneration, agarwood product traceability, establishment and maintenance of conservation areas, monitoring systems, and law enforcement will require financial investment and technical support[22]. As such, the following considerations should be taken into account:

a) Range States should consider costing out activities required for sustainable management of agarwood harvest and trade in compliance with compatible NDF methodology, for the benefit of in-country value addition, related industry development (considering both wild harvest as well as cultivated production) as well as species management and conservation. Implementing management plans for agarwood will require additional financial investment.

b) If a National Management Plan is deemed appropriate, it may be necessary to evaluate the role that various institutions play in the oversight of agarwood harvest and trade in each range State, including monitoring and law enforcement. Clearly defined institutional responsibilities may improve the efficiency and transparent use of resources. One suggestion is to centralise administration of the agarwood industry to one government institution to streamline operations and ensure a clear 'rulebook' for industry participants.

c) Development (including funding) of any management plans for agarwood should be integrated into overall sustainable forest management strategies as they pertain to commercial tree species.

d) The cost of implementing sustainable harvest management plans may have an effect on the price competitiveness of agarwood sourced from legal and sustainable production systems (both wild-harvested and cultivated agarwood). This should be carefully considered as part of an ongoing dialogue between stakeholders in range and consumer States (both government and private sector).

e) By examining the supply/market chain for opportunities for cost and benefit sharing, practical co-operation could be facilitated between producers (including harvesters, collectors, processors), traders (import and export intermediaries), established agarwood industry members, and end users. For example, if end-use markets require particular qualities of wild-harvested or cultivated agarwood, private sector industry participants or end users may consider investment in supporting legal and sustainable production, harvest and export from range States.

[22] This takes note of related discussions by Mahogany range States to recognise the need for cost effectiveness and streamlining institutional actions for NDF implementation, as detailed in CoP14 Inf. 24, and presented again to the Plants Committee as Annex I of PC 17 Doc 16.1.2.

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CITES Resolution Conf. 12.3 (Rev. CoP14) *Permits and certificates*
CITES Resolution Conf. 12.8 (Rev. CoP14) *Review of Significant Trade in specimens of Appendix-II species*
CITES Resolution Conf. 14.7 *Management of Nationally Established Export Quotas*
CITES Inf. 11.3 *Checklist to Assist in Making Non-Detriment Findings for Appendix II Exports*
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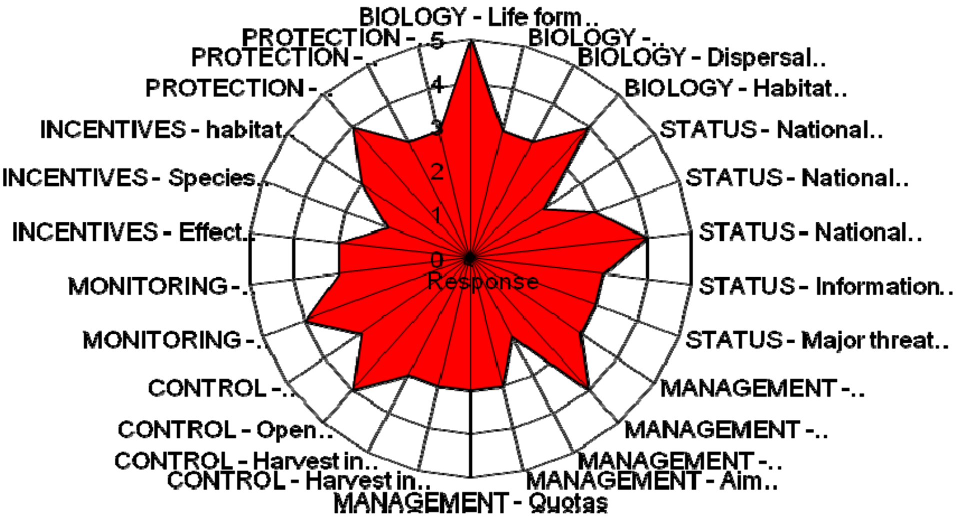
Annex 1

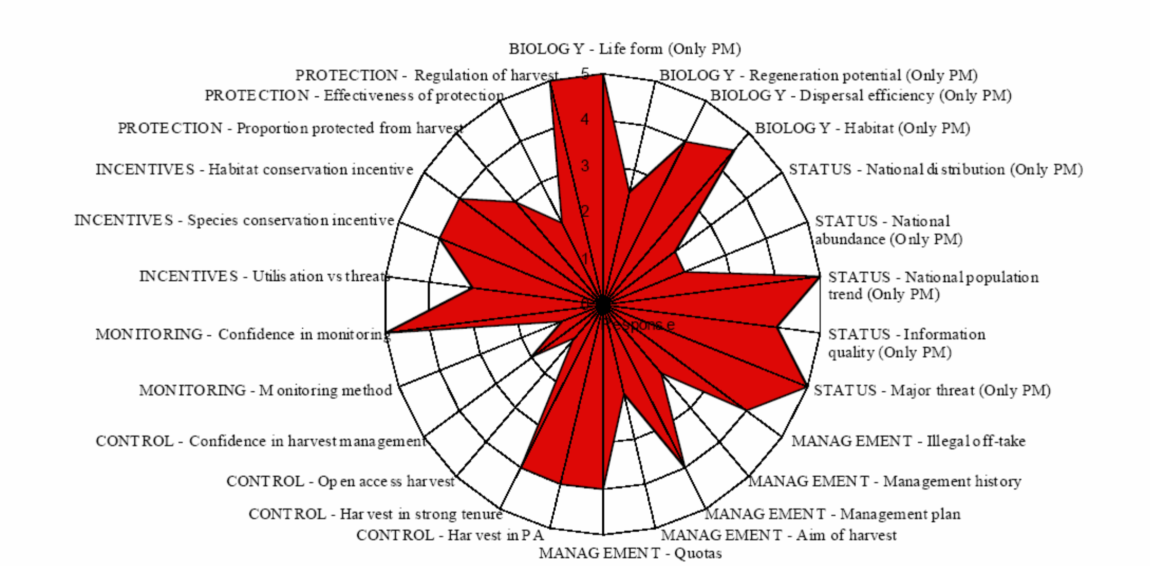
EXAMPLES OF IUCN CHECKLIST OUTPUTS FOR AGARWOOD

Figure 1 - Assessment of *Aquilaria malaccensis* in Indonesia (2003)
Plot of responses to questions to IUCN Checklist



Source: Samedi and Wiriadinata, *in litt.* to TRAFFIC Southeast Asia 2003.

Figure 2: Outcome of Working Groups, Malaysia National Workshop 2 March 2006 – Plot of responses to questions in related to agarwood-producing taxa



Note: Some of the attributed values here were referenced to a sub-national set of information (in this case Peninsular Malaysia) rather than a complete national overview.

Source: Anon. (2006a)

Annex 2

CONCEPTUAL MODELS OF RELEVANCE TO NON-DETRIMENT FINDINGS

Figure 3: Adaptive Management Model (Peters, 1994)

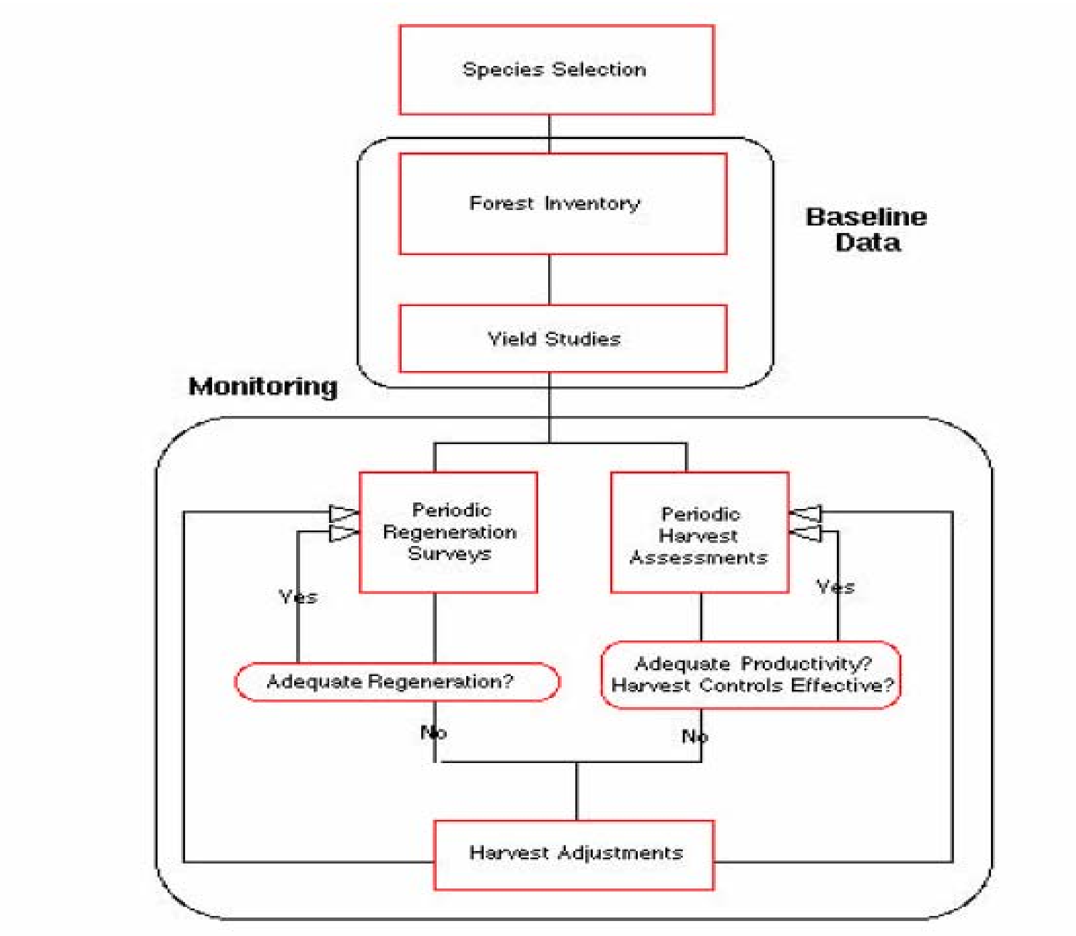
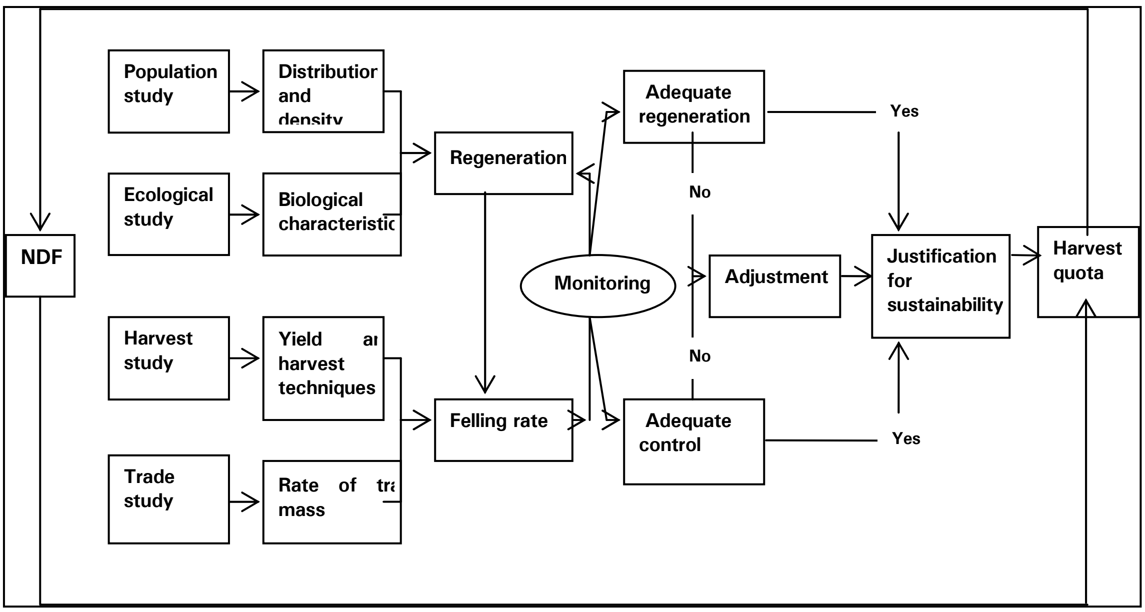


Figure 4: Schematic for assessing sustainability of harvest quota and making a NDF for agarwood (T.Soehartono *in litt. to TRAFFIC Southeast Asia,* 2006)



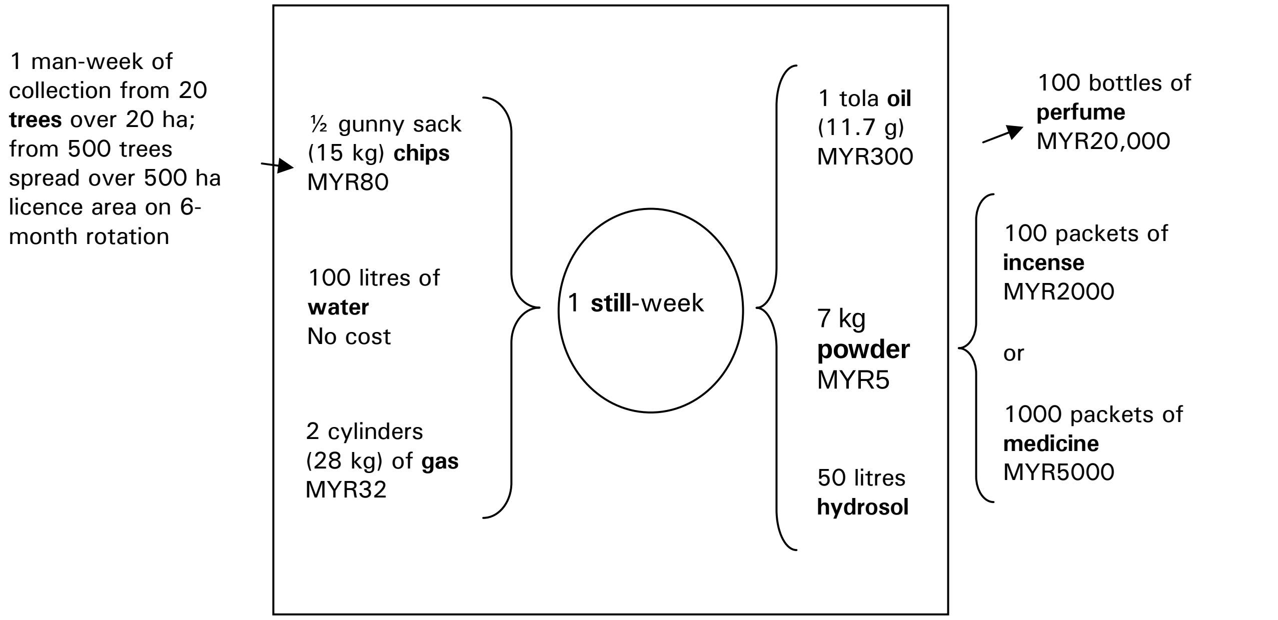
Annex 3

EXAMPLES OF CONVERSION RATES FROM TREES TO FINISHED PRODUCTS

1) Field work carried out by TRAFFIC in **Malaysia** has found that the yield from *gaharu* (agarwood) distilleries was in the order of 0.1%, i.e. roughly 1 kg of wood chips yielded 1 g of oil. However, distillation was considered a profitable enterprise as MYR1 (USD0.26) of chips could be converted into MYR3 (USD0.79) of oil (**Figure 1**).

Figure 1

Schematic diagram of the economics of *gaharu* distillation in Malaysia



MYR – Ringgit Malaysia (MYR3.8 = USD1 at 2005 rates)
Source: TRAFFIC research, Kelantan, Malaysia 2005.

2) In the United Arab Emirates, a benchmark conversion level has been set following the calculation:

To derive 6 *toulas*[23] of pure agarwood oil, 10 kg of wood is required. Therefore, to produce 1 litre of pure agarwood oil, approximately 143 kg of agarwood are used (Source: TRAFFIC research, 2006).

[23] A *toula* is a traditional unit of measurement in the markets of the Middle East (and India), approximately equal to 11.6 millilitres. Therefore, there is approximately 86 *toula* in 1 litre.

Trees Working Group Guidelines

Second document of the Working Group

1. Information about the target species or related species
Biological & species status:
ELEMENT 1: SPECIES DISTRIBUTION AREA (RANGE) AT RELEVANT SCALES
OBJECTIVE: Characterize the species' distribution at different spatial and jurisdictional scales so that production and conservation areas can be identified.
ELEMENT 2: POPULATION PARAMETERS AS INDICATORS OF SUSTAINABLE MANAGEMENT
OBJECTIVE: Characterize species population status (standing stocks & dynamics) to provide standards for evaluating harvest impacts.
Takes/uses (e.g. harvest regime):
ELEMENT 3: MANAGEMENT SYSTEMS & HARVEST RATES
OBJECTIVE: With sufficient knowledge of distribution and population parameters, determine whether management systems are appropriate to species populations subject to harvest AND whether harvest levels are sustainable.
Management, monitoring and conservation:
ELEMENT 4: MONITORING & VERIFYING HARVESTS
OBJECTIVE: Determine whether adequate monitoring & verification systems are in place to ensure the sustainability of harvest and to reduce illegal activities & illegal trade.
ELEMENT 5: CONSERVATION & THE PRECAUTIONARY PRINCIPLE
OBJECTIVE: Determine whether safeguards are in place to ensure that representative natural populations and phenotypic & genetic diversity represented in harvested populations are conserved.
2. Field methodologies and other sources of information.

Biological and species status data:

See NDF Guidelines for Trees

Harvesting and trade data:

See NDF Guidelines for Trees

3. Data integration for NDF elaboration

Consider the elements in the NDF Guidelines for Trees with specific reference to the following:

- Estimation of species range area
- Population parameters
- Management principles
- Monitoring & verifying harvests, processing
- Conservation

4. List and describe the ways data quantity and quality may be assessed

See NDF Guidelines for Trees

5. Summarize the common <u>problems, errors, challenges or difficulties</u> found on the elaboration of NDF.

The analysis of case studies helped identify elements in which information or action were inadequate. In particular:

- Population parameters considered basic to evaluating harvest impacts were generally unavailable within range States
- Silvicultural practices for reducing impacts and fostering post-harvest population recovery were considered rudimentary or inadequate
- Monitoring systems for verifying management practices and chain-of-custody were lacking
- Conservation measures were also frequently lacking
- There is a high frequency of look-alike species within the relevant taxa
- Effective taxonomic identification of species in trade (and in finished products containing a mixture of species) is often lacking

More generally, the Trees WG considered that the existence (or not) of the following conditions would impact the making of NDF:

- Political will & long-term commitment
- Human & economic resources
- Availability of accurate data
- Time constraints
- Effective monitoring

6. Summarize the main <u>recommendations</u> which could be considered when making an NDF for this taxonomic group.

It is recommended that a Scientific Authority be in place with expertise in the taxa concerned.

Consult the range of expertise available, including other range States and their experience with NDF.

Use available tools (e.g. species, trade and other databases on the CITES website, among others).

Encourage capacity building (including e-learning tools) focused on training & long-term development of Scientific Authority expertise

Promote research on:

- Population parameters considered basic to evaluating harvest impacts
- Silvicultural practices for reducing impacts and fostering post-harvest population recovery
- Monitoring systems for verifying management practices and chain-of-

custody and conservation measures Training in species identification
7. Useful references for future NDF formulation. See references included in the case studies

NDF WORKSHOP CASE STUDIES
WG 1 – Trees
CASE STUDY 1
Gonystylus bancanus
Country – **MALAYSIA**
Original language – English

RAMIN (*GONYSTYLUS BANCANUS*) IN MALAYSIA

AUTHOR:
Lillian Swee Lian Chua
Forest Research Institute Malaysia (FRIM). This document is prepared only for *Gonystylus bancanus* found in Malaysia. There is no stocking data and hardly any biological information available for other species, apart from the geographical distribution. All other *Gonystylus* spp. are dryland species and these are managed according to the Selective Management System (SMS) as outlined below.

I. BACKGROUND INFORMATION ON THE TAXA

1. BIOLOGICAL DATA

1.1 Scientific and common names

Gonystylus bancanus (Miq.) Kurz (Thymelaeaceae). Common name: ramin. Vernacular names: Indonesia: gaharu buaya, medang keladi. Malaysia: melawis.

1.2 Distribution

Its phytogeographical region comprises Sumatra, Peninsular Malaysia (Johore, Pahang, Selangor and Terengganu), Sabah, Sarawak (Malaysia), Brunei and Kalimantan (Indonesia) on the island of Borneo. As can be seen, its phytogeographical distribution is continuous. Since the species is somewhat restricted to peat swamp forests, its geographical distribution within Malaysia naturally follows the location of swamp forests (Fig. 1). In Sarawak, the mixed swamp forest is the most extensive of the five peat swamp forest types (Lee & Chai 1996).

In 2005, the size of peat swamp forests (PSF) in Peninsular Malaysia was estimated to be 300,000 hectares (ha) while that of Sabah and Sarawak were 120,000 ha and 940,000 ha, respectively. In Peninsular Malaysia, the largest peat swamp forest lies in the state of Pahang (200,000 ha; Anon 2008b) followed by Selangor (76,134 ha in 2005).

A 2004 land use map showed fragmentation within the Selangor and Pahang peat swamp forests as a result of various land developments. Wong (2005) similarly reported a large degree of fragmentation within PSFs in Sarawak.

1.3 Biological characteristics

1.3.1 *General biological and life history characteristics of ramin*

Gonystylus bancanus is reported to flower and fruit regularly in the primary PSF in Pekan Forest Reserve (FR), Pahang, Peninsular Malaysia (Shamsudin & Ng 1995, Shamsudin 1996). In her work at the same location, Nurul Huda (2003) noted that there was flowering activity followed by fruiting throughout the 19 months' observation period spanning February 2000 to August 2001 with no clear indication that drought or the onset of drought triggered flowering. This result contrasted with that of Dibor (2005) who showed that, during 2002-2003, ramin in Lingga (Sri Aman) and Naman FR (Sibu), Sarawak had an irregular flowering season with one heavy fruiting season followed by sporadic or no fruiting in the following years.

Dibor (2005) reported that the period from flowering to fruit development and ripening was about 3-4 months. Predation by birds, flying foxes, squirrels, hornbills, monkeys and other mammals occurred throughout the stages of fruit development while fallen seeds were eaten by tortoises and catfish that inhabit patches of shallow stagnant water. Seed batches collected from the 1994 fruiting episode in Pekan FR had 63% germination with the earliest germination taking place 9 days after sowing; germination is hypogeal type with non-emergent cotyledons (Shamsudin 1996). Germination on the forest floor during the same period was poor due to rapid insect and fungal infestation. Seedling regeneration on the forest floor, observed from 1992 to 1996, was also poor. This was attributed to the high predation on young and immature fruits on trees by bats and squirrels, predation on freshly germinated seedlings (Dibor 2005), and poor forest floor germination (Shamsudin 1996). These observations and results contradicted those of van der Meer *et al*. (2005b) who noted abundant regeneration where remnant ramin trees had developed into new seed trees.

Lee *et al*. (1996), Truong (2005) and van der Meer *et al*. (2005b) showed that seedlings and saplings are relatively shade intolerant, surviving better and growing most rapidly in partial sunlight. This result is supported by Ismail (2001) who showed that ramin planted in an open, *Imperata cylindrica*-dominated, regularly burnt peat swamp area in Compartment 101, Raja Musa FR, Selangor had 73.4% survival eight months after planting using the open planting method. A study conducted in areas that had been logged 20 years ago in Naman FR and Batang Reserve (Sarawak) showed that seedling survival rate in the first year was 92–94% (Palmer 1971). These results support the feasible option of planting ramin on a large scale in heavily degraded peat swamp areas.

The mean relative growth rate recorded for seedlings of initial height 10 to 200 cm in a primary 5-ha plot in Compartment 156, Pekan FR was 0.56 cm year^{-1} (Nurul Huda 2003). Plants observed six years after planting in an open, non-peat swamp area had a mean diameter increment of 0.8 cm year^{-1} and height increment of 52 cm year^{-1} (Shamsudin & Ismail 1999). In an enrichment planting in Kalimantan, seedlings were reported to have an average height growth of 12.5 cm year^{-1} and annual diameter increment of 0.5–0.7 cm among young trees, attaining 1 cm under optimal conditions (Soerianegara & Lemmens 1993). These results indicate that under natural primary forest conditions, seedlings and saplings can be expected to grow relatively slowly.

A study on the regeneration pattern of ramin in a 5-ha plot in Compartment 156, Pekan FR showed that mean density of seedlings was highly concentrated in the vicinity of adult trees with the highest mean occurring within 10 m radius from the tree (Nurul Huda 2003). Shamsudin (1996) also showed that individuals in size class 5-10 cm dbh had a tendency to clump near mother trees. The inference that ramin has a limited seed dispersal is supported by Dibor (2005) who observed that seeds dispersed by mammals were taken a very short distance from the mother trees. However, no such relationship was reported for ramin in Lingga (Sri Aman, Sarawak) (Truong 2005, Kunne 2005). Kunne (2005) in his work on ramin at Lingga, situated between the Batang Lupar and Batang Lingga Rivers in Sarawak, showed that the distribution pattern of seedlings and saplings around eight mother trees demonstrated no significant difference between distances from mother tree to seedlings and from mother tree to saplings. There were no significant differences in the density at different distances from a mother tree. Analysis of the distribution patterns using a complete spatial random test showed that seedlings had a cluster distribution and saplings a random distribution. Only a small number of seedlings survived and developed into saplings. A similar distribution trend was observed by Shamsudin (1997). Understanding clumping patterns is important to management as the impact of harvesting would be greater on clumped individuals if harvesting is not closely supervised. Individuals clumping at shorter distances from seed trees would be more prone to damage (Shamsudin 1997).

The Fourth National Forest Inventory (NFI 4), conducted in Peninsular Malaysia between 2002 and 2004, provides *G. bancanus* stocking estimates in the virgin, logged-over and stateland PSFs (Table 1; Anon 2008a). 40.7% of the total number of trees were between 15-30 cm diameter at breast height (dbh), 30.4% were between 30-45 cm dbh, and 28.9% were >45 cm dbh. The estimated timber volume for trees >45 cm dbh was 70.3% of the total volume (Table 1).

A study on the population structure of ramin within a 5-ha plot in a primary PSF showed that density of individuals declined rapidly from size class 1-10 cm to size class 10-40 cm dbh but increased in the 40-60 cm dbh size class before declining again in higher dbh classes. Very few individuals attained 100 cm dbh. The density of individuals above 40 cm dbh was 4 trees per ha and the total volume was estimated at 12.7 m3 ha-1 (Shamsudin 1997).

Table 1. *Gonystylus bancanus* stocking in virgin, logged-over and stateland PSFs.

Forest Class	Diameter Class 15–30 cm		Diameter Class 30-45 cm		Diameter Class >45 cm		Total	
	Stems	Volume (m^3)	Stems	Volume (m^3)	Stems	Volume (m^3)	Stems	Volume (m^3)
Virgin PSF	211,029	111,994	284,893	330,692	369,520	1,515,645	865,442	1,958,331
Logged over PSF	405,205	136,849	178,921	150,079	70,095	214,886	654,221	501,814
State land PSF	5,699	3,487	0	0	1467	4744	7,166	8,231
Total	**621,933**	**252,330**	**463,814**	**480,771**	**441,082**	**1,735,275**	**1,526,829**	**2,468,376**

Source: Anon 2008a

In a more specific example, the Malaysia/UNDP/GEF project (2001-2006) showed that ramin in the *Gonystylus-Calophyllum* subtype in Pekan FR represented an average volume of 40.1 m^3 ha^{-1} for size classes >50 cm dbh (Blackett & Wollesen 2005). In this subtype and Koompassia-Gonystylus-Durio subtype, the volume is concentrated in the larger diameter classes, which would be expected in a mature natural forest. The estimated number of ramin trees according to dbh classes and forest subtype is given in Table 2.

Table 2. Number of ramin trees per hectare by diameter class and forest subtype.

Forest subtype	Diameter Class (cm)				
	15-29	30-44	45-59	60-74	75+
Gonystylus-Calophyllum	0	8.1	9.6	4.6	0.4
Koompassia-Gonystylus-Durio (MXD-1)	1.9	1.4	3.5	2.4	2.3
Koompassia-Gonystylus-Durio (MXD-2)	2.3	2.8	3.0	1.5	1.1
Litsea-Gonystylus (MDG-2)	15.0	3.3	4.2	1.7	0
Mixed Zone	2.5	3.8	1.3	0	0

In a pre-felling inventory study in the North Selangor PSF, the Malaysia/DANCED project (1997-1999) found that the number of ramin trees per hectare by dbh classes >15 cm dbh, >30 cm dbh and >45 cm dbh were 9.3, 5.4 and 2.9 respectively (Bach 2000).

Analysis of ramin growth in logged-over PSF showed a mean annual dbh increment of 0.57 ± 0.36 cm s.d. (Thai *et al*. 2004). The analysis also showed that highest dbh increment of 0.79 cm was observed for class 30-39 cm. Dbh class <20 cm dbh had 0.40 cm increment while class 20-29 cm had 0.64 cm increment. Increment for classes >40 cm declined to 0.49 cm. Similar trends in mean annual dbh increment have been recorded for Sarawak with lower increment figures (Sia 2005).

Between 1987 and 2001, data from 64 growth and yield plots (YP) established in Sarawak's mixed PSF (logged and silviculturally treated) between the years 1971 and 1987 showed that ramin stocking in the plots had declined (Sia 2005). In 2001, Sia (2005) noted that at most sites, ramin had just one stem ha^{-1} or fewer for the 10-20 cm dbh class. In sites such as Naman FR, Pulau Bruit FR, Simunjan FR and Sebuyau FR, the number of trees in the 30-50 cm dbh class was double the number in the 10-30 cm dbh class. Volume was correspondingly reduced drastically, e.g., Batang Lassa PF saw a volume reduction of 90% between 1964 and 1976. The volume of ramin from YPs ranged from 0.9 to 30.1 m^3 ha^{-1} (Table 3). A similar reduction was recorded more recently by Tan (2008). He noted that in the unlogged transects at Sebuyau PF, only one tree per ha was recorded in the size class >10 cm dbh. Saplings in these transects had an average dbh of 1.66 cm.

Table 3. Ramin density and volume at each locality at the first assessment in or after 1986.

Locality	Ramin density		Volume (m^3ha^{-1})	%Total
	Stem/ha	%total		
Pulau Bruit PF	21	2.3	28.4	43.4
Naman FR	24	3.0	27.1	21.0
Simunjan FR	16	2.0	30.1	48.5
Triso PF	2	0.2	5.8	6.9
Sebuyau PF	14	1.4	27.0	33.8
Saribas FR	3	0.5	6.4	7.8
Daro FR	6	0.6	8.2	9.6
Tatau PF	19	1.7	5.5	4.4
Batang Lassa PF (YPs 30-36)	4	0.7	1.7	2.4
Loba Kabang PF	2	0.2	2.7	6.4
Bawan FR (YPs 43-48)	8	0.7	6.6	15.1
Bawan FR (YPs 65-72)	4	0.4	3.8	8.1
Batang Lassa PF (YPs 73-79)	7	0.7	2.9	8.8
Retus PF	1	0.1	0.9	3.4

Source: Sia 2005; PF = Protected Forest; FR = Forest Reserve

Although the difference was statistically insignificant, the mean annual dbh increment during 1987-2001 for trees >30 cm dbh in disturbed YPs was 0.44 cm yr^{-1} compared to 0.29 cm yr^{-1} from relatively undisturbed YPs (Sia 2005). Mean dbh increment peaked in the 30-40 cm dbh class where the mean was 0.45 cm yr^{-1}, three times the rate in size class 10-20 cm dbh (0.16 cm yr^{-1}).

Ramin in relatively undisturbed plots had a mean mortality rate of 1.1% ha^{-1} yr^{-1}. About a third each of this mortality occurred in the 10-20 cm and 40-50 cm dbh classes, respectively (Sia 2005). Harvesting activities were not thought to be factors leading to mortality. Of the fourteen YP sites, mortality exceeded recruitment in eleven sites. At these sites, mortality rates exceeded recruitment rates by two times or more.

Tan (2008) noted that in Sedilu FR, regeneration about 30 years after harvesting was poor. Ramin individuals were present in only five of the eight transects and in four of these (one unlogged), there were no trees >10 cm dbh. In addition, the number of seedlings <1 cm dbh was not significantly larger than the number of saplings (1-10 cm dbh). Clearly, ramin in these transects can be expected to have very limited or hardly any reproductive activity in the medium term as there are no trees >10 cm dbh to act as source mother trees. The population dynamics of ramin showed that the low number of trees in the smaller dbh classes would not be sufficient to replace larger trees by in-growth (van der Meer *et al*. 2005b). Tan (2008) and van der Meer et al. (2005b) attributed the loss of mother trees to the low diameter cutting limit and the change in the manner of harvesting PSF species.

1.3.2 *Habitat types*

The species is mostly restricted to the tropical lowland peat swamp forests. In Sabah and Sarawak, it occurs in the mixed peat swamp forests. It is rare in the lowland freshwater swamp and heath forests up to 100 m altitude. In a study on soil nutrients, a positive relationship was found between percentage nitrogen in the soil and the presence of ramin (Truong 2005). This is consistent with the findings of Tuah *et al.* (2000).

1.3.3 *Role of the species in its ecosystem*

The role of the species in unknown but the role of PSF in maintaining the hydrological and substrate balance and overall ecological integrity of the forest ecosystem is well recognised and documented.

1.4 Population

1.4.1 *Global Population size*

The Peninsular Malaysian data is insufficient to extrapolate the global population size of the species since little is known about the regeneration pattern and size class distribution within the larger extent of PSFs in Sumatra and Borneo.

1.4.2 *Current global population trends*

The population is decreasing.

1.5 Conservation status

1.5.1 *Global conservation status (according to IUCN Red List)*

VU A1cd (2007)

1.5.2 *National conservation status for Malaysia*

VU A4c (2007)

1.5.3 *Main threats within Malaysia*

Habitat Loss/Degradation (human induced) and associated threats such as fire, presence of drainage and irrigation canals and long-term intrinsic factors resulting from the alteration of hydrological regimes, etc. Other threats include unsustainable harvesting of its resources and the presence of canals for log transport.

2 SPECIES MANAGEMENT IN MALAYSIA

2.1 Management measures

2.1.1 *Management history*

Harvesting in the production forests of the Malaysian PSFs follows the Selective Management System (SMS). SMS was established in 1978 to recognize the importance of a balance between harvesting sustainability and long-term conservation. It was also designed to achieve harvesting sustainability with minimum development costs and optimise harvesting under prevailing conditions. All production forests of the Permanent Reserved Forests (PRFs) in Peninsular Malaysia are managed through the SMS. Details of this system were progressively improved to incorporate Reduced Impact Logging (RIL) (see 3.2.1) and independent third party certification of Permanent Reserved Forests (PRFs). This system is currently intertwined with the Malaysian Criteria and Indicators for Forest Management Certification, a market-linked tool to promote and encourage sustainable forest management as well as to provide assurance to buyers that the timber products they purchase come from sustainably managed forests. Prior to the SMS, Malaysia practised the Malayan Uniform System whereby the mature commercial trees in a primary forest were cleared in a single felling followed immediately by systematic silviculture treatments to release natural regeneration obtained from advanced growth (Wyatt-Smith 1995).

No harvesting is permitted in areas gazetted as Totally Protected. Areas gazetted under total protection include, among others, Virgin Jungle Reserves, Class 1 forests, water catchment areas (e.g. Batang Jemoreng PF, Setuan FR, Balingian FR and Batang Lassa PF in Sarawak), areas above 1,000 m elevation, National Parks (e.g. Mt. Kinabalu, Maludam, Loagan Bunut and Taman Negara National Parks), State Parks and Wildlife Reserves and Sanctuaries.

2.1.2 *Purpose of the management plan in place*

The ultimate aim of SMS is to ensure sustainable management and harvesting of finite resources with conservation of the habitats' biological diversity and controlled damage to the ecosystem.

2.1.3 *General elements of the management plan*

The Selective Management System (SMS) stipulates that harvest quotas be set annually (annual coupe). This quota is determined for every five years by the National Forestry Council which is chaired by the Honorable Deputy Prime Minister. The allocation of the annual felling coupe for the Permanent Reserved Forests (PRFs) is based on forest inventory data, net area of production forest, and prescribed silvicultural management practices. For the period 2006–2010, the annual coupes for the PRFs in Peninsular Malaysia, Sabah and Sarawak, including all dryland and wetland forest types, have been set at 36,940 ha, 60,000 ha and 170,000 ha respectively, which are about 1.2%, 2.0% and 2.8%% of their respective production forest areas. Annual coupe is calculated based on harvestable production area; the annual volume to be removed should be less than or equal to mean annual increment.

In Malaysia, the cutting cycle under SMS (otherwise known as forest harvesting rotation) is approximately 30 years with an expected net economic outturn of 40-50 m^3 ha^{-1}. Growth rates, residual stand, and the required final stand determine the length of the cutting cycle. Higher growth rates and residual stand content are expected to lead to shorter cutting cycles and higher annual coupes (Thang 1988). With respect to PSFs and ramin, the cutting cycle is extended to between 40 to 60 years. The rotation period used to determine the harvest quota for ramin is 50 years.

SMS adopts a selective cutting approach based on minimum diameter limit. Different minimum cutting limits are applied for different timber groups. For example, *Neobalanocarpus heimii* (Dipterocarpaceae, *chengal*) has a cutting limit of 60 cm dbh, other dipterocarp species are harvestable at 50 cm dbh, while non-dipterocarps are cut at 45 cm dbh. Ramin, which is included in the non-dipterocarp group, has a minimum cutting limit of 45 cm dbh in Peninsular Malaysia. Pahang State however sets the prescribed cutting limit even higher at 50 cm dbh. In general practice, trees of a much higher diameter (>70 cm dbh) are removed. Sarawak operates on an empirical harvesting period rotation of 45 years with a minimum cutting diameter of 40 cm dbh.

The State Forestry Department is required to prepare and implement a 10-year Forest Management Plan, a 5-year Forest Development Plan and an Annual Forest Operation Plan. These plans provide guidelines for the management, conservation and sustainable development of forest resources in the State and Districts. Apart from these Plans, a specific management plan has been prepared for the PSFs of Selangor, southeast Pahang, Loagan Bunut (Sarawak) and Klias Peninsula (Sabah). The integrated management plan for Selangor was prepared in collaboration with DANCED (1999; Bach 2000); southeast Pahang (Anon 2008b), Loagan Bunut (Anon 2007a) and Klias Peninsula (Anon 2007b) were prepared in collaboration with UNDP/GEF/Danida (2001-2005). A Ramin Technical Report for Sarawak was prepared in collaboration with the Netherlands (van der Meer *et al*. 2005a).

In Sarawak, a forest concession area has a Forest Management Plan which describes how the management unit is to be harvested. Prior to issuing a license, an inventory of the forest area is carried out to determine the minimum diameter cutting limit and annual permissible harvest. A selective diameter cutting system with an empirical cutting cycle of 60 years was revised to 45 years in 1970. The minimum cutting limit for ramin is 40 cm dbh. Within a year of logging, the first silvicultural operation is carried out. This entails poison girdling of defective trees and trees of no commercial value. Sampling of stocking density, species composition and degree of competition are carried out to determine subsequent silvicultural operations. Following such sampling, YPs are established to monitor stand development and predict the next cut (Lee & Chai 1996).

2.1.4 *Restoration or alleviation measures*

Several restoration trials have been undertaken in Peninsular Malaysia (Ismail *et al*. 2007). Trials in secondary PSFs in Selangor showed that line planting with a maintenance of planting lines once every three months gave better results in terms of ramin survival and basal diameter increment compared to open planting. Survival was 81% nine months after planting and average basal diameter increment was 0.5 cm. Total height increment was 8.9 cm. Similar restoration trials in Pahang PSFs had 72% survival three months after planting. Restoration trial in recently logged forest (c. two years) in Pekan FR showed a large degree of variation in survival percentage ranging from 61 to 82%. Causes of mortality included tree fall and drought.

The first *in situ* PSF gene bank was established in the Klias Peninsula, Sabah. Six gene bank plots, i.e., four at Luagan and two at Tamalang Along, were established in 2005.

There have been no other specific restoration measures taken for ramin apart from the above. Several of the recommendations made in the integrated management plans have been adopted by the respective States. These recommendations mainly pertain to issues regarding ecosystem functioning and environmental quality. Examples are the development of an integrated database management system, preparation to gazette stateland PSFs in Sabah, the initiation of two pilot community-based conservation initiatives promoting protection of peatland (Anon. 2007b), and the classification and zonation of the southeast Pahang PSFs and area consolidation (Anon 2008b).

2.2 Monitoring system

2.2.1 *Methods used to monitor harvest*

Subsequent to the identification and approval of areas to be licensed for harvesting, several operations are necessary before the license can be issued (Table 4). In this regard, the boundary earmarked for logging is marked, checked and approved on the ground. A pre-felling inventory with 10% sampling intensity using systematic line plots is carried out one to two years before harvesting to collect information on trees of all sizes from seedlings to mature trees. The results of the pre-felling forest inventory are analyzed and based on the prescribed cutting limits for the different groups of trees, all trees to be felled are marked and its felling direction determined. Trees that cannot be logged are also marked, including mother trees, protected trees and trees along the boundary of buffer strips. The residual stand after harvesting should contain at least 32 sound trees per hectare of class 30-45 cm. Tree marking is implemented to control output and prevent illegal felling and excessive removal from the timber stand.

Table 4. SMS: sequence of operations practiced in Peninsular Malaysia.

Year	Operation
n-2 to n-1	Pre-felling forest inventory of 10% sampling intensity using systematic line plots to determine appropriate cutting limits (cutting regimes)
n-1 to n	Tree marking incorporating directional felling • Marking of trees to be felled • Marking of seed/mother trees • Marking of protected trees • Marking of trees for road construction • Demarcating boundary of buffer zones for permanent watercourses
n	Felling of trees
n1/4 to n 1/2	Forest survey to determine damage to residuals and royalty on short logs and tops
n+2 to n+5	Post-felling forest inventory of 10% sampling intensity using systematic line plots to determine residual stocking and appropriate silvicultural treatments
n+10	Forest inventory to determine regeneration status of the forest

It has been the practice of the Department to conduct monthly monitoring of forest harvesting operations to prevent over-cutting in the licensed area and thus violating one of the principles of sustainable management. The procedures for monitoring harvesting operations are regularly updated to strengthen the monitoring process in order to minimize the loss of forest biological diversity during harvesting and decline in environmental qualities. At the completion of the harvesting operation, a closing report is required. The procedures for monitoring harvest operations are contained in the document entitled 'Checking and Monitoring Forest Harvesting', while those for the preparation of the Closing Report on forest harvested are contained in 'Preparation of Closing Report on Forest Harvesting'. Each document outlines the steps to be taken and indicates the people responsible for implementation.

2.2.2 *Confidence in the use of monitoring*

As can be seen, the forest harvesting plan is based on projections of growth and yield and regeneration patterns. The accuracy of data and projections of the ability of the forest to grow is crucial in the formulation of sustainable forest management. To assess population dynamics and develop population projection models, the Forestry Department has established two types of permanent sample plots (PSPs) to monitor growth parameters and study the response of forest growth under various cutting options with respect to stocking density of healthy residual trees, growth, mortality and recruitment rates. These PSPs are designated as growth plots and growth and yield (YP) plots. Growth plots are established in logged-over forest areas of varying ages to monitor the growth of harvested forests, while growth and yield plots are established in areas which have been harvested based on pre-determined cutting regimes to enable the Department to study the responses of forest growth under various cutting options. For the PSFs in Peninsular Malaysia, two growth plots in Sungai Karang FR, Selangor were established in 1993-1994. These plots monitor the growth of residual trees in logged-over PSFs. Two more PSPs were subsequently established and monitored, one each in the state of Pahang and Selangor. Periodic remeasurement in these PSPs will continue indefinitely. In Sarawak, 64 YPs were established between 1971 and 1987 (see section 1.3.1).

2.3 Legal framework and law enforcement

In Malaysia, the National Forestry Policy 1978 laid the foundation for the development of the forestry sector. It was revised in 1992 in recognition of the role of forests in providing a multiplicity of goods and services. The revised policy has had direct impacts on the management of forests through the establishment of permanent forest estates (PFE), large-scale forest plantations, importation of logs, greater incentives for downstream processing, promoting the utilization of lesser-known species and small-diameter logs, and manufacturing of value-added products. The Policy and the National Forestry Act 1984 provide Malaysia with a strong policy framework and legislation to support sustainable forest management. Both the Policy and Act provide a sufficient basis for protection against harmful activities, promote establishment of wildlife parks and reserves, and reduce activities that may cause detrimental impacts to the environment. Apart from these, there are many other policies, Acts, Enactments and Ordinances that indirectly affect the management and harvest of ramin in Peninsular Malaysia, Sabah and Sarawak.

In Peninsular Malaysia, the National Forestry Act 1984 was amended in 1993 to tighten the provisions and measures to safeguard and protect forest resources. With respect to encroachment and illegal logging, the penalty for the commission of any forest offence has been increased from the maximum penalty of RM10,000 (± US$2,940) or imprisonment for a term not exceeding three years or both to a maximum penalty of RM500,000 (± US$147,060) and imprisonment not exceeding 20 years with a mandatory imprisonment of not less than one year. The amended Act has also enacted provisions for the Police and Armed Forces to undertake surveillance of forestry activities to curb illegal logging, encroachment of forest areas and timber theft. This provision has proven to be very successful in slowing illegal logging activities and timber theft. In 2000, Malaysia reported a decline in the average number of illegal logging over recent years. In this regard, Malaysian forestry statistics (trade reports) are widely recognized as among the strongest in the tropics (Johnson 2003).

The International Trade in Endangered Species Act 2008 [*Act 686*] passed by the Parliament on 24 December 2007 provides for the administration and management of international trade in endangered species to ensure that the trade does not threaten the survival of any species of wild fauna and flora. The Act shall be gazetted soon and regulations are being drafted to ensure its smooth implementation.

As mentioned in section 2.1.1., no harvesting is permitted in areas gazetted as Totally Protected.

Long before ramin was listed under Appendix II, Sarawak imposed several restrictions to control its harvest and trade. The Ramin Logs Prohibition of Export Order 1980 and the Ramin Shorts and Ramin Squares Prohibition of Export Order 1991 were proactively enforced. These Orders attempt to minimize wholesale export of unprocessed logs and encourage more local downstream processing. As required by

CITES, export permits were issued by the relevant authorities in addition to an export license issued by the Controller of Wild Life, Schedule of Timber Shipment and Sales Contract. Further nation-wide measures such as the administrative ban on imports of all types of logs and large squares and scantlings (LSS) from Indonesia have been put into place since 2002 and 2003, respectively. The ban was later incorporated into the Customs Prohibition (Amendment) Order 2006; it is now an offence to import Indonesian logs and LSS into Malaysia. Particularly for Sarawak, only five entry points have been authorized for timber products to ensure effective monitoring and control of log movements to and from the state. Authorization of imports is subjected to valid documentation such as the Indonesian transport permits (SKSHH) and customs documentation (PEB).

In Sabah, the Sabah Forest Enactment 1968 (amended 1992) provides the empowerment instrument in forest resource management. Section 5 of the Enactment outlines the establishment of different forest classes, several of which are given totally protected status.

At the regional level specific to ramin, Malaysia, Indonesia and Singapore, through the Tri-National Task Force on Ramin, are attempting to curb the trade of illegal ramin. Close cooperation between Management Authorities, Scientific Authorities, Customs, enforcement agencies, trade and foreign affair-related Ministries at the national and regional levels ensure an efficient and effective networking. Malaysia has also established MY-WEN in support of the ASEAN Wildlife Enforcement Network (ASEAN WEN) initiative.

3 UTILIZATION AND TRADE FOR MALAYSIA

3.1 **Type of use** (origin) **and destinations** (purposes)

Ramin timber is widely used to make decorative cabinets, furniture, and interior decoration such as wall panelling, light flooring, door and window frames, mouldings, skirtings, ceilings, partitions, stair treads and counter tops. Ramin is also used to make toys, turnery, broom handles, venetian blind slats, dowels, picture frames and drawing boards. Ramin is suitable for veneer, plywood and blockboard manufacture. However, the timber is susceptible to decay and can only be used indoors. The resin is used by local communities as incense, while pounded fruits are used to poison fish. A concoction of roots is administered after childbirth.

Major importing countries include the USA, Europe, Japan, Australia and Taiwan. All derivatives are obtained from wild specimens.

3.2 Harvest

3.2.1 *Harvesting regime*

As can be seen from section 2.1.3, the cutting limit for ramin applied in Pahang is much higher than the one prescribed for the entire country. This cutting limit is currently being reviewed in a study in Pahang PSF. In addition, at least 32 sound commercial trees per hectare for diameter classes of 30 cm dbh and above should be retained.

Following the tree marking exercise (see 2.2.1), a forest harvesting plan is prepared. The plan also contains a map showing pre-determined feeder roads (railways or canals) and skid trails to be constructed to comply with various specified guidelines. Once the forest harvesting plan is approved by the Department and the premium paid by the license holder, a forest logging license is issued and harvesting commences.

Reduced Impact Logging (RIL) is the implementation of a collection of forest harvesting techniques that results in lowering the level of damage to residual trees and environmental quality. Harvesting in the PSFs is carried out using traxcavator and canal systems. Logs are hauled to the river or main road for transportation to outside landing sites or sawmills. In Pahang, Reduced Impact Logging (RIL) employing a modified excavator with a long arm and cable winching capabilities has been used for several years. This equipment winches logs from a distance of 150 m to the feeder road where they are stacked for transportation. In Sarawak, logging using heavy machinery has replaced the 'kuda-kuda' method, thought to be labor intensive but more environmental friendly (Lee & Chai 1996). A revision of the logging damage factor for peat swamp forest is being looked into as long-haulage machinery that causes less damage to the site and residual trees is introduced. RIL has also been implemented in Sabah (Marsh et al. 1996, Anon 2001) and Sarawak (Jonathan *et al*. 1999).

3.2.2 *Harvest management/control* (quotas, seasons, permits, etc.)

The National Forestry Act stipulates that all movement of logs must be accompanied by a removal pass. The removal pass is issued by the Forestry Department officer as proof that all fees have been paid and that the logs were harvested from licensed area. This paper-based system is one of the control mechanisms in place to monitor harvesting operations and the movement of logs. To enhance ramin conservation through stricter harvesting control, logs of *Gonystylus bancanus* are to be recorded at the species level in the removal pass.

Malaysia also subscribes to the permit requirement of CITES.

3.3 Legal and illegal trade levels

The ramin export quota for Peninsular Malaysia and Sabah in 2007 was 20,000 m^3; the quota was 3,178 m^3 for Sarawak. About 6,394 m^3 of ramin products, parts and derivatives were exported from Peninsular Malaysia and 5,674 m^3 of sawn timber and 4,319 m^3 in dowel/moulding from Sarawak in 2007. Products exported consist of sawn timber (35%), dressed timber (25%), picture frames (15%), mouldings (10%), baby cots (10%) and various products of finger-jointed S4S, venetian blind, baby crib, louver doors, wood frame, basinet and furniture (5%). The reduction in export was due to the temporary suspension of export to the European Union and Australia. The EU ban was subsequently lifted on 07 December 2007 while the Australian ban is still in effect.

II. Non-detriment finding procedure (NDFs)

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

_X_ Yes ___No

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED.

The criteria, parameters and/or indicators used to make the non-detriment finding for *Gonystylus bancanus* are:

- habitat preference to peat swamp forests;
- extent of the PSF areas and demarcation of PSF into areas belonging to the State and areas under private ownership;
- density and demography of populations in various Permanent Sample Plots (PSPs), Growth and Yield Plots (GYPs), and plots laid out for national forest inventories (NFIs);
- flowering phenology and reproductive behaviour;
- germination, seedling and sapling establishment, growth rates in primary and logged-over areas;
- annual coupe and harvesting regimes/limits employed under the Selective Management System and Sustainable Forest Management;
- suitability of the Reduced Impact Logging (RIL) method; and
- pattern and level of exploitation for international trade.

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

The main sources of data for NDF are data from the Third and Fourth NFIs, PSPs, GYPs, academic research, pre- and post-felling inventories in targeted areas. These are sample-based and field-evaluated. For the plots established under PSP, GYP and NFI, the published data is data that has been analysed. National Forest Inventories are conducted only for Peninsular Malaysia. See literature cited.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT.

The evaluation of data quantity and quality for the assessment of *G. bancanus* NDF is fairly good because data quantity, particularly with respect to growth and yield and harvest management, is not lacking. However, biological aspects such as reproductive capacity and natural regeneration patterns in primary and disturbed PSFs are not sufficiently enumerated. Quality of current analysis and assessment may be somewhat compromised due to the loss of long-term data resulting from factors such as the loss of PSPs.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF.

As can be seen from this example, Malaysia has had for many decades a long-term commitment of political will, financial resources and the use of forestry technologies to ensure that its forest resources are sustainably managed. To embark on a similar scale for any taxa in the Appendices is indeed an uphill task.

The elaboration of an NDF for *G. bancanus* is, to Malaysia, a straightforward process. The taxonomy of the genus *Gonystylus* is well defined and morphological characters are reliable. What makes this process complicated is that the trade in timber is undertaken by groupings and not by species. Apart from the use of sophisticated fingerprinting methods, resource-intensive tagging systems, and or the on-site monitoring of harvests, there is currently no method allowing quick and reliable identification of species used in any timber products.

6. RECOMMENDATIONS

Major importing countries should help finance inventory activities and the formulation and implementation of action plans and management measures in Range States. To ensure a degree of autonomy, the funds should be channelled through the CITES Secretariat.

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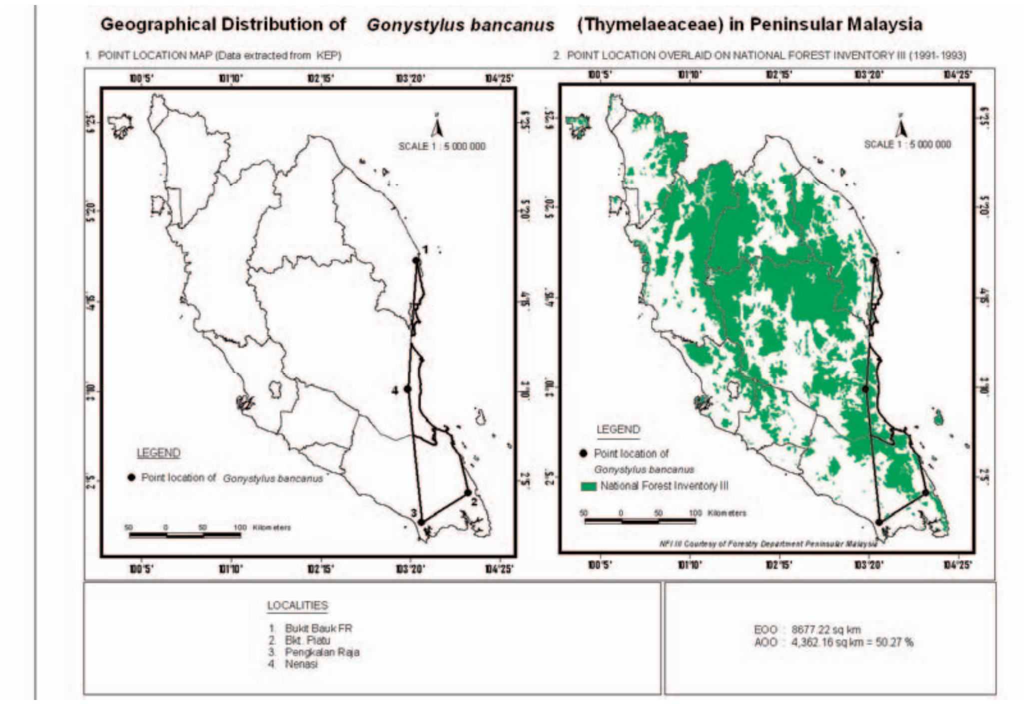
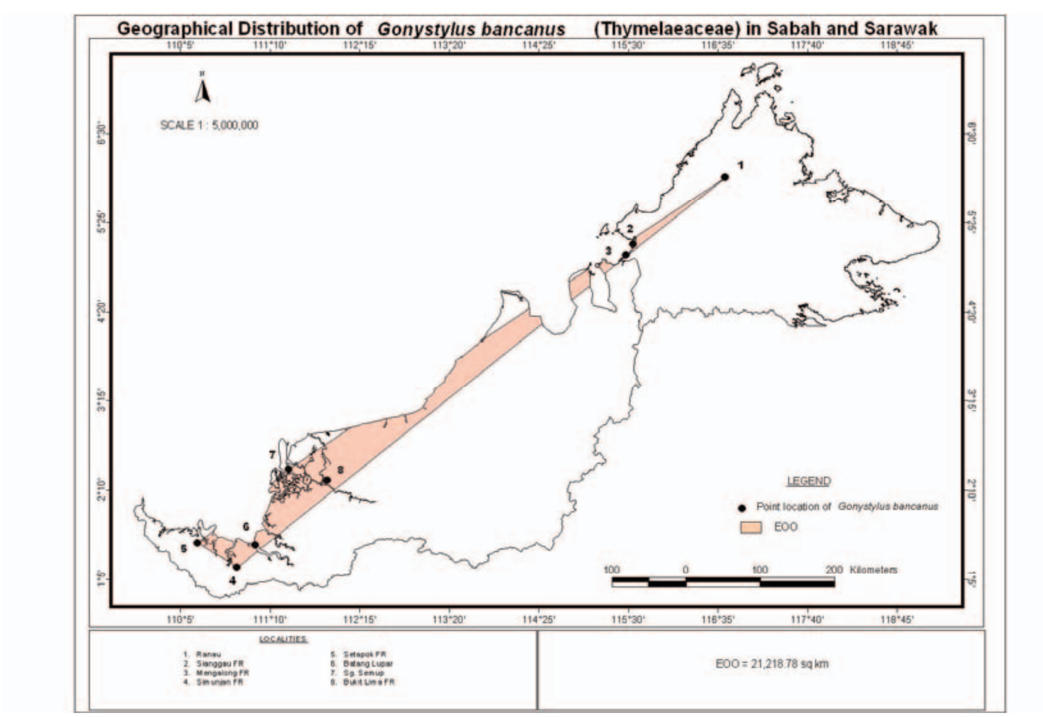
Fig. 1. Geographical distribution of *Gonystylus bancanus* in Malaysia.





NDF Workshop Case Studies
WG 1 – Trees
CASE STUDY 5 SUMMARY
Caesalpinia echinata
Country: Brazil
Original Language - English

Brazilwood (*Caesalpinia echinata*) in Brazil

AUTHORS:
Elena Mejía
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Brazilwood (*Caesalpinia echinata*, Fabaceae) is the national tree of Brazil, where it is commonly known as pau brasil. Extracted since the 16th Century from natural forests, this species is highly endangered. Harvests have been illegal in Brazil since 2001, and the species was included on CITES Appendix II in September 2007. However, exploitation continues due to its extremely dense hardwood ideal for making bows for stringed musical instruments. Estimated annual worldwide demand is approximately 200 m^3.

Brazilwood is a late-secondary canopy tree whose natural habitat is mainly semi-deciduous seasonal forests occurring on sandy marine soils of Brazil's coastal Atlantic Forest (Mata Atlântica) between Rio Grande do Norte and Rio de Janeiro. Despite its high profile, little information exists regarding Brazilwood's ecology and life history, with limited data available on distribution, species variation, and population size. It is a medium-sized tree, semi-deciduous, and slow-growing.

The main threats to Brazilwood are deforestation and illegal logging for exports. Deforestation of the Mata Atlântica has been accelerated by urban sprawl, agriculture and timber harvesting. Some regions have suffered considerable impact in recent years through tourism development. Detailed figures on the proportion of deforestation in the remaining forest areas where *C. echinata* occurs are unavailable.

Principal importing nations include the United Kingdom, France, Germany, China, Switzerland, Korea, Japan and the USA. Within this importers framework the International Pernambuco Conservation Initiative (IPCI) was created. The IPCI has supported the 'Pau-Brasil Program' through CEPLAC (Executive Commission of the Cocoa Planting Plan) with assistance from IBAMA (the CITES Management and Scientific Authority in Brazil) and the Rio de Janeiro Botanic Garden since 2004. The Program's objectives include promoting conservation actions, production research, environmental education, and sustainable use of *C. echinata*.

Brazilwood cannot be legally harvested at present. All currently held material should be declared and updated in the Forestry Origin Document. This system is used for monitoring forest-derived products, allowing control of Brazilwood-derived products from point of origin until their export location. Current Brazilwood trade is permitted only for declared material. No possibility exists for approval of management plans for Brazilwood until a range-wide inventory is completed. Timber that is currently available for export was harvested before Brazilwood's Appendix II listing in 2007; these volumes are considered pre-convention.

The extent and quantity of surviving Brazilwood stocks are unknown. According to IBAMA, hidden volumes remain available for illegal trade in spite of legal requirements that timber companies declare quantities of *C. echinata* under ownership. While illegal logging is known to occur, the extent of such practice has not been determined because timber merchants are reluctant to divulge this information.

Brazil does not allow extraction from natural forests and no plantations are known. The Brazilian government recognizes the need for adequate data on surviving natural stocks and other biological information before NDF can be provided. Steps currently underway to obtain the necessary information are outlined in this case study.

Non detrimental Finding Procedures

Gonystylus bancanus (Miq.) Kurz
(Thymelaeaceae)
Ramin

Criteria, parameters and/or indicators

- Phytogeographical patterns and habitat preferences;
- Extent of the PSF areas and demarcation of PSF into areas belonging to the State and areas under private ownership;
- Biological characteristics and life history;
- Current stocking based on sound inventory methods and predicting future stocking using prediction growth models;
- Threats;
- Management system, controls and monitoring;
- Harvesting techniques;
- Conservation;
- Production derived from cultivated sources;
- International trade (consumption and trend).

INSTITUT PENYELIDIKAN PERHUTANAN MALAYSIA
FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)


MAL/UNDP/GEF

Phytogeography

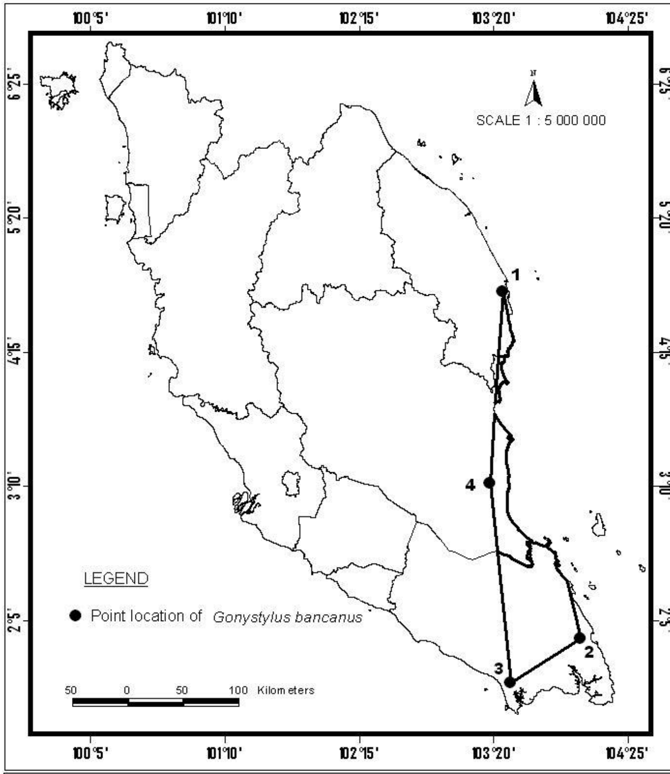
- Indonesia (Sumatra, Kalimantan)
- Malaysia (Peninsular Malaysia, Sabah, Sarawak)
- Brunei

Habitat

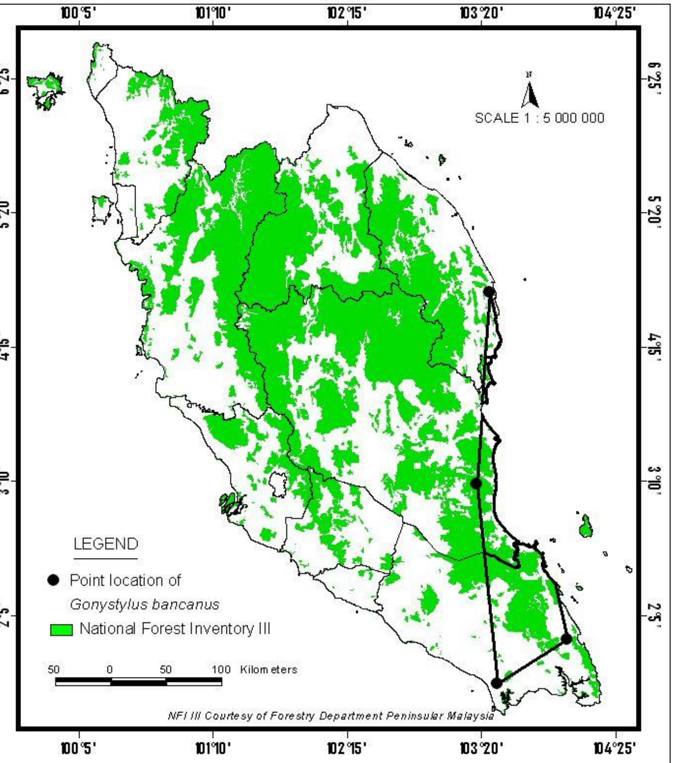
- Tropical lowland peat and mixed peatswamp forest
- Tropical lowland freshwater swamp forest
- Heath forest

Geographical Distribution of *Gonystylus bancanus* (Thymelaeaceae) in Peninsular Malaysia

1. POINT LOCATION MAP (Data extracted from KEP)



2. POINT LOCATION OVERLAID ON NATIONAL FOREST INVENTORY III (1991-1993)

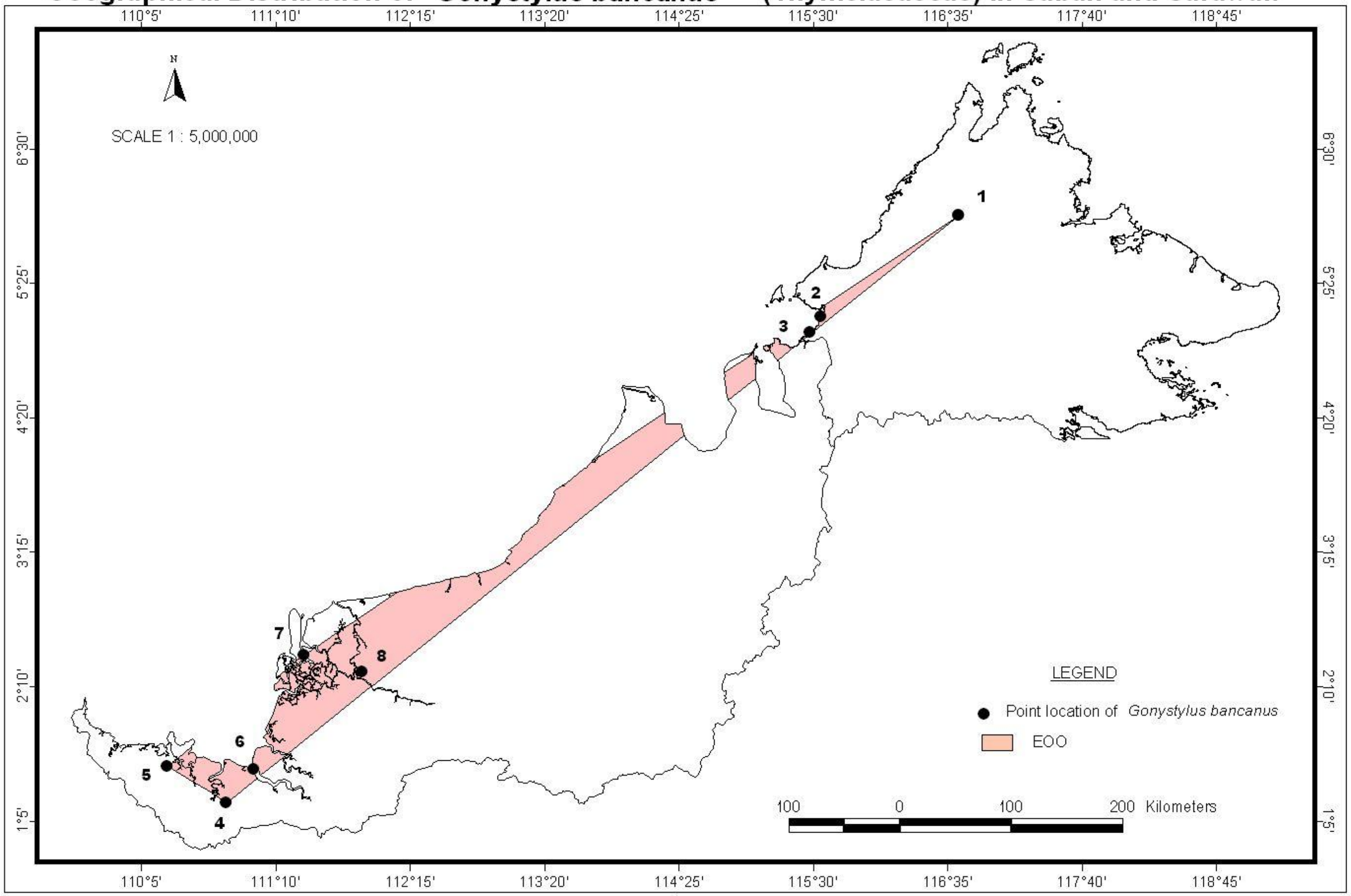


LOCALITIES

1. Bukit Bauk FR
2. Bkt. Piatu
3. Pengkalan Raja
4. Nenasi

EOO : 8677.22 sq km
AOO : 4,362.16 sq km = 50.27 %

Geographical Distribution of *Gonystylus bancanus* (Thymelaeaceae) in Sabah and Sarawak



LOCALITIES

1. Ranau
2. Sianggau FR
3. Mengalong FR
4. Simunjan FR
5. Setapok FR
6. Batang Lupar
7. Sg. Semup
8. Bukit Lima FR

EOO = 21,218.78 sq km

Malaysian peat swamp forests (PSF) in 2005

Estimation

- Peninsular Malaysia : 300,000 hectares
- Sarawak : 940,000 hectares
- Sabah : 120,000 hectares

Main Sources of Data*

- Third and Fourth National Forest Inventories (Peninsular Malaysia),
- Permanent Sample Plots (Growth & Yield Plots, Growth Plots), and
- Academic research.
- Pre- and post-felling inventories in targeted areas.

* These are sample-based and field-evaluated.

Life History

- flowers and fruits regularly in a primary PSF, Pahang. In Sarawak, flowering season is irregular.
- Period from flowering to fruit ripening is 3-4 months.
- Predation occurrs throughout the stages of fruit development and detachment.
- Poor germination on the forest floor.
- Seedlings and saplings are relatively shade intolerant, surviving better and growing most rapidly in partial sunlight.
- Juveniles are concentrated in the vicinity of adult trees indicating that ramin has limited seed dispersal.

Gonystylus bancanus stocking in virgin, logged-over and stateland PSFs

Forest Class	Diameter Class 15-30 cm		Diameter Class 30-45 cm		Diameter Class > 45 cm		Total	
	Stem no.	Volume (m^3)	Stem no.	Volume (m^3)	Stem no.	Volume (m^3)	Stem no.	Volume (m^3)
Virgin PSF	211,029	111,994	284,893	330,692	369,520	1,515,645	865,442	1,958,331
Logged over PSF	405,205	136,849	178,921	150,079	70,095	214,886	654,221	501,814
State land PSF	5,699	3,487	0	0	1467	4744	7,166	8,231
Total	**621,933**	**252,330**	**463,814**	**480,771**	**441,082**	**1,735,275**	**1,526,829**	**2,468,376**

Fourth National Forest Inventory (NFI 4) Peninsular Malaysia

Population Structure

Number of ramin trees per hectare by diameter class and forest subtype in Pekan Forest Reserve, Pahang

Forest subtype	Diameter Class (cm)				
	15-29	30-44	45-59	60-74	75+
Gonystylus-Calophyllum	0	8.1	9.6	4.6	0.4
Koompassia-Gonystylus-Durio (MXD-1)	1.9	1.4	3.5	2.4	2.3
Koompassia-Gonystylus-Durio (MXD-2)	2.3	2.8	3.0	1.5	1.1
Litsea-Gonystylus (MDG-2)	15.0	3.3	4.2	1.7	0
Mixed Zone	2.5	3.8	1.3	0	0

Malaysia/UNDP/GEF project (2001-2006)

- Peninsular Malaysia. Mean annual dbh increment of 0.57±0.36 cm sd. Highest increment (0.79 cm) observed for class 30-39 cm. Classes <30 cm and >40 cm had increments lower than the mean.
- Sarawak. Similar trend with lower increment figures. Ramin has mean mortality rate of 1.1% ha/yr with mortality being highest in 10-20 cm and 40-50 cm dbh classes. Mortality rates were twice or more than recruitment rates in eleven out of fourteen YP sites. Between 1987 and 2001, data from 64 YP established in Sarawak's mixed PSF between the years 1971 and 1987 showed a decline in ramin stocking.

Conservation status

- IUCN Red List : VU A1cd (2007)
- National status : VU A4c (2007)
- Main threats in Malaysia: habitat loss/degradation (human induced), fire, presence of drainage and irrigation canals, long-term intrinsic factors resulting from the alteration of hydrological regimes etc., unsustainable harvesting of its resources.

Management in Malaysia

Selective Management System (SMS) (Peninsular Malaysia)

- Annual harvest quota. Data is acquired through the long-term monitoring of growth parameters and responses of forest growth under various cutting options with respect to stocking density of healthy residual trees, growth, mortality and recruitment rates in permanent sample plots (growth plots and growth & yield plots).
- Cutting cycle of 50 years.
- Minimum cutting limit of 45 cm dbh (50 cm in the state of Pahang).
- Reduced Impact Logging.
- No harvesting permitted in areas gazetted as Totally Protected.

Sarawak

- Forest Management Plan for concession area;
- Minimum diameter cutting limit of 40 cm;
- Annual permissible harvest;
- Cutting cycle of 45 years;
- Silvicultural operations e.g. determining sampling of stocking density, species composition and degree of competition;
- Reduced Impact Logging.

Integrated Management Plans

- PSFs of Selangor, prepared in collaboration with DANCED (1999) (Bach 2000);
- Southeast Pahang, prepared in collaboration with UNDP/GEF/Danida (2001-2005);
- Loagan Bunut (Sarawak), prepared in collaboration with UNDP/GEF/Danida (2001-2005);
- Klias Peninsula (Sabah), in collaboration with UNDP/GEF/Danida (2001-2005);
- Ramin Technical Report for Sarawak, prepared in collaboration with the Netherlands.

Monitoring system used in Peninsular Malaysia

Year	Operation
n-2 to n-1	Pre-felling forest inventory of 10% sampling intensity using systematic line plots to determine appropriate cutting limits (cutting regimes)
n-1 to n	Tree marking incorporating directional felling • Marking of trees to be felled • Marking of seed/mother trees • Marking of protected trees • Marking of trees for road construction • Demarcating boundary of buffer zones for permanent watercourses
n	Felling of trees
n¼ to n½	Forest survey to determine damage to residuals and royalty on short logs and tops
n+2 to n+5	Post-felling forest inventory of 10% sampling intensity using systematic line plots to determine residual stocking and appropriate silvicultural treatments
n+10	Forest inventory to determine regeneration status of the forest

Conservation

- Small fragments of PSFs gazetted under Virgin Jungle Reserves, water catchment areas and National Parks (Maludam and Loagan Bunut).
- Ecosystem conservation as recommended in the Integrated Management Plans.
- *In situ* PSF gene bank in Klias Peninsula (Sabah).
- *Ex situ* conservation as a part of trial planting.

Cultivated sources

None at the commercial scale. Restoration trials only.

Legal Framework and Law Enforcement

- National Forestry Policy 1978 revised 1992;
- National Forestry Act 1984 amended 1993;
- International Trade in Endangered Species Act 2008;
- Ramin Logs Prohibitions of Export Order 1980;
- Ramin Shorts and Ramin Squares Prohibition of Export Order 1991;
- Customs Prohibition (Amendment) Order 2006;
- Sabah Forest Enactment 1968, amended 1992;
- CITES compliance;
- Tri-National Task Force on Ramin (Malaysia, Indonesia and Singapore)

Uses and Trade

- Main products : sawntimber (35%), dressed timber (25%), picture frames (15%), mouldings (10%) and baby cots (10%).
- Main importing countries : Europe, USA, Australia, Japan, Taiwan and Hong Kong SAR.

Export figures for *Gonystylus* (cubic m) (parts & derivatives) between 2004 and 2007

	2004		**2005**		**2006**		**2007**	
	export quota	volume	export quota	volume	export quota	volume	export quota	volume
PM & Sabah	-	46,200		25,569	23,000	11,643	20,000	4,757
Sarawak	-	n.a.	-	19,678	22,000	12,161	12,875	8,306

PM = Peninsular Malaysia

Summary

Non detrimental Finding Procedure (NDFs)

Criteria, parameters and/or indicators used to obtain non detrimental findings are based on :

- Ecological, biological and demographic data.
- Extent of the PSF areas and demarcation of PSF into areas belonging to the State and areas under private ownership.
- Stocking data derived from National Forest Inventories, permanent sample plots, pre- and post-felling inventories, academic research and various other data that produced integrated management plans. These are sample-based and field-evaluated.
- Harvesting controls in place – annual coupe, cutting limit, cutting cycle, retention of mother trees, forest harvesting/management plan, implementation of Reduced Impact Logging, logs accompanied by removal pass, export quota, permit system, forest certification scheme, legal entity and law enforcement.

Cont.

- There is sufficient data to conduct an NDF. Data quantity, particularly with respect to growth and yield and harvest management, is not lacking. Quality of assessment is, to a small degree, compromised because biological aspects, e.g., reproductive capacity and natural regeneration patterns in primary and disturbed PSFs and responses to habitat loss are not clearly understood.
- There is full confidence in the present monitoring system.
- Main problems, challenges or difficulties found on the elaboration of NDF. Challenges are mainly technical in nature e.g. recovery rates and taxon identification in finished products.

Photos courtesy of
Ismail P (FRIM)

Thank you

NON-DETRIMENT FINDINGS REPORT ON *PERICOPSIS ELATA* (FABACEAE) IN CAMEROON

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INTRODUCTION

Pericopsis elata is a leguminosaea species of the Fabaceae family, known under its trade/pilot name as afrormosia or assamela. It is a tree species of the close, Guinean-Congolese forest type. Its natural range is discontinued, with several isolated sub-stands in Ghana, Côte d'Ivoire, South-eastern Cameroon, Northern Congo, the North-eastern portion of the Democratic Republic of Congo, and the South-Western portion of the Central African Republic (CAR).

Pericopsis elata is classified by the World Alliance for Nature (IUCN) as endangered species, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). This decision had a significant impact on the revenues produced from this value timber species in the range countries.

As it is, the species is indeed endangered and has become all but locally extinct in West African countries, including Côte d'Ivoire (*Here, the species is virtually extinct* - Kouassi Amian/CITES management authority of Côte d'Ivoire, personal communication), Ghana and Nigeria, where the exploitation and international trade in this species had begun some 55 years ago. Significant stocks of the species still exist, however, in the Congo Basin, including Cameroon, Congo, and the Democratic Republic of the Congo. In CAR, afrormosia is still hardly used.

In various African countries, policies have been established to ensure the sustainable management of forests having afrormosia stands in them. However, enforcement issues and control problems do persist. The development of clear procedures to deliver Non-Detrimental Findings (NDFs) remains a priority for most producer countries (CITES 2003).

The annual quota of export volume fixed for the Cameroon government is 15,200 m^3, but since 2000, the national export volume has never reached 8 000 m^3 (Akagou 2008). To enhance the sustainable trade of this species, the

Cameroon government has fixed its minimum exploitable diameter at 100 cm, which is the highest in the Congo basin. According to forest companies, *P. elata* is not threatened in Cameroon, its minimum exploitable diameter should therefore be reduced as to allow them to get quality timber from that plant species.

As a response of some questions asked by the CITES, the Cameroon government through its forest administration has produced two main reports (MINEF 2002, 2004a) as to demonstrate that *P. elata* is not threatened in the country. The first report was addressed in 2002, while the second was sent in 2004. No one of these reports has led to the review of the position of the CITES decision on this plant species in Cameroon.

This work aims to gather and analyse data for dressing a Non-Detriment Findings Report on *Pericopsis elata* in Cameroon. The main objectives are to summarize the basic information on this plant species, its management, utilization and trade, and to present a comprehensive description on the procedure followed to make the non-detriment findings for *P. elata*.

The document is prepared to be presented at the International Expert Workshop on CITES Non-Detriment Findings, projected in Mexico, November 17th-22th, 2008. It is divided in two parties: Back ground information on the taxa, and the Non-detrimental Finding procedure.

I. MATERIAL AND METHOD

This section presents the milieu and the method used to draft this report.

1.1. **Study area**

The Congo Basin is one of the two most extensive forest continue at global level, second only to the Amazon basin; it epitomizes the dialectics of conservation and forest use for sustainable development. Because forests provide both a source of income and a life-supporting environment to many peoples, forest use and exploitation and even forest conservation pose more complex challenges.

Cameroon belongs to the Congo basin, it is located at the centre of Africa near the Equator and covers about 475,000 km^2. It totals about 16.5 millions ha of dense rainforests. The flora component (higher plants) has 7,000 species of which 300 are woody plants, ranking Cameroon 4th in Africa after the Democratic Republic of Congo, Tanzania, and Madagascar (MINEF 1995). From South to North, there are various types of tropical rainforests, humid savannah, forest galleries, dry forests, dry savannah, steppes and yaeres. Apart from these natural ecosystems, there are also man-made agro-ecosystems (Letouzey, 1968; 1985). Figure 1 illustrates the main phytogeographical regions found in Cameroon including: the shrubbery steppe in the Far-north province, the wooded savannah in the North province, the forest savannah in the Adamaoua and West provinces, the transition forests in the Adamoua and East provinces, the semi-deciduous forests in the East and South provinces, the mangrove and evergreen forests in the Littoral and South west provinces (MINEF 1995).Cameroon's phytogeographical map can also be classified as follow: afromountain region, in South west, west and north west provinces, the soudano-zambezian region in the North and Far north provinces, the Guineo-congolease region found mainly in the Centre, South, south west and East provinces, the Dja Congolese district found in the East and south provinces, and the pery-forest savannah found in the Adamaoua province (Letouzey cit. Sonké 1998).

Cameroon is often considered as Africa in miniature due to its large variety of ecosystems and climates. The various ecosystems have always been inhabited by Cameroonians who have, some how, reshaped them through the years by harvesting this rich biodiversity for food, medication, construction of houses, etc…. The rate at which they are used varies from rural areas to towns.

According to the Cameroon's minister of forestry and wildlife, "the forest sector of Cameroon contributes to some 30% of total non-oil export revenues. Presently, the timber industry ranks first in terms of exported goods deadweight and accounts for 20% of the total value of exported goods. Its contribution to GDP rose from 4.3% in 1992 to 8% in 1999 and is currently exceeding 12%. It directly and indirectly employs 90,000 persons. This development potential can only become sustainable within a participatory management plan articulated both outside and inside the country" (Ngolle Ngolle 2008).

The utilization of resources is not always rational and sustainable thus constituting a threat to biodiversity. Systems of farming such as slash – and – burn agriculture constitute the major cause of the destruction of the tropical forest, recognised as a real reservoir of biological diversity. It is also important to note that poaching which used to check animal populations has now become a real bane of wildlife. Activities of forest logging are viewed as one of the main cause of intensive poaching and commercial hunting (Betti, 2004; MINEF, 1995).

Among the ten provinces of Cameroon, six, namely the Centre (Yaoundé being the capital), East (Bertoua), Littoral (Douala), South (Ebolowa), Southwest (Buea) and West (Bafoussam) provinces, are situated in the forest zone where logging and "wild sawing" are restricted. The three Northern provinces, namely the Adamaoua (Ngaoundéré), the North (Garoua) and the Far North (Maroua) provinces, are situated in the savannah area, that is mostly concerned with sport hunting activities and, which are supplied with wood coming from Southern part of the country.

In Cameroon the distribution of *Pericopsis elata* is largely restricted to the East province.

The East province of Cameroon is largely covered by the semi-deciduous and the transition forests, and is referred as the main reserve of timber resources in the country. In fact, the province contributed for about 53.5 % of the total volume of timber produced in Cameroon (MINEFI, 2006). This province also contributes for about 3 billions of FCFA as the felling taxes per year (Mr Mbandji, the East Provincial Delegate of Forest and Wildlife in 2007, pers. Com.).

1.2. Method

Data presented in this report are based on the literature revue, discussions with different stake holders, and my own field experience.

Area of extent occurrence and area of occupancy of *Pericopsis elata* were estimated based on the important work conducted by Vivien and Faure in 1985 on African trees (Vivien et Faure 1985). The map was completed using results of the forest inventories conducted by the National Centre for Forest Development (CENADEFOR) and the Technical Tropical Forest Centre (CTFT) in the south (1983) and East (1985, 1986) provinces of Cameroon (CENADEFOR – CTFT 1983, 1985, 1986). The final confection of the map was done by taking in account, update data on Assamela logging found in different reports of the forest administration and in the documents of management plans of some forest companies. General elements regarding the management plan and production forests were obtained from the forest law, and management plans. The arête *n° 0222/A/MINEF/ of the 25 may 2001* fixing the procedures of the elaboration, approbation, monitoring, and control of the implementation of the management plans of production forests was largely used (MINEF 2001). The report of the ITTO/CITES training workshop on sustainable trade of *Pericopsis elata* held in Kribi, from 2 to 4 April 2008 was largely exploited (ITTO 2008).

Discussions were conducted with several resource persons in Yaoundé, Kribi, and Bertoua. The Director of forests, the Sub Director of forest management and inventories, the Chief service of managements, the CITES management authority, the Chief Service of forests database, CITES Scientific authority, the staff of the provincial delegation of Forestry and Wildlife in Bertoua, researchers from the Institute for Agricultural Research and Development (IRAD)/Kribi and the Association of Timber and Forest Industries (ATFI) of Cameroon were interviewed to get their point of view and problems related to the management of *Pericopsis elata* in Cameroon.

II. **BIOLOGICAL DATA**

2.1. Distribution of *Pericopsis elata* in Africa

Pericopsis elata is a leguminosaea species of the Fabaceae family, known under its trade/pilot name as Afrormosia or Assamela. It is a tree species of the close, Guinean-Congolese forest type. Its natural range is discontinued (see figure 2: distribution of *Pericopsis elata* in Africa according to Bourland 2008), with several isolated sub-stands in four different areas (Vivien et Faure 1985) including: (1) East of Côte d'Ivoire – west of Ghana, (2) the west of Nigeria and Cameroon, (3) the Sangha – Ngoko basin, and (4) central basin of the Democratic Republic of Congo (DRC).

2.2. Scientific and common names

Different vernacular names are used to design *Pericopsis elata* within the range areas where the plant occurs: Obang by the Bangantou ethnic group and Nguep by the Mvong-mvong ethnic group, in the Boumba Ngoko division in the East province, Nom eyen by the Mbulu ethnic group in the south province, and Mobay by the Baka pygmies settled in the south and south east of the country (Vivien et Faure 1985).

2.3. Distribution of *Pericopsis elata* in Cameroon

In Cameroon the distribution of *Pericopsis elata* is largely restricted to the East province of the country in the Dja, Boumba, Ngoko, and Sangha river basins (see figure 3a). This main area of distribution is approximately 4 071 857 ha (MINEF 2004a, CENADEFOR-CTFT 1983, 1985, Vivien et Faure 1985) and represents about 19% of the national forest domain. There are also some small and isolated stains in the south (Dja et Lobo, Ntem, and Ocean divisions), Centre (Ndom division) and South west (Manfé) provinces (CENADEFOR-CTFT 1983, Vivien et Faure 1985).

In the east province, *Pericopsis elata* is largely found in three divisions including, the Boumba & Ngoko, Haut-Nyong, and Kadei. This area is largely composed of three main forest types including: the semi-deciduous forests of Sterculiaceae and Ulmaceae, mix forests (sempervirent or evergreen and deciduous) with a predominance of elements of the semi-deciduous forest, and mix forest (evergreen and semi-deciduous) with predominance of the Dja forests. Aside of these tree forest types, there are also many other forest types, which are disseminated all over the area of *Pericopsis elata*. They include: the swamp forests, the mono dominant forests of *Gilbertiodendron dewevrei*, secondary forests on former logging sites and dominated by light demand plant species such as *Alstonia boonei*, *Macaranga spp*, *Musanga cecropioides*, *Terminalia superba*, forests on rocks or inselbergs dominated with *Croton mayumbensis*, *Oncoba crepiniaina*, drained forets along rivers as sangha, Boumba, Lobéké inhabited with *Uapaca heudelotii* and *Guibourtia demeusei*, ripicol forest of *Irvingia smithii*, *Trichilia retusa* and *Cathormion altissimum*, and swamp forest of *Raphia laurentii* and *Phoenix reclinata* (MINEF 2004b, MINFOF 2007a).

Data collected during this work from different documents (management plans) tend to show that, the area of distribution of *Pericopsis elata* is more important than what was previously said by Vivien et Faure (1985). This area also covers an important part of the Kadey division, including the Bimba village in the north of Mbang (fig. 3b).

But we are not in position to tell if or not, the distribution area of Assamela has increased. May be, Vivien and Faure who first drew the distribution map of

Pericopsis elata in Cameroon did not covered those zones during their botanical expeditions.

2.4. Biological characteristics

2.4.1. Life history

Pericopsis elata is a semi-gregarious species with a limited but widely dispersed distribution. It is locally abundant in parts of its main range. *P. elata* is a high tree, up to 20 m that can rich 1.3 m of diameter at breast high. The trunk is tortuous and irregular. Trees with high diameter are often hollow or rotten in their heart (Vivien et Faure 1985, Bourland 2008). The bark is more characteristic (0.5-1 cm), greyish and smooth. The trunk has brown to reddish stains. The slice of the trunk is yellow to orange, with an external green ring. The sapwood is well differentiated, yellow (1-2 cm). The wood is brown yellowish. Leaves are light, on horizontal branches. Leaves are deciduous, composed of 7-11 small leaves (follioles in French). Fruits consist of linear indehiscent pods, with brown and smooth surface (Vivien et Faure 1985).

The lack of natural regeneration for this species has been widely noted by many authors. Forni (1997) and Bourland (2008) reported low recruitment and regeneration levels under closed canopy conditions in unexploited forest in East province of Cameroon. The natural regeneration depends on the light conditions. This regeneration is high in areas where forest logging and forest roads have been realized (Kabala et al. 2008). In natural regeneration experiments, it has been observed that the seedlings of *P. elata* are scarce no matter the overhead canopy is light, medium or dense. It has been suggested that, insect damage to the seeds may be the cause of the scarcity of regeneration. But it is not thought that this species is more liable to insect damage than others especially as its germination period is short. Growth is slow in early youth, but increases when overhead light is available (Dei-Amoah & Cardoso 2008). It is said that a noticeable amount of natural regeneration for *P. elata* depends on some conditions such as: sufficient number of mother trees, ripe and abundant fruits, and sufficient quantity of seed, a soil well drained, and an optimal light of more than 40% (Peters 1994 cit. Kabala et al. 2008). However, natural seedlings are remarkably rare. *P. elata* produces flowers every year or every two years at the minor rainy season (March – May). Ripe and indehiscent pods, are wind-dispersed in strong winds and are produced from January to April (Bourland 2008). Each pod contains (Vivien et Faure op cit.) between 1-4 flat seeds (with diameter 1-1.5 cm). Seedlings are reported to be drought tolerant. In early youth it is tolerant of overhead shade but would appear to be a light demander later (Dei-Amoah & Cardoso 2008).

2.4.2. Habitat type

Pericopsis elata is a light demand plant species. The species occurs in 9 different forest stratums in the East and South provinces of Cameroon (see table 1). In the South province, *Pericopsis* is only found in the humid dense forests on soil. In the East province, *Pericopsis* is found in humid dense forests and others forest habitats. The moist semi-deciduous forests with annual rainfall of 1000 – 1500 mm seem to be the specific habitat type where occurs *P. elata* in Cameroon (CENADEFOR-CTFT 1983, 1985). *Pericopsis elata* is semi gregarious to gregarious tree and uses to grow on flat ground, valleys and slopes. It is found in high density along rivers (Vivien et Faure 1985). *P. elata* is a true pioneer species, stimulated to germinate by gaps in the canopy (Forni 1997, MINEF 2004a, Dei-Amoah & Cardoso 2008, Dimanche & Regner 2008, Kabala et al. 2008). This plant species accepts soils of "Reddish-yellow latosols", with an annual temperature of 23 – 26°C (Kabala et al. 2008).

Table 1: Distribution of *Pericopsis elata* in different forest stratums and habitat types in East and South provinces in Cameroon, data extracted from the Forest Resources National Inventory (CENADEFOR –CTFT 1983 & 1985).

PROVINCE	STRATUM	SPECIFIC HABITAT TYPE	DIAMETER 20 – 40 CM (stem ha^{-1})	DIAMETER SUP. 40 CM (stem ha^{-1})	OBSERVATION threatened if density < 0.05stems/ha according to API project
SOUTH	The Dja forests	Humid dense forest on soil	0.00	0.01	threatened
	Mix forests with the Dja and semi-deciduous forests	Humid dense forest on soil	0.00	0.01	threatened
	Power Atlantic forest	Humid dense forest on soil	0.00	0.01	threatened
	Mix forest with dominant semi-deciduous species	Humid dense forest on soil	0.00	0.01	threatened
	Typical Caesalpiniaceae forest (Cristal mount)	Humid dense forest on soil	0.00	0.01	threatened
EAST	Evergreen forest of Irvingiaceae	Humid dense forest on soil and other forest habitats	0.02	0.23	not threatened
	Evergreen forest of *Gilbertiodendron dewevrei*	Humid dense forest on soil	0.00	0.01	threatened
	Transition forest	Humid dense forest on soil and other forest habitats	0.03	0.18	
	Semi-deciduous forest	Humid dense forest on soil and other forest habitats	0.06	0.61	

2.4.3. Role of the species in its ecosystem

2.5. Population

2.5.1. Global population size

According to Pilot Integrated Management project (API project) which have been working in the East province of Cameroon for a long time, a plant species is said to be threatened if its medium density is less than 0.05 stem/ha (Forni 1997). This argument has been used by the forest administration to claim that *Pericopsis elata* is not threatened in Cameroon (MINEF 2002, 2004). If we consider this assumption, we can said that *Pericopsis elata* is threatened in the South province of Cameroon, where it occurs with densities less than 0.02 stem/ha in all forests stratums and habitat types, and for diameter classes 20 cm (CENADEFOR-CTFT 1983). This is not the case for the East province (CENADEFOR-CTFT 1985). In fact, except for the Evergreen forest of *Gilbertiodendron dewevrei* where the density is less than 0.02 stem/ha, *P. elata* is well represented in the East province of Cameroon, particularly in the semi-deciduous forests where it occurs with densities of 0.66 stem/ha for diameter classes 20 cm. For this reason, permits for exploitation of *Pericopsis elata* have never been attributed for the south province.

Figure 4 illustrates the population size map of *Pericopsis elata* in its main distribution area (Fauvet 2008). The map was drawn, based on the national resources inventory conducted in South Cameroon in 1983 and 1985 (CENADEFOR – CTFT 1983, 1985). For stems of diameter 40 cm, the density of Assamela ranges from 0.22 to 4.35 stems/ha. The high density being observed at the Yokadouma region, in the Boumba & Ngoko division.

The recent national forest resources assessment conducted by FAO from 2003 to 2004 gives the density of 0.03 stem/ha for *Pericopsis elata* in the whole country, which tends to show that this plant species is vulnerable in Cameroon (MINEF - FAO 2005). This low density may be due to the fact that, the 2003 inventory covered many ecological zones of Cameroon, including those where *P. elata* does not occur. Also, this density includes trees with diameter less than 20 cm.

2.5.2. Current global population trends

In the following sections, we focus the analysis on the East province of Cameroon, considered as the main reserve of *Pericopsis elata* timber in the country.

During the second phase of the Forest Resources National Inventory (CENADEFOR – CTFT 1985, 1986), the National Centre for Forestry Development (CENADEFOR) delimited the East province in 6 forest blocs, with numbers from 6 to 11. The delimitation was not only based on ecological or floristic conditions, but also on physic and other considerations. A total of 23 Forest Management Units (FMU) are currently logged by timber companies in the main reserve of Assamela in the East province of Cameroon. Those FMU are distributed as follow in different blocs delimited by CENADEFOR: bloc 7 (2 FMU), bloc 8 (7), bloc 9 (1), bloc 10 (8), bloc 11 (5), and bloc 6 (0). Table 2 shows estimated densities of *Pericopsis elata* trees with diameter high than 40 cm in the six forest blocs. The following Forest Management Units 10 026 (ALPICAM), 10 038 (CAMBOIS), 10 039 (PALLISCO), 10 054 (SFID) and 10 056 (SFID), which also contain important stocks of *Pericopsis elata* in the East province of Cameroon, are not included in this analysis. These FMU were covered with the fourth phase of the national inventory. They are found in the Kadei division. The analysis does not also include Assamela found in the sales of standing volume (Ventes de coupe in French) n° 10 01 153, 10 03 115, and 10 01 116.

Table 2. Distribution of Assamela density in different blocs in the East province of Cameroon

BLOC N°	DENOMINATION	SURFACE AREA (ha)	UFA	CENADEFOR-CTFT (1985) (stem ha^{-1})	MINEF (2004) (stem ha^{-1})	OBSERVATIONS
6	Haut-Nyong South	528 750.00	-	0.00	-	
7	Haut-Nyong Centre	431 250.00	10 029, 10 037	0.045	0.14	Nki national park
8	Boumba–Ngoko and Haut-Nyong	731 250.00	10 018, 10 020, 10 021, 10 022, 10 023, 10 030, 10 031	0.45	0.58	
9	Boumba–Ngoko South-West	675 000.00	10 015	0.36	0.37	Boumba bek (321 076 ha) & Nki national parcs
10	Boumba–Ngoko North-East	601 250.00	10 001, 10 002, 10 003, 10 004, 10 005, 10 007, 10 008, 10 009	0.22	0.51	
11	Boumba – Ngoko South-East	857 500.00	10 010, 10 011, 10 012, 10 063, 10 064	0.55	0.42	Lobéké national park (217 854 ha)
TOTAL				0.27	0.40	

Figure 5 illustrates those densities per bloc. This figure is not proposed to compare the two year of inventories, since the methods used were different and for specific purposes. For example, CENADEFOR report does not give detail information on densities in different classes of diameter. This would be appreciated if we got the raw data. These data may exist in CIRAD at Mont Pellier, France. However whatever be the year, the figure tends to show that *Pericopsis* occurs in high densities in the Boumba-Ngoko division. Haut-Nyong-South area is on the limit between the East and the South provinces, which explains the low density of *Pericopsis elata* in this zone.

Except for the bloc Boumba-Ngoko-North East, the density of *Pericopsis* tends to increase within the two years. If it is the case, it would be interesting to link it with the logging activities undertaken in this area since many years. But once again as we said above, these data may be considered with prudence. The 1985 inventory's for example data does not represent the environment of the whole bloc, to authorize statistical analyses (CENADEFOR-CTFT 1985). Detail inventory data obtained from the CENADEFOR's work as far as the national inventory conducted with the help of FAO in 2006 should be used and analysed, to get an idea on the current global population trends.

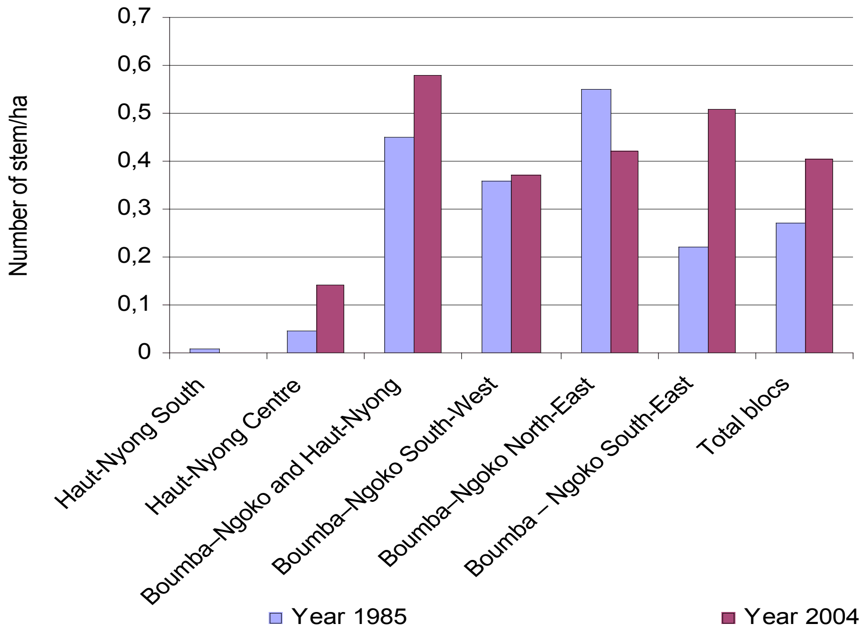

Figure 5: Distribution of *Pericopsis* densities in different blocs in the East province of Cameroon.

2.6. Conservation status

2.6.1. Global conservation status

Pericopsis elata is classified by the World Alliance for Nature (IUCN) as endangered species (EN).

2.6.2. National conservation status for Cameroon

*Pericopsis elata'*s is listed as 'exceptionelle' species with its minimum exploitable diameter (MED) set at 100 cm.

2.6.3. Main threats within the case study country

Two main threats can be observed for *Pericopsis elata* in Cameroon: habitat loss/degradation (human induced) and illegal logging.

Habitat loss through agricultural activities is considered as one of the main threat on forest biodiversity in Cameroon. Large-scale agriculture and other human activities in the area are leading to the degradation of primary forests (UICN, 1989; Betti, 2002), thus causing "vulnerability" of the wild plants. According to IUCN (1989), the rate of deforestation in Cameroon is the most high in the Congo basin, with an annual rate of 0.5%.

Illegal logging, composed mainly of “wild sawing” is considered as one of the main threat on the forests of the Eastern province of Cameroon (Betti & Bobo 2007).

III. MANAGEMENT MEASURES

3.1. Management history

Cameroon is considered as the most advanced in terms of forest sector policy in the Congo basin (Carret 2000, Karsenty 2006). This means that Cameroon is the first country to have produced and implemented a good and coherent forest code in the sub-region, after the summit of the world (Rio de Janeiro in 1992).

Cameroon government through its forest administration acted in different logical steps to ensure the conservation of forest resources: the knowledge of the resource, the zoning of the country and affectation of different land uses, the enhancement of the forest and wildlife control, monitoring and revenues.

More than 25 years ago, Cameroon Government decided with the help of the international Community, to tackle the general problematic of sustainable forest development. The Government therefore first focused its efforts on the knowledge of the timber resource of the meridional or forest zone of the country. A national forest inventory has therefore been established, comprising 7 phases (figure 6). Four out of these phases have yet been finalised by the years 80, for a total forest bloc of 14 000 000 hectares, with the north limit situated at about 4th parallel. In fact, the basis work undertook within the national inventory conducted during the years 1980 (CENADEFOR – CTFT 1983, 1985) led to the elaboration of principal norms and technical tools for the management of the forest domain. These tools include: (1) the zoning plan of the meridional area (phases 1-4 of national inventory) which led to division of the forest zone in two main domain types, namely the permanent domain and the non-permanent domain, and (2) all norms related to the interventions in the forest milieu (production forests to be précised).

The non-permanent domain comprises the community forests, sales of standing volume (small forest concessions of not more than 2,500 ha), and mining zones. It is also composed of lands affected for agricultural and other agroforestry activities (République du Cameroun 1994, 1995).

The permanent domain (République du Cameroun 1994, 1995) is divided into the domanial or state forests which belong to the State, and communal forests which belong to the private domain of the council. The states forests are themselves divided into production forests, protected areas, and forest reserves. Production forests are the most important in terms of surface area, 64% of the permanent domain, and 40% of the meridional zone. They are the type of forest affectation which interests us in this text. Production forests are mainly composed of big forest concessions. Each forest concession is composed of one or many forest of more than 5,000 ha, called the forest management units (FMU). The process of establishment (classification) of a FMU includes three main steps: (1) data collection and local consultations, (2) confection of the file and signature of the decree of establishment (décret de classement in french), and (3) boundary stone (bornage).

The forest logging is conducted in the country through the logging convention (convention d'exploitation in french) for what concerns the permanent domain, and through the management convention (convention de gestion) for what is done in the non-permanent domain. The attribution of these different conventions is subordinated by the validation of the management plan (forest concessions) or the simple management plans (community forests) by an Inter ministerial Committee presided by the forest administration.

Forest Management Units (FMU) are assigned to the sustainable production of the wood and other resources (non timber forest resources for example) in respect to the conditions that allow the preservation of ecological functions of the forest. More than 83 forest management units have been attributed for a total area of 1,835,367 ha. Nine FMU are allocated for the conservation of biodiversity, in the East province. All those conservation units are located within the phytogeographical area of Assamela.

When allocating the FMU to a given company, a preliminary three years convention is signed between the Forest administration and the forest company. The terms of this preliminary convention precise that the forest company has to produce within the three-years of the convention and before the definitive convention has been signed, three types of documents in respect to the norms and rules indicated in the forest law, and including: a management plan for the whole concession (FMU), a five-years management plan (for the forest logging unit), and the operation plan of the first year of activity. At the end of the preliminary convention, a definitive convention is then signed between the forest Company and the Cameroon government for a renewable period of 15 years. At any step of the elaboration of the management plan, the forest administration verifies what has been realised in the previous step before giving his quitus (ok) for the next step.

More than 20 forest companies have produced their management plans, many of which are in the process of validation by the Inter ministerial Committee, established to this end. The implementation of the management plan implies two main constraints for the company: the respect of specific part of the forest that has to be exploited (block of exploitation for 5 years, also called the forest logging units) and the respect of the minimum exploitable diameter (MED).

The forest law seeks to promote a sustainable exploitation of the timber (by the increase of the harvesting volume per hectare) and the non timber forest products, and also diversify and ensure high processing of forest resources. This does not only imply the settlement of appropriated and perform processing units (sawmills), but also requires the adequacy between the capacities of sawmills and the availability of the resources.

The measures undertook within the application of the new forest law have had a significant impact in the development of the forest sector. These measures and rules included: the ban of the exportation of logs for many plant species, the instauration of additional tax for the exportation of logs of the remaining plant species, the obligation for forest companies to settle a fair sawmill. Following these measures, the number of forest industries increased in the country, but the harvest volume per hectare did not increase more.

To ensure the contribution of the forest sector in the national economy, Cameroon government took two important measures: the allocation of FMU through a competitive bidding process namely adjudication, and the creation of the Forest Revenues Enhancement Program (FREP). The competitive allocation of FMU ensures high revenues, while the creation of the FREP in 1999 aimed to secure those revenues and to combat taxes frauds. Such measures are known as main conditions, required to improve forest or environment taxes (Scholl 2005).

According to the forest administration (MINEF 2002, 2004a) the distribution area of *Pericopsis elata* in East Cameroon is covered by protected areas and forest management units. The four protected areas are: the national park of Boumba-Bek (321,078 ha), national park of Nki (238,853 ha), national park of Lobeké (217,200 ha) and the integral ecological reserve of Messomesso (51,797 ha).

These represent 22 percent of the distribution area of assamela. In addition there are 30 FMU in this area, nine of which, with an area of 895,494 ha, are covered by a biodiversity conservation project. In total therefore, 46 percent of the area of distribution of *Pericopsis elata* in Cameroon is protected (MINEF, 2002, 2004a).

These data do not reflect the real potential of the country in *Pericopsis elata*. The distribution map of Assamela often used by the forest administration and many authors is the one published by Vivien et Faure (1985). This map limits the area of distribution of Assamela in the south of the Mbang subdivision (Kadei division). Data gathered during this work from different documents (management plans) tend to show that, the area of distribution of *Pericopsis elata* also covers an important part of the Kadey division, including the Bimba village in the north of Mbang. FMU 10 054 (67,942 ha) and 10 056 (72,391 ha) belonging to the Doumé Industrial Forest Society (SFID) and covering a total area of 140,333 ha in the Mbang region are not often included in the analysis.

Of the 21 FMU assigned for timber production, twelve have finalised their management plans and have signed definitive management conventions with the forest administration (see table 3).

Table 3: list of concessions (FMU) with a definitive management convention in 2007 and with *Pericopsis elata* (MINFOF 2008).

COMPAGNY	CONCESSION	FMU	AREA (ha)	VOLUME OF ASSAMELA LOGGED IN 2007 (m^3)	OBSERVATION
SIBAF/STBK	1003	10 018	81 397	1958	
SFCS	1007	10 023	57 996	316	
SFDB		10 029	46 922	117	
SEFAC	1052	10012		528	Certified by ICILIA (CITES Scientific, pers. Com.)
GREEN VALEY		10 021	66 183	561	Certified by FSC (Delegate of Haut-Nyong forest, pers. com.)
ALPICAM	1040	10 026	67 217	459	
CAMBOIS	1043	10 038	44 651	1047	In the certification process (Delegate of Haut-Nyong forest, pers. com.)
SEBAC	1022	10 009	88 796	229	
CFC	1025	10001, 10 002, 10 003, 10 004	193 105	1439	Certified by FSC (MINFOF 2008)
Total		12 FMU		13 123	

Some of these FMU have already been certified by ICILIA (SEFAC company) and FSC (CFC). Others are in the process of certification.

It is only to those concessions which have signed their definitive management convention, that the forest administration attributes quotas for Assamela's timber.

3.2. Purpose of the management plan in place

The management plan of a FMU aims to exploit the timber resource in a sustainable manner. For Assamela, the management plan aims to ensure that the international trade in that plant species is non detrimental to its conservation in Cameroon.

3.3. General elements of the management plan

Elements of the management plan are précised in the arête *n° 0222/A/MINEF/ 25 may 2001.* This Arête sets the procedures of the elaboration and approbation of management plans, and the procedures for monitoring and control of the implementation of the management plans for the production forests, in the permanent domain.

The article 5 of the arête stipules that, the management plan is a document which aims to fix the forest logging activity in the permanent forests, through a fair planning of harvests in space and time, and by enhancing sylvicultural interventions, as to ensure a sustainable and equilibrium logging activity. This document is composed of five main sections including: (1) description of the natural milieu of the forest concession, (2) mapping, (3) management inventory, (4) affectation of soils and use rights, (5) Calculation of the forest possibility (stock).

The above sections contain following information.

1) Description of the natural milieu of the forest concession: it describes the biophysical characteristics of the forest, the socio-economic environment, and the history of the forest, based on appropriated studies.
2) Mapping:
    a. stratification of the forest territory at the 1/50 000 scale
    b. the produced map may contain following information: the final stratification realized beyond the management inventory, affectation of soils or delimitation in series, and the delimitation of five-year blocs (logging management units) in annual logging units.
3) Management forest inventory
    a. the list of tree species to assess obligatory are contained in the technical files (sheets) published by the forest administration. For those timber species, the inventory counts, measures and identifies all stems with diameter at Breast High of over 20 cm. Stems are classed in 10 cm diameter classes (20-30, 30-40, 40-50, …).
    b. Data analysis is done with a special computer package, validated by the forest administration. The package currently used by the Cameroonian forest administration is the TIAMA package (Computer treatment applied to forest management).
    c. The sample rate for the management inventory should not be less than 1% for a forest concession less than 50,000 ha, and not less than 0.5% for a concession more than 50,000 ha (not less than 50,000 ha).
4) Affectation of soils and use rights: this consists of identifying and mapping the soil uses within the forest concession.
5) Calculation of the forest possibility: this item will be discussed in section 3.4.2.

3.4. Restoration and alleviation measures.

3.4.1. General provisions

A few general provisions for the management of Assamela have been taken by the forest administration. They include the minimum girth limit: 100 cm in Cameroon instead of 80 in other countries of the Central African sub-region, the marking of seed-trees (with a record of GPS coordinates for each one of them), adequate spatial distribution and artificial regeneration work undertaken in some management units.

Annual production forecasts in the managed forests are over 45,000 m^3 raw timber (round timber).

3.4.2. Elements of the arête *n° 0222/A/MINEF/ 25 may 2001*

The basis of restoration and alleviation measures is outlined in the arête *n° 0222/A/MINEF/ of 25^th^ may 2001,* article 6 (element 5: calculation of the forest possibility) to article 10 as follow.

The possibility is the quantity of wood that can be harvested per hectare after each cutting cycle. The calculation of the annual cutting (logging) possibility is an iterative process of optimization, aiming to well determine the rotation (periodicity of cutting) and the minimum exploitable (or harvesting) diameters for managed trees (this is call the managed minimum exploitable diameter = MED/AME or the minimum managed diameter = MMD).

The management inventory (census) divides the tree species inventoried in five groups which are: (1) the managed tree species which will be used for the calculation of the forest possibility, (2) the complementary principal tree species, (3) the promotion tree species, (4) the special tree species which are subjected to particular sylvicultural regime, and (5) the remaining (other) tree species.

For analysis, all principal timber species are arbitrary classified in group 2. The forest manager may include in group 1 (managed tree species), a minimum of 20 tree species for which the exploitable volume is not less than 75% of the initial exploitable volume of the principal tree species. Group 3 is composed of the promotion tree species, and group 4 contains tree species subjected to special sylvicultural regime.

The parameters used in the calculation of the forest possibility and the determination of the MED/AME include: the choice of the managed trees, the rotation, the growth rate in diameter of trees, the cubage tariff (tariff de cubage in french), the damage rate and the mortality rate.

Rotation is the delay between two successive harvests. It is the time spent between two successive logging years in the same space. In Cameroon, it is fixed at 30 years. However, this can increase in case of some specific constraints revealed by the analysis of the inventory data.

The growth rates in diameter used are published in the technical files (sheets) by the forest administration. For *Pericopsis elata*, the growth rate is 0.4 cm/year.

The minimum exploitable diameter of managed trees MED/AME proposed by the manager (forest company), may not be less than the one (MED/ADM) fixed by the forest administration. The administrative minimum exploitable diameter (MED/ADM) fixed for *Pericopsis elata* in Cameroon is 100 cm, which is the highest in the Congo basin.

For the managed species, stems with diameter high than MED/ADM + 40 cm, are retrieved from the initial population table which serves to simulate the forest possibility. These stems are called the "bonus".

However, all trees of this group "bonus" are subjected to technologic inventory, aiming to appreciate the quality of the wood, and to allow the selection of mother trees (useful for seedlings production) which will be banned (forbidden) for any exploitation in the concession.

The rate of reconstitution (or the reconstitution rate) of species to manage, the managed minimum exploitable diameter (MED/AME), and the rotation time, interact one another towards the determination of the possibility.

The percentage of reconstitution (or reconstitution rate) is calculated using the following formula.

$$\mathbf{\%RE = \quad (No\ (1\text{-}\Delta)\ (1\text{-}\alpha)^{T})/Np}$$

Where:

No: number of stems of diameter classes < MED, which are used for the reconstitution (reestablishment) of the ligneous resource;

α: natural mortality (1%) per year;

Δ: mortality caused by logging damage;

^{T}: rotation (30 years);

Np: total exploitable stems (MED + 3) to be reconstituted;

%Re: percentage of reconstitution (reestablishment).

The reconstitution (reestablishment) is good when %Re is more than 50%. The principle of the simulation consists of increasing progressively the administrative minimum exploitable diameter (MED/ADM) as to get a %Re 50%. The new minimum exploitable diameter which provides the best simulation (%Re 50%.) is called the managed minimum exploitable diameter (MED/AME).

The managed trees cannot be exploited under the MED fixed during the calculation of the forest possibility (MED/AME). All other tree species can be exploited in respect of the MED fixed by the forest administration (MED/ADM).

The forest delimitation is done on a map at 1/50 000 based on the results of the management inventory. It is realised in two steps:

Step 1. Firstly, the forest concession is divided into five-years blocs as to obtain a difference of less than 5% of the exploitable volume for the principal tree species (managed and complementary);

Step 2. Secondly, the five-year blocs are then divided as to allow a continuous progression of logging activity in the space and time. Each five-year bloc is divided in 5 logging units (assiette de coupe in French), contiguous and with equitable surfaces.

Sylvicultural treatments, rather than cutting in respect with the MED, must be conducted as to ensure the forest reconstitution (reestablishment) at the end of each rotation.

The nature, objectives, intensity, and the planning of sylvicultural operations are described in the documents of the management plan, and of the five-year management plan. The annual operation plans precise the areas managed, the forest strata logged, and the planning of future interventions.

Research activities useful to complete the based data, which are necessary to ensure sustainable management are précised in the management plan.

As it was said in section 2.1.1., the approbation of the management plan implies two main constraints to exportation: the respect plots (five-year blocs) and the respect of MED.

The area constraint is determined by the respect of annual plots in space and time. Many plots can be opened to forest logging simultaneously, but they must be contiguous. A five-year management unit is definitively closed to forest logging, 6 years after its opening by the forest administration.

3.4.3. Example of management measures in the Forest Management Unit N° 10 039.

To illustrate the calculation of the forest possibility, let us take the example of ETs ASSENE NKOU, a forest logging company working in the East province.

3.4.3.1. General presentation of the Forest Management Unit.

The FMU 10 039 belongs to ASSENE NKOU forest company (ETS ASSENE NKOU 2003). It covers a total area of 47 585 ha, in the East province, Haut Nyong Division, Lomié Subdivision, Dja district.

3.4.3.2. Synthesis of results of the management inventory

A management inventory was realized in 2002.

The characteristics of such an inventory are presented in table 4

Table 4. characteristics of the inventory

Characteristics	Data obtained
Surface area of the FMU	47 585 ha
Sample rate	1.29%
Assessed surface area	613.84 ha
Compilation unit	1
Dimension of a given plot	250 m x 20 m = 0.5 ha
Number of complete plots	1223
Total length of the assessed transects	306.92 km
Number of transects	48
Distance between transects	1,500 m
Sample rate of stems 20 cm of diameter	1.29%
Sample rate of stems < 20 cm diameter	0.02%

Data obtained from the forest inventory are analysed with the TIAMA package. This package provides following elements:

- table of content (areas of forest strata with number of plots);
- the list of tree species inventoried (per group of species);
- the distribution of stems per strata and group of species;
- the curve of stems distribution per diameter class;
- the population table;
- the table of stock (volume for principal tree species);

- the sample rate (obtained from the number of plots of forest strata and the total area of the FMU).

Some of these results are presented for illustration as follow.

a) Density

A total of 424 plant species was inventoried in the FMU. They are distributed in 5 groups as follow:

- Group 1: managed species, 28 species;
- Group : complementary species TOP 50, 25.
- Group 3: promotion species, 23;
- Group 4: special species, 13;
- Group 5: other species, 335.

A total number of 6309 stems of Assamela was inventoried, with 485 exploitable stems. The density of Assamela is 0.14 stems/ha.

b) Volume

The cubage tariff is a formula which calculates quickly for a given parameter, the volume of the log. The cubage tariff established for Asamela during the second phase of the national forest inventory (CENADEFOR – CTFT 1986b) was used. This is $V = - 0.609 + 9.668D^2$.

D = diameter of the log. For example, for a log with D = 25 cm, the volume of Assamela will be: $V = -0.609 + 9.668*(25)^2 = 6041.89$ m^3

Raw volume

The raw volumes of Assamela is f 33 246 m^3 in that forest management unit. The exploitable volume is 6,757 m^3.

Commercial or trade volume

Commercial volume (Vc) is calculated based on the trade coefficient (CC) and the raw volume (Vr).

Vc = Vr x CC.

The trade rates are published by the forest administration, for all tree species in the technical files (sheets). Those trade rates were proposed by the Pilot Integrated Management project (API) and also by the phase II of the national forest inventory. For Assamela, CC = 0.50; this gives the trade volume of Vc of 3,378.5 m^3 .

3.4.3.3. Productivity of the forest

a) Growth rate

Growth rates currently used in Cameroon derive from studies conducted in the Central African Republic (CAR), Ghana, and Côte d'Ivoire. Studies on growth rings have been realised by the Pilot Integrated Management project (API) and have only concerned 10 tree species (API 1994, API Dimako 1995). The annual growth rate used by ETS ASSENE NKOU in the FMU 10 039 is the one arbitrary proposed by the Cameroon forest administration. The annual growth rate for Assamela is 0.4 cm/year.

b) Mortality

The mortality rate used here is 1% for all diameter classes. It is the official mortality rate fixed by the forest administration.

c) Logging damages

Forest logging implies destruction of some remaining (residual) tree species. Those damages vary according to different types of activities. The main activities causing damages on residual tree species are the settlement of the road network, the settlement of the logs parks, the extraction of stems or logs, the cutting of trees, the opening of transects, and many others. The forest administration had fixed the damage rate at 7% of the residual stock of the forest.

3.4.3.4. Proposed management

a) Management objectives

The FMU 10 039 is a forest of the permanent domain. So, the main objective is to ensure a sustainable and long term timber production. This main objective is also that of these management activities. Another objective pursued by ASSENE NKOU activities in the area is to valorise Non Timber Forest Products (NTFP).

b) Soils affectation and usage rights.

b.1. Soils affectation

The forest stratification led to the identification of 9 strata which can be distinguished in two different series of forest: protection forests and production forests.

The production forests are the most important (80% of the total surface area of the FMU). It covers a total area of 44,623 ha, and will be retained for logging activities.

The protection forest is composed of swamp forests: temporary drained swamp forest of bamboos, and permanent drained swamp forest boarding the rivers. These two strata will be affected to total protection, due to their vulnerable ecology. The remaining 7 strata will be affected to timber logging, although there exist one strata with temporary drained swamp forest.

b.2. Usages rights

According to the proposed management decree that was submitted to the signature of the Cameroon Prime minister (Head of Government) and related to the delimitation of the FMU 10 039, local people are authorized to collect fire wood, construction wood, other non timber forest products (wild fruits, medicinal plants) under respected limits. Only the traditional hunting will be allowed but with some regulations.

c) Management of the production forests.

c.1. List of the managed tree species

All principal tree species assessed in the forest are considered as management species; these are the species on which the management decisions will be taken. A total of 53 tree species was listed for that. Fourteen tree species are less represented. Their density is < 0.01 stem/ha, which is too small for ETS ASSENE

NKOU. That is why the company decided to delete the 14 tree species from his list.

Then, the list of the 20 most abundant tree species was fixed (table 6). These species totalise 2 605 069 m^3 and represent 92.27% of the total exploitable volume of all principal tree species. This list was previously retained for the simulation of the net (trade) production.

Table 6. Tree species previously retained for the simulation of the net production

Species	Stem /ha	Exploitable stems (D MED)	Volume/ha	Exploitable volume (D MED)	%Volume
emien	1.93	71174	11.46	504843	17.88
alep	3.74	65216	9.37	356899	12.64
tali	1.21	47351	7.64	340081	12.05
fraké	1.6	49765	7.23	29445	10.43
okan	0.87	18637	4.66	194094	6.87
dabéma	0.97	19642	4.09	161930	5.74
sapelli	0.62	8055	3.74	107413	3.8
ayous	0.23	10391	2.43	100194	3.55
illomba	1.33	13894	2.75	88608	3.14
Padouk rouge	1.62	16545	2.95	85245	3.02
kosipo	0.24	4173	1.41	55527	1.97
bongo H (olon)	1.05	9697	1.81	51650	1.83
abam vrai	0.81	7980	1.37	44885	1.59
fromager	0.14	5090	0.95	41693	1.48
moabi	0.2	2376	1.04	40507	1.43
sipo	0.08	1497	0.79	33274	1.18
kotibé	0.36	6846	0.81	28869	1.02
niové	0.67	6273	0.93	27006	0.96
longhi	0.14	3917	0.64	26612	0.94
mambodé	0.08	2515	0.48	21274	0.75
Total	**17.89**	**371034**	**66.55**	**2605069**	**92.27**

In the second phase, ASSENE NKOU discussed with his trade partner, the PALLISCO forest industrial company. As a result of discussions, it was decided to move from the above list, 4 tree species including Moabi, Sapelli, Kossipo, Ilomba. Many reasons guided ASSENE NKOU in this decision including: the form of their specific curves and economic reasons. Moabi, Sapelli, and Kossipo get an irregular distribution in different diameter classes. It is not easy to obtain for these species, a sufficient reconstitution (reestablishment) rate, without increasing too much the MED. Enhancing the reconstitution (reestablishment) of those tree species through the increasing of their MED, will not profit to the company. Sylvicultural operations will be implemented for those species. Trade in Ilomba timber is not attractive for the moment. This tree species does not currently represent any economic interest for ASSENE NKOU Company.

Assamela and other tree species were considered as complementary tree species (group 2) and added to the selected 20 tree species.

Finally, a total of 28 plant species was retained as managed species for the calculation of the forest possibility.

c.2. Rotation

The rotation has been fixed at a minimum period of 30 years according to the arête n° 0222.

c.3. Simulation of the net production

The simulation of the net production concerned all exploitable managed tree species, with diameter between MED/ADM and MED/ADM + 3 classes, or + 30 cm. These were considered as stems exploitable within the first rotation (EEI).

All trees with diameter MED + 4 classes, which were considered to be too old (cannot rather grow) were retrieved from the simulation. Those stems are available for the logging, but will not be used for the calculation of the reconstitution (reestablishment). They will constitute the "Bonus" of the first rotation.

To obtain the reconstitution (reestablishment) rate, ASSENE NKOU proceeded in two steps.

Step1. In the first step, logging damages in terms of stems, were deduced on trees with diameter class < MED/ADM.

Step 2. In the second step, the growth and mortality rates, were deduced to the new number of stems obtained from step1. This calculation led to the determination of the number of stems which will be logged in the next rotation (EER). Only stems with diameter class MED/ADM, and for which the simulation has produced a good reconstitution (reestablishment) of the forest (Re 50), were retained for logging.

All those calculations were conducted on the 28 managed species. Table 7 shows an example of such a result, for ten tree species.

Table 7. Retained simulation

EEI: possibility for the first rotation; EER: possibility for the second rotation

Species	Possibility =current possibility = EEI (number of stems)	Bonus (number of stems)	EER = next possibility (number of stems)	Reconstitution (Re)	MED (cm)
assamela	498	0	597	119.88	100
emien	13509	28687	18268	135.23	80

alep	9909	15714	10541	106.38	80
tali	11300	20123	6248	55.29	80
fraké	17872	5553	18893	105.72	80
ayous	3275	2239	1884	57.53	90
padouk rouge	4033	957	5137	127.39	80
bongo H (olon)	8468	559	7200	85.03	60
niové	5706	583	2981	52.25	50
mambodé	89	1634	279	312.1	80
Total	**135377**	**102458**	**103813**		

c.4. Forest possibility (total volume and volume/ha)

The possibility in terms of stems defined in the precedent simulation corresponds to a possibility of 1,005,980 m^3 and a bonus of 1,201,509 m^3 (table 8). This gives a total possibility of 2,207,489 m^3 on an exploitable surface area (production forest) of 45,461 ha. This volume will be harvested during the 30 years, which corresponds to an average annual volume of 73,583 m^3, 48.6 m^3/ha/an.

Table 8. Possibility in term of volume (example)

VEI: possibility for the first rotation; VER: possibility for the second rotation

Species	Possibility (m^3/ha)	Possibility (m^3)	Bonus (m^3/ha)	Bonus (m^3)	VER (m^3/ha)	VER (m^3)	MED (cm)
assamela	0.15	6929	0	0	0.2	7781	100
emien	1.87	85042	7.05	320334	3.3	149756	90
alep	1.37	62376	3.43	155744	1.5	69551	80
tali	1.56	71136	4.54	206220	0.9	41379	80
fraké	2.71	123070	1.4	63438	3.1	141794	80
ayous	0.88	40037	1.13	51317	0.5	23056	90
Total	**22.13**	**1005980**	**26.43**	**1201509**	**16**	**709039**	

c.5. Determination of MED/AME

The Minimum exploitable diameters for management have been determined for all tree species of group 1.

The percentage of reconstitution rate was established using the formula proposed by the forest administration (see section 2.1.4.b).

%RE = (No (1-) (1-))/Np

The evolution of the reconstitution (reestablishment) rate for each species in relation with the increase of the minimum exploitable diameter (MED) is presented in table 9. Only 10 tree species are represented. The forest reconstitution is good when %Re 50%.

Table 9. MED/ADM and MED/AME for the managed tree species.

SPECIES	MED/ADM	MED/AME	%Re
assamela	100	100	120%
emien	50	80	135%
alep	50	80	106%

SPECIES	MED/ADM	MED/AME	%Re
tali	50	80	55%
fraké	60	80	105%
ayous	80	90	57%
bossé clair	80	80	62%
bilinga	80	80	102%
dabéma	60	80	58%
doussié R	80	80	190%

Some tree species have seen their MED increased, in order to obtain an enough reconstitution (reestablishment) percentage. Other species such as Assamela, Bossé clair, Bilinga, and Doussier R get enough reconstitution (reestablishment) percentage (%Re 50%) at MED/ADM, so their MED do not need to be increased.

c.6. Sylviculture

c.6.1. Distribution of stems per diameter classes.

The distribution of stems per diameter classes for a tree species is important and fundamental for its management. It allows to visualise the structure of the present population, and to identify different anomalies and deficiencies related to the regeneration and the state of the population. It is on this basis that the adapted sylvicultural interventions will be proposed.
Table 10 shows an example of the distribution of those stems per diameter classes for four tree species: Assamela, Ayous, Emien, Fraké.

Table 10. Distribution of number of stems per class of diameter (centres of the classes are represented in cm)

SPECIES	MED	25	35	45	55	65	75	85	95	105	115	125	135	145	155	MED	Total
Assamela	100	850	313	317	487	769	1650	709	729	263	222	0	0	0	0	485	6309
Ayous	80	662	636	395	317	653	965	1326	796	1363	1070	1033	261	170	745	6764	10391
Emien	50	5616	4974	5682	7762	9455	11635	13549	8041	11131	4844	3117	839	93	708	71174	87447
Fraké	60	4252	4029	6678	8002	11428	15026	11995	5790	3938	1062	349	0	0	178	49765	72726

Figure 7 illustrates the correspondent specific curves. The diameter classes are as follow: class 1 = 25 cm, class 2 = 35 cm,…class 6 = 75 cm,…,class 9 = 105 cm, …, class 14 = 155 cm.

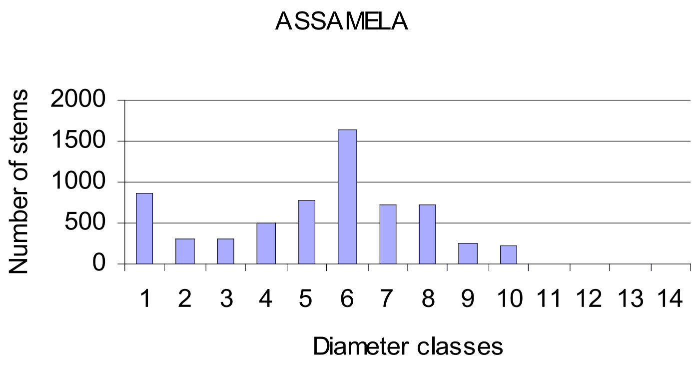

Figure 7.a. Assamela (*Pericopsis elata*)

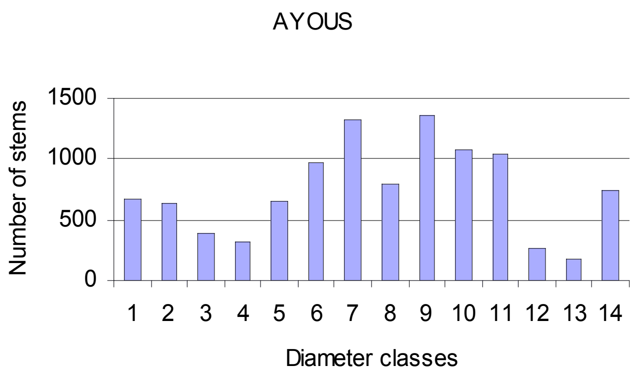

Figure 7.b. Ayous (*Triplochyton scleroxylon*)

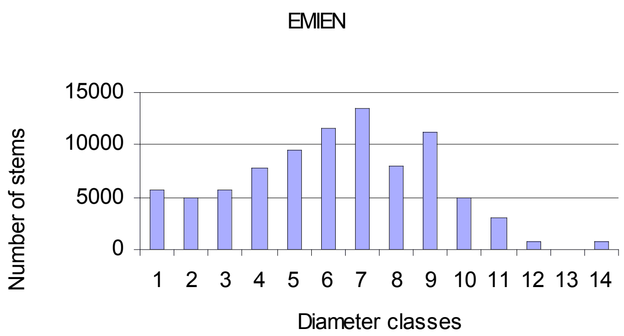

Figure 7.c. Emien (*Alstonia boonei*)

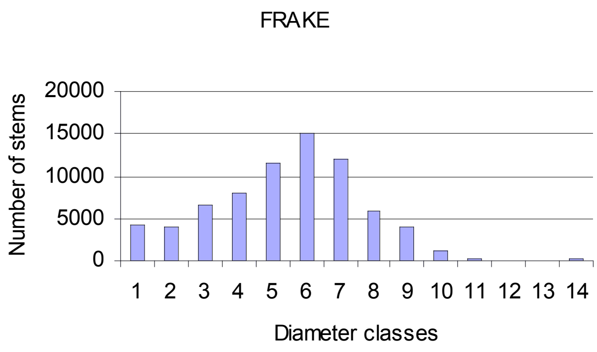

Figure 7.d. Fraké (*Terminalia superba*)

These are exclusively light-demand tree species. Stems with small diameter are less represented, compared to median classes. This characterises species with low regeneration. Except for Assamela, the summit of the curve of those plant species is often located in the right side of the MED/ADM, which characterises an insufficient rate of reconstitution (reestablishment). For example, the summit of the curve of Fraké (*Terminalia superba*) is at 75 cm (class 6), which is in the right side of the minimum exploitable diameter (MED/ADM), fixed by the forest administration at 60 cm. To ensure a sufficient reconstitution (reestablishment) of those species, the manager has to increase the MED/ADM. By adding two more diameter classes to this administrative MED, the reconstitution (reestablishment) rate will be 50%. The new MED obtained is MED/AME, which is: MED/AME = MED/ADM + 2 X 10 cm = 60 cm + 20 cm = 80 cm.

For most of those species and due to their regular fructification (except for Ayous), there will be not necessary to develop specific sylvicultural interventions; they will profit of the opening of the forest canopy by the logging activities to enhance their regeneration and increase their populations.

c.6.2. Specific case of Assamela

Assamela is the only tree species of this group (light demand plants) for which the manager does not need to increase the MED/ADM. This MED is too high according to most of the forest concessionaires. The individuals of Assamela at diameter 100 cm are wilting, and stems of many of them are rotten. This is confirmed by many authors (Vivien et Faure 1985, Bourland 2008) and the Association of Timber and Forest Industries in Cameroon (Ouguia pers. Com.). Those individuals are therefore often abandoned in the forest, which lead to an economic loss for both the forest company and the Cameroon government (ETS ASSENE NKOU 2003, Bourland 2008). These problems were largely outlined by the Association of Timber and Forest Industries (ATFI) of Cameroon during the ITTO/CITES regional workshop held in April 2008 at Kribi, Cameroon, on the sustainable logging and trade of Assamela (ITTO 2008). As we can see, the summit of the curve for Assamela is at 75 cm of diameter, while the MED/ADM is at 100 cm. This means that, Assamela is logged in Cameroon when it is not rather alive. Almost dead individuals of this plant species are logged, which is not correct.

In the other side, it has been reported that management through controlled exploitation benefits the natural regeneration and population dynamics of *Pericopsis elata* primarily by creating forest gaps (ATIBT, 2001). *Pericopsis elata* can be easily propagated from seed and from rooted stem cuttings (CITES 2003).

Sylvicultural trials were realised in many forest species in Cameroon, including *Baillonella toxisperma* (Moabi), *Entandrophragma sp* (Sapelli, Sipo, Kossipo, …), *Milicia excelsa* (Iroko), *P. elata*, *Triplochyton scleroxylon*, etc. *P. elata* was planted in two forest reserves: the Ndeng Ndeng forest reserve in East province, and the Kienké sud forest reserve, in the South province.

Different sylvicultural methods were developed and tested with some interesting results. Assamela was largely tested with the enrichment method (Table 11). The problem is that those plantations have been abandoned following the economic crisis which attacked the country in the late 1990 and the economical structural adjustment (MINEF 2004c).

Table 11. General physiognomy of *Pericopsis elata* plantations in Cameroon (MINEF 2004).

PLANTATION	YEAR	SPECIES	PLANTED	METHOD	SEEDLINGS AND ORIGIN	ACTUAL SURFAC	STATE OF THE PLANTATION
BIDOU	1979	Assamela	2	Enrichment planting (recrû in French?)	Seeds from local mother trees	2	Average density: 340 individuals/ha; Øm = 17 cm, Hm = 18.5 m. Trunks are extremely branched and crooked so that satisfactory intermediate yields cannot be provided. This result cannot militate to use this plantation as a demonstrative plot.
Dend-Deng	1996 - 1997	Assamela Framiré Moabi Bibolo	8	Enrichment planting		5.5	Lack of cleanings and multiple damages caused by the passage of herds of cows. Only Moabi and Cedrella have resisted.
Dend-Deng	1998 - 1999	Assamela Bibolo	5	Enrichment planting		3.5	Assamela seems to grow well and has Øm = 7 cm, Hm = 6 m. layons need to be cleaned.

PLANTATION	YEAR	SPECIES	PLANTED	METHOD	SEEDLINGS AND ORIGIN	ACTUAL SURFAC	STATE OF THE PLANTATION
Deng-Deng	1999 - 2000	Assamela Cedrella	16	Enrichment planting		11	Assamela grows well, but needs cleaning operations.
Total			31			22	29% of the surface area lost.

Data are not available to capitalise those results. For example, nothing is said concerning the nature and origin of the seedlings used in the Deng-Deng forest reserve. Also, most of those plantations are currently exposed to different forms of pressures including the extension of agricultural areas, the illegal logging and sawing, the bush fires, … These activities are not compatible with the research targets assigned to the plantations.

Germination trials conducted by ETS ASSENE NKOU showed that, Assamela can easily be educated in nurseries. Germination takes place in five days, without particular sylvicultural treatments. Assamela has a regular fructification (fruits production) regime, and seeds are easily collected. In plantation, Assamela grows well in high light, and can therefore be easily reintroduced. This confirms the idea that *Pericopsis elata* can be easily propagated from seed and from rooted stem cuttings. In Ghana, trials conducted showed that germination takes place in 8 days but seedlings are scarce (Dei-Amoah & Cardoso 2008). Plantation trials in Côte d'Ivoire have shown growth to around 20 cm in diameter after 20 years (Kouame cit. CITES 2003). In Bidou, the growth is about 17 cm in 20 years.

In the Democratic republic of Congo, sylvicultural trials were conducted during years 1940 – 1950, mainly on the enrichment planting method and the monitoring of the natural regeneration. Some interesting results were obtained (Kabala Tshikala et al. 2008): (1) Afrormosia is a typical light-demand plant species during its early age (young individuals), the natural seedlings need a relative light of about 40-50% after 2 – 3 weeks of germination; (2) the regeneration rate (germinative power) decreases with the intensity of the clearings and the natural forest was considered as the suitable milieu for the germination; (3) in forest management, cleanings and clearings (éclaircies in french) are necessary during the first year to obtain quickly the massif that will combat the overhead shade. The Afrormosia trees introduced in those plots are exploitable in DRC where the minimum exploitable diameter is 60 cm. The average annual growth observed was 0.45 m/year between 1949 and 1974. This result is less than what is observed in Bidou, and which 18.5 m high of trunks is for the same number of years (24 years). Growth trials undertaken in Nigeria have shown that the rate of growth was medium but sapling growth was extremely branched and crooked so that satisfactory intermediate yields were not provided. Furthermore the coloured resistant heartwood is valuable rather than the pale sapwood. These factors militate against the use of the species in timber plantations because the economics of plantation forestry depend considerably on sale of material early in the rotation (Lowe, in litt. 2003cit. CITES 2003).

Densities and reconstitution (reestablishment) rate of Assamela are presented in table 12 for 10 forest management units.

Table 12. Distribution of density and the reconstitution (reestablishment) rate (%Re) of Assamela for 10 forest management units, in the East province of Cameroon.

FMU	DENSITY	%Re
10039	0.14	120%
10063	0.58	74%
10026	0.69	163%
10022	0.3	506%
10023	0.65	75%
10020		228%
10037	0.12	243%
10009	0.17	72%
10038	1.82	282%
10018	0.29	91%
MEAN	**0.53**	**185%**

Data presented in this table tend to show that Assamela is not threatened in the East province of Cameroon, at least in those 10 forest management units. Although the differences observed in the process of census, mainly link to the use of different sample rates by timber companies, it is clear that the density of 0.53 stem/ha is quite high compared to what was suggested for threatened plant species (< 0.05 stem/ha) by the API project (API 1995, 1994, Forni 1997). The value of the percentage of reconstitution (reestablishment) is too high (average 185%) compared to the limit required by the forest administration for sustainable management, and which is 50%. This high level of %Re is due to the high value of the minimum exploitable diameter which is 100 cm.

For ETs ASSENE NKOU and many other managers, it would be interesting to reduce the minimum harvesting diameter of Assamela to 70 or 80 cm in regard with current availability of the resource and the characteristics of its wood. Because of its economic importance, the silvicultural interventions to be conducted by ETS ASSENE NKOU will aim to facilitate its regeneration and to improve the development of future stems (tiges d'avenir in French). Harvesting is said to be the main silvicultural intervention used by the forest managers (ATIBT 2002). ETs ASSENE NKOU will therefore limit the resulting damage caused to the residual stand by logging activities, by putting in place methods and techniques of reduced impact, and prohibiting re-passage in already cut stands so as to facilitate regeneration of the stand.

3.5. Synthesis on the management measures.

As it can be observed, the management measures undertook by the Cameroonian forest administration in the forest sector take in account the main principles of the sustainable forest management as outlined by the international tropical timber organization (ITTO 1992). Those measures follow the framework developed by the international technical tropical timber association (ATIBT 2002).

According to the results obtained by compiling the rate of reconstitution of *Pericopsis elata* in different forest management units, it would be interesting to reduce the administrative minimum exploitable diameter (MED/ADM) of this plant species to 70-80 cm as to maximise its exploitation and trade.

UTILIZATION AND TRADE

4.1. Type of use

Pericopsis elata is in Appendix II of CITES with annotation number 5 since June 1992. Logs, sawn wood, and veneer sheets of *Pericopsis elata* are subject to CITES controls. A ban on log exports was introduced in 1999 for all species except *Triplochiton scleroxylon*. This has led to an increase in secondary processing of *Pericopsis elata* within the country mainly in sawn wood, but increasingly into solid flooring boards. All national production of Assamela comes from wild trees.

4.2. Harvest

According to the CITES Management authority, the national annual production previsions (possibilities) of Assamela are more than 45 000 m^3 (Akagou 2008). Data obtained from Eastern Delegation of Forestry and Wildlife in 2007 revealed a processing rate of about 43% for Assamela timber for a total of 23 permits (MINFOF 2008).

A total of 43 forest companies exported products from Assamela timber between 2004 and 2006. Table 13 shows for each company, the annual production and possibilities obtained for three years: 2004, 2005, 2006.

Table 13. Produced volume and possibility (available volume) of Assamela in different permits between 2004 and 2006.

PERMIT NUMBER	YEAR 2004		YEAR 2005		YEAR 2006		TOTAL		MEAN	
	PRODUCT VOLUME	POSSIBILITY	PRODUCT VOLUME	POSSIBILITY	PRODUCT VOLUME	POSSIBILITY	PRODUCT VOLUME	POSSIBILITY	PRODUCT VOLUME	POSSIBILITY
10003	879	2480	1744	6601	2604	4185	5227	13266	1742.3	4422.0
10005	890	8856	577	5430	2148	2579	3615	16865	1205.0	5621.7
10007	93	1017	356	1188	192	531	641	2736	213.7	912.0
10008	0	0	0	0	0	389	0	389	0.0	129.7
10009	884	1008	647	1316	59	151	1590	2475	530.0	825.0
10010	50	228	249	556	227	1184	526	1968	175.3	656.0
10011	203	548	0	935	0	202	203	1685	67.7	561.7
10012	436	625	1568	3168	680	1376	2684	5169	894.7	1723.0
10013	722	1921	0	0	0	0	722	1921	240.7	640.3
10015	280	497	229	3250	388	3340	897	7087	299.0	2362.3
10018	50	1885	4635	5464	1428	4812	6113	12161	2037.7	4053.7
10020	0	360	11	22	0	0	11	382	3.7	127.3
10021	765	1921	1653	2486	1000	2634	3418	7041	1139.3	2347.0
10022	436	812	126	176	0	24	562	1012	187.3	337.3
10023	582	2494	1718	2309	1216	2880	3516	7683	1172.0	2561.0
10026	343	1247	798	2611	1053	1373	2194	5231	731.3	1743.7
10029	750	2120	178	1259	71	963	999	4342	333.0	1447.3
10030	82	299	449	697	416	914	947	1910	315.7	636.7
10031	863	1568	688	1219	580	0	2131	2787	710.3	929.0
10037	0	0	0	1327	0	0	0	1327	0.0	442.3
10038	1050	1449	1147	1683	1103	1758	3300	4890	1100.0	1630.0

PERMIT NUMBER	YEAR 2004 PRODUCT VOLUME	YEAR 2004 POSSIBILITY	YEAR 2005 PRODUCT VOLUME	YEAR 2005 POSSIBILITY	YEAR 2006 PRODUCT VOLUME	YEAR 2006 POSSIBILITY	TOTAL PRODUCT VOLUME	TOTAL POSSIBILITY	MEAN PRODUCT VOLUME	MEAN POSSIBILITY
10039	120	244	12	223	29	578	161	1045	53.7	348.3
10045	0	19	0	0	0	0	0	19	0.0	6.3
10054	67	132	13	11	0	84	80	227	26.7	75.7
10063	650	1098	758	2449	14	83	1422	3630	474.0	1210.0
10062	0	0	4	0	0	0	4	0	1.3	0.0
10064	1841	1716	48	323	1837	2648	3726	4687	1242.0	1562.3
VC1001116	0	0	0	0	3119	0	3119	0	1039.7	0.0
VC1001153	0	0	0	0	0	5114	0	5114	0.0	1704.7
9006	29	0	0	0	9	4539	38	4539	12.7	1513.0
1475	0	175	0	0	292	101	292	276	97.3	92.0
1478	0	0	0	0	0	498	0	498	0.0	166.0
1002147	0	0	0	0	7	22	7	22	2.3	7.3
807103	0	0	0	0	0	3600	0	3600	0.0	1200.0
VC 1001117	722	0	0	0	0	22	722	22	240.7	7.3
VC 1001119	519	1689	0	0	0	0	519	1689	173.0	563.0
VC 1001140	0	1250	0	0	0	0	0	1250	0.0	416.7
VC 1001155	0	2108	0	0	0	0	0	2108	0.0	702.7
VC 1003143	0	254	0	0	0	0	0	254	0.0	84.7
VC 1004125	0	213	0	213	0	0	0	426	0.0	142.0
VC 104128	0	153	0	153	0	0	0	306	0.0	102.0
AR1005001	0	272	0	272	0	0	0	544	0.0	181.3
AR0000004	0	0	6	100	0	0	6	100	2.0	33.3
	13306	**40658**	**17614**	**45441**	**18472**	**46584**	**49392**	**132683**	**16464.0**	**44227.7**

To obtain the 15,200 m^3 as the annual quota (Q), the Forest administration considered a processing rate (R) of 33.77% for the annual production (P) of 45,000 m^3.

$Q = P \times R$

$Q = 45\,000 \times 33.77\% = 15{,}200$ m^3.

The above processing rate is less than the 43% obtained in the East province. This confirms the preoccupation of the Cameroonian CITES Management authority who has the problem of lack of exact processing rate, that may guide the attribution of quotas to different companies (Akagou 2008).

Table 14 shows the sawn wood volume of *Pericopsis elata* exported from Cameroon between 1992 and 2006 (UNEP-WCMC CITES Trade Database). The 2007 data were provided by the Cameroonian CITES management authority (Akagou 2008).

Table 14. Exports volume of *Pericopsis elata* from Cameroon (1992 – 2006)

YEAR	EXPORTS (m^3)
1992	4419
1993	13009
1994	21101
1995	17673
1996	26147
1997	27657
1998	19074
1999	21379
2000	7641
2001	2720
2002	6501
2003	7285
2004	7358
2005	7626
2006	6415
2007	7785

Cameroon exported its main important volume of *Pericopsis elata* in 1997 and 1996, with 27,657 m^3 and 26,147 m^3 respectively (figure 8). In 1995, the new forest law was published, announcing eminent ban of log exports. But any special decision, banning the log exports was not taken. Timber companies therefore profited of this situation to increase their log exports in 1996 and 1997. In 1999, the ban on log exports was introduced, which led to a decrease on Assamela exports. Since 2000, production levels have been under 8,000 m^3 of lumber, although its annual exportation quota is 15,200 m^3 (CITES 2003, Akagou 2008).

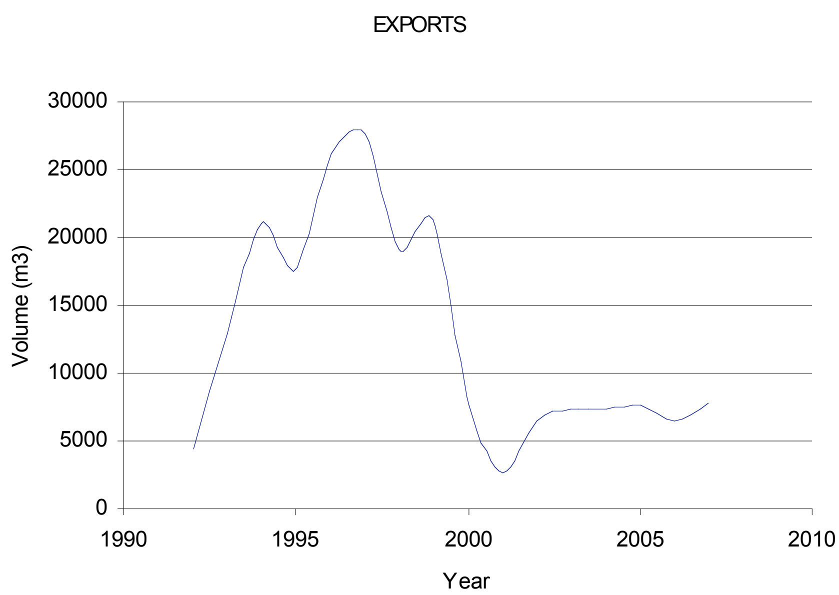

Figure 8. Exports volume of *Pericopsis elata* from Cameroon between 1992 and 2006.

Table 15 presents the exports volume per country for the two last years (2006 and 2007). We can note that at total of 18 countries imported Assamela products from Cameroon, for a total volume of 14,303.5 m^3 , which is less than the 15,200 m^3 authorized per year by the CITES.

Table 15. Export volumes per country (Akagou 2008).

COUNTRY	YEAR 2006	YEAR 2007	TOTAL
AFRIQUE DU SUD	94.3	178.5	272.9
Belgique	4673.8	5270.6	9944.5
CANADA	65.1	0.0	65.1
CHINE	19.8	125.8	145.6
Espagne	56.7	63.0	119.7
France	109.7	52.7	162.4
GRECE	91.4	82.7	174.1
Italie	961.2	1397.0	2358.2
TUNISIE	78.0	0.0	78.0
UAE	16.8	0.0	16.8
USA	351.4	382.7	734.1
DANEMARK		31.4	31.4
EMIRATS A		90.9	90.9
MAROC		24.7	24.7
ROUMANIE		25.7	25.7
TAIWAN		59.4	59.4
TOTAL	**6518.2**	**7785.3**	**14303.5**

We can note in figure 9 that, what ever be the year, Belgium (9944.5 m^3), Italy (2353.2 m^3), and USA (734.1 m^3) are in this order the three main importing countries of Afrormosia of Cameroon for the two years 2006 and 2007.

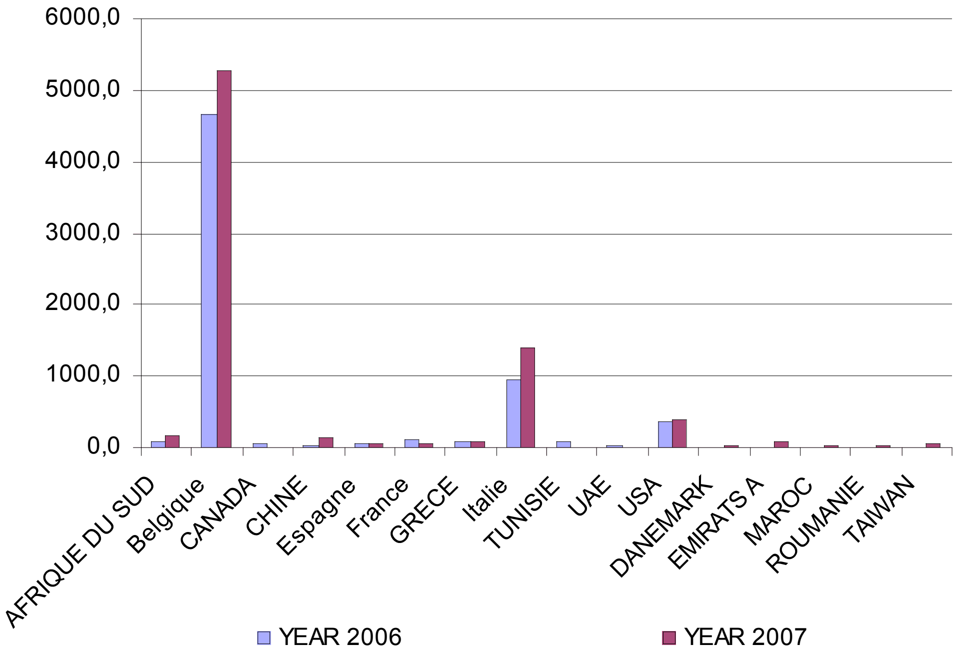

Figure 9: Distribution of exports in different importing countries

IV. MONITORING

Control of timber exploitation, trade and exportation is the main responsibility of the Ministry of Forestry and Wildlife (MINFOF). Other services are concerned, such as the Ministry of Finance through the Forest Revenue Enhancement Program (FREP) and the General Division of Customs (GDC).

5.1. General elements of control as outlined in the arête n° 0222/A/MINEF/25 may 2001.

Before talking about the control and monitoring of Assamela in Cameroon, it is important to first understand the general elements required by the forest administration. The basic elements of the monitoring or control system are précised in the arête 222, articles 25 - 49. The monitoring starts in the central administration by the attribution of the forest management unit, the approbation of the document of the management plan, till the external services (provincial delegations) of the forest administration.

The process of approbation of the management plan of the FMU comprises eight main steps: (1) attribution of the FMU on a competitive basis (adjudication), (2) signature of the preliminary convention (3) sampling design or protocol, to be approved by the forest administration, (4) the management inventory to be approved by the forest administration, (5) the document of the management plan, (6) sub-commission for analysis of the document of the management plan, in charge to examine and issue a technical avis on the contain of the document of the management plan (7), the inter-ministerial commission for approbation of the management plan assisted by one independent observer; (8) the definitive convention which aims to implement the management plan.

The sub-commission in charge to examine and issue a technical avis on the contain of the document of the management plan is mainly composed of researchers from different domain (foresters, biologists, socio-economists, jurists, etc.), the National Agency for the Forest development (ANAFOR), universities, and the Institute for Agricultural Research and Development (IRAD).

The inter-ministerial commission in charge with the approbation of the document of the management plan is composed of: the Director of forests representing the Ministry of forestry and wildlife (MINFOF): president – one representative of the Ministry of territorial administration: member – one representative of the Ministry of planning and territorial management: member – one representative of the Ministry of scientific and technical research: member – the Director of wildlife and protected areas (MINFOF)/: member – the Director of timber promotion and processing (MINFOF): member – the Director of sustainable development of the Ministry of environment and nature protection: member – the provincial Delegate of environment and forestry (MINFOF) of the province where the forest concession is located.

The Committee meets at least twice a year. The evaluations of the implementation of the management plan are realized at the end of each logging unit (5 years), at the end of the convention (15 years), and also at the end of the rotation (30 years). Those evaluations can even be conducted if necessary at any moment of the year, by the competent forest services.

The management plan can be revised after every 5 years. Any modification of the management plan can imply the realization of new or complementary inventories.

The development, and implementation of the management plan is a fund demand and many companies have problem to get their forests. By the year 2003, some companies used to develop their management plan, using services of the consulting offices (consortium), and many of those companies did not get the technical know – how, necessary to implement their management plans. One of the innovation made in the forest sector there after, was the creation in each forest company, a management unit. This unit is directed by a forest engineer who is in charge of the development, the implementation, and the revision of the management plan. The existence of this unit as far as the qualification of the person in charged to work on it are some criteria also appreciated by the Government for the approbation of the management plan.

Since 2 – 3 years ago, the International Technical Tropical Timber Association (ATIBT) trains forest managers of timber companies on different tool for the development, revision, and implementation of the management plans for tropical forests. Hence, more than 30 forest managers have been trained in the Congo basin.

During the preliminary convention, the beginning of activities in a new annual logging plot requires the obtention (detention) of an annual logging certificate. The maximal area to attribute within the year is fixed in conformity with the current legislation. Each annual plot cannot be attributed twice.

During the definitive convention, the beginning of logging activities in a new annual plot, or the renewable of a given annual plot requires the obtention (detention) of the annual operation permit. This permit also cannot be attributed twice.

All felled trees obtained during forest logging activities are noted in a logging book. Sheets of this book also called the “DF10 sheets”, are filled every day by the forest company.

The logging book or the “DF10 sheets” are printed by the forest administration, and sold to regular possessors (holders) of annual permits. The cods (numbers) of sheets allocated to a given company, and for a specific title (annual permit) are registered in the forest data base, settled in the Ministry of Forestry and Wildlife/forest department (SIGIF). Each concessionaire is responsible of the “DF10 sheets” perceived. These sheets can only be used for a specific permit and a specific year for which they have been edited. The cods of sheets that have been destroyed (spoiled) or loss, must be declared by the company to the forest administration, so they can be deleted from the forest data base (SIGIF). The control (monitoring) of “DF 10 sheets” that are in movement in the country, is permanently realized by the forest administration officers, who punish any irregular utilization.

Any “DF 10 sheet” must contain the logs coming from the same permit (annual logging plot). Every week, the forest logger must put together, sheets belonging to the same group “month of logging – permit” and transmit them to the provincial delegation of forestry and wildlife.

Each regrouping sheets constitutes a weekly portion. And a weekly control sheet DF 11, must be annexed to each portion.

The portions are consecutively numbered (codified) per year and per permit. A portion can only contain “DF10 sheets” belonging to the same month of logging. In the section “provenance of timber”, the forest logger must precise the councils names. If the permit covers more than one council, the forest logger will have to indicate the percentage of the area of each council. The forest logger must depose (transmit) the "DF 10 sheets" not late than 10 days after the end of the logging month, to the Provincial delegation of forestry and wildlife. The Provincial Delegate has thereafter to deliver the DF10 attestation of deposit to the logger. The compilation of those sheets is done in the provincial delegation of forest/Service of forest database (external SIGIF), before being transmitted to the central forest database in Yaoundé (SIGIF central).

The annual plot is closed to forest logging at the 30th of June of the year. And the company must depose the annual report of forest interventions (RAIF) not late than the 31th of July of the same year.

5.2. Participative implementation of the management plan

The implementation of the management plan focuses on three different stake holders: forest administration, forest company, local population. The management plan must precise how the notion of participative management is applied at the level of the forest concession. It must also describe the mechanisms that should be develop to resolve conflicts.

In the annex of the document of the management plan, there exists an agreement convention linking the forest company and the local communities. This agreement states the obligation of the two parties (logger and the population). Local populations are authorized to harvest some products in the forest concessions, mainly composed of non timber forest products such as wild fruits, vegetables, and medicinal plants. They are also allowed to undertake fishing and small scale traditional hunting of small mammals which are authorized by the forest law. Sometimes, local communities are also authorized to conduct small scale agricultural activities, with low impact on timber production. They are committed to work together with the timber company to combat poaching and illegal or "wild" sawing.

The forest logger has to pay regularly his forest taxes, and to contribute to development projects for the benefice of the community. In fact, the social and cultural dimension is one of the important innovations outlined in the Cameroon forest legislation. This dimension states that, the local people may participate to the management of forest resources and may gain some profits of the exploitation of those resources. The concrete measures undertaken by the Cameroon government in this regard are for e.g., the obligation of forest companies to realise certain number of social activities (duties) such as the creation of schools, health centres, etc… for the benefit of local communities, the payment of the annual forest tax ("*Redevance forestière annuelle*" in French) by the exploiter. The annual forest tax is a specific tax that is settled on the surface area of the forest under exploitation. Revenues coming from this tax are shared between the public treasury or the forest administration (50%), the local council (40%), and the local communities (10%). When the permit is a sale of standing volume, local communities perceived additional informal tax of 1,000 FCFA/M^3 .

The parts of the forest tax allocated to the council and communities are destined to realise some small development projects at the local level. A specific arête was published by the forest administration to precise the modalities of using those funds. Number of dispositions have been put in place to ensure that the money is effectively used for such a projects. The activity reports of councils are regularly sent to the forest administration to monitor the management of the forest revenues.

The forest administration works to ensure the conservation and development of permanent forests all over the country. His job does not only consist of controlling and monitoring the forest logging activities; but also to protect the loggers against illegal sawing done by some villagers in the forest concessions. The forest administration is also committed to plant trees in zones were forests have been destroyed or degraded. All these tasks require lot of money. To enhance the contribution of the forest revenues in the conservation of forests, the Government of Cameroon created the Special Funds for Forests Development (FSDF). The main objective of this fund is to re-inject some parts of the forest revenues in the sustainable management of those forests. The decree n° 96-237-PM of 10 April 1996 fixing the modalities of functioning of this fund states that, the FSDF is a special fund of the public treasury destined to finance the management, conservation, and sustainable development operations of the forest resources. The revenues of the FSDF comes from different sources including: (i) the quote-part of revenues produced by the annual forest tax (RFA), the felling tax, the tax of transfer of a forest concession, the exit tax (at the port), the progressive surtax paid for the exportation of unprocessed or raw products, the price from selling the forest products, penalties, transactions, damages-interests, other selling forms such as selling the seized products, (2) the recuperation including authorization of gathering logs within the agricultural activities, roads construction, or abandoned logs in the forest, (iii) Revenues affected by the law, (iv) selling of files by the forest concessionaires including forest agreements, permits, (v) selling of administrative documents including the DF10 sheets, the factory entrance book, the way bills book (for logs and for sawn wood), (vi) subventions, contributions, and dons, and others.

Revenues gained from the seized products are shared as follow: 35% go to feed the public treasury and 65% go to the FSDF. The 65% of the FSDF are furthermore shared as follow: 40% for buying different forest material and equipment (Global positioning systems, maps, tents, etc.), capacity building, or as the Government contribution in the financing of some forest projects (The forest administration has like this contributed to the financing of the recent National forest inventory together with the FAO), 25% are paid to the forest officers who have participated to the control mission that led to the payment of those revenues. Before, the money generated by the selling of seized products was collected by the forest officers and reversed in total to the General Directorate of Taxes (GDT) , with the repartitions showed above. The problem is that, the GDT did not used to send back the quote parts of the forest administration. That is why, since the month of March 2006, the forest administration has decided to retain the part belonging to its services. And since there, things seem to work well.

The expenditures supported by the FSDF include (i) management of forest reserves, (ii) regeneration of forests, (iii) forest inventory, (iv) materialization of limits of forest concessions and creation of infrastructures, (v) equipments for forest inventories, (vi) technical control and monitoring of forest management in concessions, (vii) dissemination of results of research on forest management, (vii) research in forestry, (viii) functioning of different committee (for agreements, permits, management plans, etc..), (ix) counterpart funds in the forest projects, (x) contribution of the Government to international Institutions, (xi) motivation of the forest agents and officers.

5.3. Specific CITES provisions

5.3.1. CITES regulations

Cameroon signed the Convention on the International Trade of Endangered Species in June 1981 and ratified it in September of the same year. To guarantee the effective implementation of this Convention, and in pursuance of the relevant provisions of its Articles 8 and 9, Cameroon adopted a number of legislations, composed of tree major measures:

- Decree n° 2005/2869/PM of 29 July 2005 setting forth the enactment provisions of a number of provisions of the Convention on the International Trade in Endangered Species (CITES);
- Ministerial Order N° 067/PM of 27 June 2006 providing the organisational set-up and operational procedure of the Inter-ministerial Coordination and Monitoring Committee for the implementation of the Convention on the International Trade in Endangered Species (CITES);
- Decision N° 0104/D/MINFOF/SG/DF/SDAFF/SN of 02 March 2006 providing the designation and definition of role of the CITES Scientific Authority in Cameroon.

The adoption of these regulations bears witness, if need be, of the ownership process of the CITES Convention by Cameroon at national level.

Cameroon government has appointed two CITES organs: the management and scientific authorities.

During the recent ITTO/CITES training workshop on the *Pericopsis elata*, held in Kribi, Cameroon from 2 to 4 April 2008, the Minister of Forestry and Wildlife, Prof. Dr. Elvis Ngolle Ngolle, focussed his address on those efforts done by Cameroon to own and implement CITES regulations.

5.3.2. CITES management authority

This role belongs to the Ministry of Forestry and Wildlife, Forest department, Sub-directorate of agreements and permits, service of intervention norms in the forest sector. This service is in charge of allocating annual quotas of Assamela to logging companies, issuance of the CITES permits for export. The service is also concerned with the elaboration, diffusion, and monitoring the respect of qualitative norms of logging, and norms related to the forest certification.

The Cameroon's CITES management authority faces many problems including the lack of scientific data on biology, ecology, phenology, processing, …to ensure a sustainable trade of *Pericopsis elata*. During the ITTO/CITES training workshop on Assamela, the CITES management authority declared that it faces the problem of attributing quotas to different timber companies. Due to the lack of information on the relation between the raw volume (logs) and the processed volume (sawn wood), it is difficult for the management authority to allocate suitable logging volumes to forest companies. Effort should be made to target to address this problem.

5.3.3. CITES Scientific authority

The National Forest Development Agency (ANAFOR)'s main mission consists of assisting the public sector, privates and local communities in developing plantation forests in all over the country. It also assists forest concessions in the implementation of their management plans.

ANAFOR was appointed by the Forest administration to play the role of the CITES scientific authority for plants issues in Cameroon. Hence, its mission consists of giving advices to the CITES management authority on scientific questions.

During the ITTO/CITES training workshop held in Kribi, the ANAFOR representative outlined the problem of lack of capacities. Considering the role of the CITES Scientific Authority for plants in the chain of decision for the trade of CITES-listed species, it would be interesting to build its capacities in order for it to be better able to fulfil its mandate. The CITES Scientific Authority for Plants being a rather young body, it suffers from a shortage of technical, financial and material capacities. This situation does not enable this Authority to formulate any Non-Detrimental Findings on the Assamala exports from Cameroon in the present circumstances. It is essentially in view of this situation that the Scientific Authority have submitted to ITTO a project to build the capacities of its executives (Mbarga 2008).

5.4. Other provisions

Cameroon has also taken ad hoc measures to ensure healthy trade practices and to meet the challenge(1) the allocation of logging titles by an inter-ministerial commission assisted by one independent observer, (2) the support of one independent monitoring organization (Global Forest Watch) to monitor the status of plant cover, (3) the publication of a national strategy document for forest and wildlife controls in Cameroon which is validated by all stakeholders, (4) the strengthening (securisation) of forest logging documents, (5), the enhancement of the forest revenues through the forest administration and the finances administration, (6) the reinstatement of the visa to certify the legal origin of timber, (7) the suspension or rescission of concession agreements where applicable tax have not been paid or where the details of the forest management plan have not been validated, (8) the requirement to have an environmental impact study implemented before the start of any forest management work for all concessions exceeding 50 ha.

The Government of Cameroon is firmly committed to improving the national forest governance but is also committed to raise the level of confidence that already exists between the Cameroonian forest sector and its external partners who have been providing their long-standing support.

5.5. Control of logging

According to the forest law, two main documents are required before undertaking any forest logging activity in Cameroon: the forest logging agreement and the permit. The agreement gives access to the forest logging profession, while the permit gives access to the forest resource (timber in this case). One must have these two documents before extracting any log from the forest, and mainly from the permanent domain (Republic of Cameroon 1994, 1995).

In the control of logging, one can distinguish two types of controls: the technical control and the administrative control. Technical control consists of control measures at the point of felling and along transport routes.

In 2000, a Central Unit for Control/Unité Centrale de Contrôle (UCC) was set up by the forest administration to coordinate forestry controls nationally and to support provincial Brigades de Contrôle. Since 2004, that unit (UCC) became the National Brigade for Control (Brigade Nationale de Contrôle in French). To reinforce transparency in control measures the forest administration has appointed an independent observer, Global Witness (MINEF, 2002). Global

Witness is currently working together with the National Brigade for Control to ensure the sustainable forest logging in Cameroon.

In the forest, the technical control consists of verifying the delimitation and the respect of the annual logging area, respect of MED/ADM, the logging inventory, the respect of the sylvicultural prescriptions, the verification of the cubage in the parks, the felling techniques. This is mainly done by the National Brigade for Control assisted by the independent Observer, but also by the provincial Brigade, the provincial chief of forest service, the divisional chief of forest service (chef de section forêts in french), the local chief of forest and wildlife post.

The administrative control consists mainly to the verification of different documents including management plans, DF10 sheets, and activity reports transmitted by the forest company to the forest administration.

5.6. Control of timber products along transport routes and in the points of export: circuit of timber from forest to abroad.

This section aims to present the regular circuit of timber, since the felling site, till the points of export by a legal forest company as outlined in the forest law (République du Cameroun 1994, 1995). Let us take the example of a given concessionaire who wants to convey his products to Douala, the economical capital of Cameroon.

Once a log has been confectioned in the logs park, the local chief of forest and wildlife post must deliver, after further verification, two documents to the exploiter: the certificate of origin and the way bill for logs transport. This log is then conducted in the saw mill for processing (here we suppose that the saw mill is not located in the same place of the felling site or wood park). At the processing operation (the entrance of the saw mill), there exists a check point of control. This is, an external service of the Forest Revenue Enhancement Program (FREP). This service aims to verify and to compile, the volume of timber at the entrance and at the exit of the manufactory. When the timber has been processed, the local chief of forest and wildlife post must deliver two other documents which shall convey the sawn wood to the points of export including the certificate of origin and the way bill for sawn wood. Along the road, there are many control forest posts and check points. In each post, the forest agent has to control the existence and the authenticity of the required documents for log or sawn wood transportation including: the forest agreement, the annual permit with volumes indicated, the certificate of origin, cubage, the way bill. He also has to verify the conformity of these documents with the real volume of timber transported, before putting his stamp on the way bill. Thereafter, the controller must record all the data in a register book, provided by the forest administration to this end. The summation of the sawn wood volume recorded at the end of the season should be done for further verifications.

Once in Douala, the company has two alternatives: selling the wood in the domestic market, or exporting this wood. Most of the wood produced by the timber companies in Cameroon is usually destined to export. The local market is furnished by the illegal or "wild sawn wood" (Betti 2007b). In the Douala port, the exporter has to deal with two main administrations: the forest administration and the customs administration. The forest administration is mainly composed of three main services: the chief of forest and wildlife post n° 1, the chief of forest and wildlife post n°2, and the Trade wood database (COMCAM).

The exporter has first to present himself with his product to the Chief of forest and wildlife post n°1, settled at the entrance of the port, known as "port 1".

There, he has to present many documents including: the agreement, the annual permit, the certificate of origin of sawn wood, the way bill for sawn wood, the certificate for export, and the CITES certificate for what concerns the CITES products (*Pericopsis* and *Prunus*). The certificate for export is delivered by the Ministry of Forestry and Wildlife/Division of promotion and processing/Sub-direction of processing. This certificate is issued, after having verifying that the company has paid all taxes related to the volume and quality of the wood subjected to export (felling tax and saw mill entrance tax). The certificate for export provides information on the origin of the wood, the volume, the products (sawn wood, veneer, or flooring board,…), the country of destination, the address of the buyer in the importing country. The company may therefore present the payment receipts issued by the FREP. The CITES certificate is issued by the Ministry of Forestry and Wildlife/Division of forests/Sub-direction of forest management/service of intervention norms in forests. This service is also the one which plays the role of the CITES management authority. The CITES certificate is issued after having verifying that, the company has respect the requirements prescribed for the exportation of CITES products, including mainly the respect of the quotas allocated. Once the Chief of forest and wildlife post n°1 has verified the existence and the authenticity of all those documents in conformity with the product subject to exportation, he then delivers the specific bulletin. The specific bulletin records data on the origin of the product (FMU), agreement, permit, volume, products, destination (importing country). This bulletin is produced in many copies; some of which are given to the exporter and some to the trade wood database (COMCAM).

With his specific bulletin, the exporter has thereafter to present himself with his product to the Chief of forest and wildlife post n°2, settled in the port 2, together with the customs officers. These controllers (forest and custom officers) have to check the conformity of the declared products with what is mentioned in the specific bulletins. After these verifications (checking), the exporter has to pay the exit taxes (fees) (droits de sortie in French), before putting the product in the container for export.

5.7. Problems observed in the field of control

5.7.1. During logging activities

During the logging control, forest officers are often faced to problems. The most important being the lack of financial and logistical resources to appropriately conduct forest monitoring and achieve the several tiers of objectives ascribed to SFM. Many chiefs of forest and wildlife post do not get any bike, so they use to be transported in the forest by the forest concessionaire himself. In this condition, they are often sensitive to any "tentation" (corruption) coming from the forest company. Some of the forest officers who refused to make some arrangements with the concessionaire have been abandoned in the forest.

Another problem often observed in the control of timber logging in the forest, is that of the lack of coordination between different services of the forest administration. This problem which has already been outlined for non timber forest products (Betti 2007) is also observed in the timber sector.

Illegal logging constitutes together with poaching, the two serious problems of the forest sector in Cameroon (MINEF, 1995; MINEFI, 2006). Illegal logging is the harvesting of timber in contravention of a country's laws. Together with the associated international trade in illegally-harvested wood products, it causes environmental damage, costs governments billions of dollars in lost revenue, and is closely associated with corruption and organised crime. It also undermines the competitiveness of legitimate forest operations in both exporting and importing countries.

Different forms of illegal logging exist, including: exceeding allowed cutting boundaries, the non respect of the minimum exploitable diameter, the non respect of the volume of timber allocated, illegal felling, false declarations (Betti, 2004). Illegal felling and false declarations are said to be the two major types of illegal practices found in the forest sector in Cameroon (http://www.idrc.ca/en/ev-28727-201-1-DO_TOPIC.html). The importance of illegal logging has increased with the implementation of the new forest code. In fact, the more the forest activities are regulated, the more the number of infractions increases (Karsenty, 2006).

Although neglected by forest industries, the national need of wood covers by the informal sector represents some 300 000 m^3/year of timber (Koffi Yeboa, 2005). This sector is growing more and more and its economic impact is crucial at all levels including production, processing, distribution and employment (MINEFI, 1998; 2004). The evolution of the production and exportations of sawn wood in Cameroon (all exploited timbers) from 1995 to 1997 for both formal and informal sectors is illustrated in table 16.

Table 16. Evolution of the production and exportations of sawn wood in Cameroon from 1995 to 1997 (x 1000 m^3) (MINEFI, 2004).

Products	1995/1996	1996/1997
Production of the formal sector	436	460
Production of the informal sector	245	260
Total production	681	720
Local or domestic consumption	420	445
Exportations	261	275

The informal sector contributed for 505,000m^3, which represents 35.6% of the national production of sawn wood for the two exercises (1995/1996 and 1996/1997). The formal sector contributed for 64.5% with 896,000 m^3. Knowing that the logging companies prefer to produce their wood for the foreign market (536,000 m^3 for the exportation of the two periods), it is clear that the remaining 360,000 m^3 is not enough to satisfy the domestic demand which is about 865,000 m^3.

Different reasons explain the proliferations of illegal logging or sawing sector in Cameroon. The main reasons include: the lack of motivations among the logging companies, the lack of clearance in the management of funds that have to be given to local communities, the complexity of the conditions required for allocating small permits and the economic crisis.

Timber companies export products according to the buyer's requirements.

5.7.2. Along transport routes

Along the transport routes, technical control consists of verifying relevant documents and their conformity with the product transported. The problems observed here include the lack of sufficient and qualified personal, the lack of material of control, the lack of motivation for the forest agents, the competence conflicts with other administration. Following the structural economic adjustment undertaken in the late 1990, the Cameroon government has stopped the recruitment of forest officers in the forest administration. This had a negative impact in the forest control and monitoring activities. In many forest posts and check points settled along the road, there are one, two or three forest agents who are currently doing control. This number is not enough to ensure the control of log trucks all days and nights (24 hours/24). Also, many of the agents affected in those posts are too old now and do not get sufficient material for staying awake and resisting to cold all night long. Due to the lack of motivation, following the reduction of the salary, most of the forest agents are sensitive to any corruption activities. Many of them do not record data from checking in their register book, as required by the forest administration. So many of these register books cannot be used, for further verifications. One cannot try to retrace the timber volume trade transported to Douala, through data recorded in those books (Betti 2007).

Another problem largely observed along the roads is that of conflict of competency with other administrations such as police forces. These persons use to stop cars for checking forest products (Betti 2007).

5.7.3. At the points of export

The Cameroon wood is exported from the ports of Douala, Kribi, Limbé, Tiko. The first and main problem observed here is the lack of synergy between the custom officers and the forest officers. Often, the custom officers, who are posted at the end of the exportation chain, refuse to consider the specific bulletins dressed by the forest officers. Also, they used to refuse that the forest officers check the final container and consigns the transport document "connaissement in french". In this condition, some products are exported without the visa of the forest officers.

The second problem in export is at the level of the chief of post N°1. Normally, the chief of forest and wildlife post n°1 must transmitted all specific bulletins to the Trade Wood database. This is not always the case, since some specific bulletins do not exist or disappear. Such behaviour which is certainly link to corruption is detrimental to the monitoring, and checking of statistical data on the trade wood.

The third problem is that of the non existence of COMCAM in other ports. Only COMCAM Doula has work correctly till date. COMCAM Limbé, Kribi, Tiko have not been functioning in fair manner. COMCAM Kribi has just started working.

The fourth problem observed in the control of timber products is that of the proliferation of the "criques". "Criques" are informal points of export, found in many localities settled along the frontier Cameroon – Nigeria, in the south province of Cameroon. These are unsafe sites, where forest officers cannot undertake any control mission (Betti 2007).

The fifth problem is that of lack of connection between the two forest database systems belonging to the Ministry of Forestry and Wildlife. As we can see, specific CITES requirements for *Pericopsis elata* are the responsibility of MINFOF which is the Cameroonian Management Authority for CITES. MINFOF records information on trade in timber through two database systems for the collection of revenue and to support law enforcement: SIGIF at Yaoundé and COMCAM at Douala. The problem is that, there is no connection between the two database systems. In Yaoundé, SIGIF records data on a log by log basis, while in Doula, COMCAM records data on sawn wood by sawn wood basis. Such a system cannot allow to monitor the circulation of timber in the whole country, and to make a linkage between the logs volume and the processed volume.

The sixth problem is that of lack of such a system for monitoring domestic trade in wood products. Till date, the forest administration has never developed a fair system for controlling and monitoring domestic trade, which cannot help to get a global trade volume of wood in the country.

In 2001, the Scientific Review Group (SRG) convened under EU legislation, on which member States' Scientific Authorities are represented, formed a negative opinion on the conservation effects of imports of *Pericopsis elata* from Cameroon, resulting in an effective suspension of imports. The grounds for this decision, which was based on a proposal from Belgium, were doubts as to the legal provenance of much of the timber being exported. This decision was reversed following consultation with Cameroon. The SRG was sufficiently reassured to allow imports to resume, pending the outcome of the Significant Trade process. During 2002, various fines and withdrawal of permission to export have been imposed for activities relating to trade in *Pericopsis elata* in contravention with the provisions of CITES (CITES 2003, MINEF, 2002).

5.8. Perspectives

Although the control and monitoring system put in place in Cameroon faces many problems, there are some perspectives which need to be outlined here. The most important include the implementation of the Forest and Environment Sectorial Program (PSFE), and the progressive certification of production forests.

5.8.1. The Forest and Environment Sectorial Program (PSFE)

The Forest and Environment Sectorial Program (PSFE) is a national program for sectorial development, elaborated by the Cameroon Government and opened to the funding of all donors, including international or bilateral aids, the civil society, and NGOs. It aims to develop a coherent framework for all interventions which contribute to the realisation of the objectives of the forest and wildlife policy of the country.

Through the PSFE, the Cameroon Government wants to get a guide that will allow him to ensure a fair monitoring and an efficient control of the forest and environmental activities by strengthening a global dynamic to the isolated efforts made by projects. The PSFE aims to ensure that those projects be coherent with the objectives of sustainable development of the country.

The PSFE was developed in 2003 (MINEF 2003) for a period of 10 years, distributed in two 5 years phases. The first 5 years phase was estimated at 66,148 millions of FCFA (1 FCFA = 650 euros).

The implementation of the PSFE is done on a participative basis, with the forest administration being the main interlocutor. The architecture of the program distinguishes three main levels: (1) the national level of the global management, (2) the national level of component management, (3) and the provincial level of implementation. At any level, a program Committee defines the orientations, the programmes, and the Annual work plans (AWP).

The Forest and Environment Sectorial Program is made of 5 components including: (1) environmental management of forest activities, (2) management of production forests and valorisation of the forest products, (3) biodiversity conservation and valorisation of faunal or wildlife resources, (4) community management of forest and wildlife resources, (5) institutional building, training, and research.

The Component 2, dealing with the management of production forests and valorisation of the forest products is the one that largely interests us in this document. This component is composed of five sub-components including: (1) zoning the remaining national territory (mainly the northern part of the country), (2) management of production forest, (3) valorisation and processing of the timber resources, (4) valorisation and processing of the Non timber forest products (NTFP), and (5) forest control, monitoring and forest tax enhancement.

The function of forest control and monitoring is the main and legal role of the forest administration, however and according to what precedes, this function dos not work well, which impacts negatively the sustainable development of the forest sector. A national strategy for control of forest and wildlife products was elaborated in 1999, but with mitigate results in a context where almost all the forest agents make control (or research of the infractions). The new view of the strategy of control as outlined in the fifth sub-component of Component 2 of PSFE suggests to:

- (1) re-centre or clarify the role of each service according to its position. It is not interesting to multiply the control actors. Most important is to facilitate the responsibility and the monitoring of each actor on a specific task. In this basis, the role of each service should be clarified as follow: (i) orient the forest control posts on the monitoring and the struggle against the illegal logging, since they are suitable to ensure a permanent monitoring of the national territory, (ii) withdraw the "check points" mission from the forest posts, and develop a specific network, like the one already put in place by the Forest Revenues Enhancement Program (PSRF), to ensure safety in strategic points using the new control technologies, (iii) confirm the Provincial Delegate as the main coordinator of the control, (iv) enhance the services of the forest department on control and monitoring tools.

- (2) move towards a planning control system, which is based on a database system. If the actual system of control is not working correctly, it is because many complementary functions (services) to the above services are not working. This leads to the isolated control activities, with a weak efficiency and lack of transparency. To solve these problems, it is important to build a control chain which will permit to activate the process of leading, treatment, monitoring, and classification of files and trials (process verbal in French). This system should be built on: (i) a database system which will allow to follow all necessary steps, from the trials till the contentious, (ii) an inter-action with the Forest Revenues Enhancement Program (PSRF) Forest Revenues Enhancement Program (PSRF) in terms of transmission of fines or penalties, (iii) development at the provincial level of simple mechanisms for planning and monitoring-evaluation/coordination, (iv) an improvement of the forest logging database (SIGIF) in terms of integrating data on sawn wood, (v) an inter-action between the two forest databases: SIGIF (logging) and COMCAM (trade database), (vi) institutionalisation and the dissemination of the two databases at the provincial levels.

5.8.2. Certification

5.8.2.1. Certified forests or companies

Under the pressure of the ecologist movements, le external market becomes more and more reluctant on products coming from natural forests, and mostly non managed forests. By 2010, it is obviously possible that only products harvested in managed forest will enter the international market.

Although the Principles, Criterion, and indicators (PCI) for the sustainable management of forest are not yet approved by all parties in Cameroon, the efforts made by the Government in the forest sector can be useful for the forest certification. In fact, the Cameroon forest law together with the measures undertook to enhance the sustainable management of forest resources as underlined in this document, are a suitable framework to reach the forest certification target. The challenge here is that of implementing strictly those measures in the field.

Six out of the forests concessions which are exploiting the *Pericopsis elata* timber species in Cameroon have already been certified yet by ICILIA or FSC (see table 3).

5.8.2.2. The Forest Law Enforcement, Governance and Trade (FLEGT) process

The IITO/CITES training workshop held at Kribi also provided the Cameroonian Minister of forestry and wildlife, the opportunity to introduce the Cameroonian forest sector in its assets in terms of achievements, challenges and perspectives. For information, Cameroon is currently engaged in negotiations with the European Union to reach a Voluntary Partnership Agreement (APV/FLEGT) to improve the governance and transparency of the timber trade between the two partners.

The Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan was adopted by the European Commission in May 2003 as part of the EU's response to the call for action at the World Summit on Sustainable Development. The Action Plan sets out a new and innovative approach to tackling illegal logging, linking good governance in developing countries with the legal trade instruments and leverage offered by the EU's internal market.

At the core of the Action Plan are Voluntary Partnership Agreements with timber-producing countries that wish to eliminate illegal timber from their trade with the EU. These agreements will involve establishment of a licensing scheme to ensure that only legal timber from producing countries ("Partner Countries") is allowed into the EU. Unlicensed consignments from Partner Countries would be denied access to the European market under the scheme.

The agreements are voluntary. This means that Partner Countries can decide whether or not to sign up, although once they do so the licensing scheme is obligatory.

Each Voluntary Partnership Agreement will require a definition of "legally-produced timber" and the means to verify that wood products destined for the EU have been produced in line with the requirements of this definition. Both the definition of legality and the verification system should be appropriate to circumstances in the Partner Country. Details of these will be negotiated between each Partner Country and the EU. Where needed, EU development assistance will be provided to help establish licensing schemes.

Several meetings have been organized between representatives of the two parties (Cameroon and European Commission). The main area of discussions include: the nature of products that will be concerned by the FLEGT, the origin of those products, the chain of custody, the system of licences issuance, audit, the institutional framework, the forest governance.

a) Extend of the FLEGT system:

For the beginning, the FLEGT process will concern some products, there after, the process will be enlarged to other products, and mainly finished products for which the definition is not clear yet. The FLEGT will concern timber of all origins, including timber of legal companies and seized products that have been sold legally by the forest administration.

b) Funding of the system:

The FLEGT monitoring system will start in the forest, from the raw product till the exit port. Two exit ports have been retained including the Douala and the Kribi ports. The monitoring system will be based on the codes bares system. Cameroon Government has prepared himself for the financing of the monitoring system. The materials and other equipments will be supported by the public treasury, while the capacity building of the monitors and studies will be financed by the FSDF. The European Commission has declared to help the Cameroon Government in the development of such a system for a total amount of 3.5 billions of FCFA. The development of the monitoring system is a long process including the selection of an expert for the development of the system, buying of materials and equipment, and the training of local forest agents in charged of using materials devoted of such a system.

c) System of issuance of FLEGT certificates

There will be two types of certificates: the "legality certificate" that will be delivered at the central forest administration (Forest Department), and the "exit authorization or "authorization of export" that will be delivered at the exit points by the local forest Delegates. The certificates concerns the societies (companies) while the authorizations concerns the products. The problem that has to be arranged here (exit points) is that of collaboration between the forest and the custom agents.

d) The audit system:

The EC would like to finance and validate the audit of the FLEGT system. The Cameroon party thinks that this specific task belongs to the Government of Cameroon. For the Cameroon representatives, the audit will not only concerned the monitoring of forest logging and trade, but also the impact of such a system in the whole forest revenues of the country. Does the system of FLEGT profit to the Cameroon Government or not? So there are two types of questions: policy and visibility.

e) The institutional framework:

The European Commission thinks that, the FLEGT process must be implemented within a specific project, that they will support. For Cameroon party, this is not necessary. To avoid weaknesses often observed with projects, the system should be integrated within the current monitoring and control system of the forest administration. This is to warrant the efficiency and the long term of the system. The institutional framework is structured as follow: (1) at the central level, there will be two departments including the forest department and the processing and promotion department; (2) at the external levels there will be: the local forest post, the check points and forest posts along the road, the check points at the entrance of the factories (saw mills), the exit forest posts (at the exit points: Douala & Kribi), the provincial Delegate, and the customs. It is the provincial Delegate who will deliver the exit authorizations.

The new monitoring system is supposed to be more efficient. In fact, contrary to what was done before, the results of logging inventories (annual inventories in logging plots) will be largely used and mapped. The central forest administration will be able to know and monitored almost all the trees which will be logged during the year in a given plot. These logs will be integrated in the forest control. The details of such a monitoring system will be précised in the appendix 5 of the FLEGT agreement.

The FLEGT agreement is supposed to be signed by the two parties by December 2008.

CONCLUSIONS AND RECOMMANDATIONS

Pericopsis elata is classified by the World Alliance for Nature (IUCN) as endangered species, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). The annual quota of export volume for Cameroon is 15,200 m^3 while the girth limit or the administrative exploitable diameter was fixed by the Government at 100 cm.

In Cameroon the distribution of *Pericopsis elata* is largely restricted to the East province of the country, the moist semi-deciduous forest with annual rainfall of 1 000 – 1 500 mm being its specific habitat.

The basis of restoration and alleviation measures or Non-Detriment Findings (NDF) is outlined in element 5, article 6 of the arête *n° 0222/A/MINEF of 25 May 2001/:* calculation of the forest possibility and determination of the managed minimum exploitable diameter.

Control of timber exploitation, trade and exportation is the main responsibility of the Ministry of Forestry and Wildlife. The problem resides on the application of control and monitoring system. This still faces many weaknesses. The lack of financial and logistical resources to appropriately conduct forest monitoring and achieve the several tiers of objectives ascribed to sustainable forest management constitutes one of the main problem. However, Cameroon is currently engaged in negotiations with the European Union to reach a Voluntary Partnership Agreement (APV/FLEGT) to improve the governance and transparency of the timber trade between the two partners. This will contribute to mitigate monitoring limits and combat the illegal logging.

The restoration and alleviation measures adopted by the Cameroon government for the development and implementation of management plans, are relevant to ensure a fair sustainable logging on *Pericopsis elata*. The method used to calculate the forest possibility and the managed minimum exploitable diameter can be advised for a Non-Detriment Findings protocol for CITES plant species for a specific country or specific production forest. Analyses made in this document do not authorize to consider *Pericopsis elata* found in Cameroon as a threatened plant species, in accordance with the actual availability and the level of exploitation. But this must be considered with some reserves, due to the lack of scientific updated census and data.

This report was dressed, based mainly on available information found in the forest administration at Yaoundé. The elaboration of a complete NDF report is a time and funds demand. Due to the lack of sufficient means (funds, car, and other logistics), I was not able to go to all zones where this plant species occurs. It was not easy to get some reports, mainly the management plans.

For a complete Non-detriment Findings report on *Pericopsis elata*, I recommend (1) to limit the elaboration of NDF reports on production forests, (2) to gather and analyse management and logging inventories data of all production forests were *Pericopsis* is logged (more than 30 management plans), and determines the suitable MED/ADM, (3) conducting target inventories in forest concessions to confirm or reject results of inventories made by the forest concessionaires, (4) conducting target inventories including individuals with diameter less than 20 cm in production forests, community forests, communal forests, and protected areas and update the real density and the map of *Pericopsis* in Cameroon, (5) gathering relevant data on processing in different sawmills to define a suitable and adaptive processing rate of *Pericopsis*: this information will help the CITES management authority to allocate suitable quotas for *Pericopsis* to different companies, (6) gathering relevant data on illegal logging and domestic trade, (7) undertaking phonological studies and define the production and the MED of Assamela trees, (8) conducting complementary studies on the sylviculture in both forest management units and plantation forests and establish a seed bank (9) developing and implementing the management plans of *Pericopsis*'s plantations, (10) build capacity of the CITES scientific officers .

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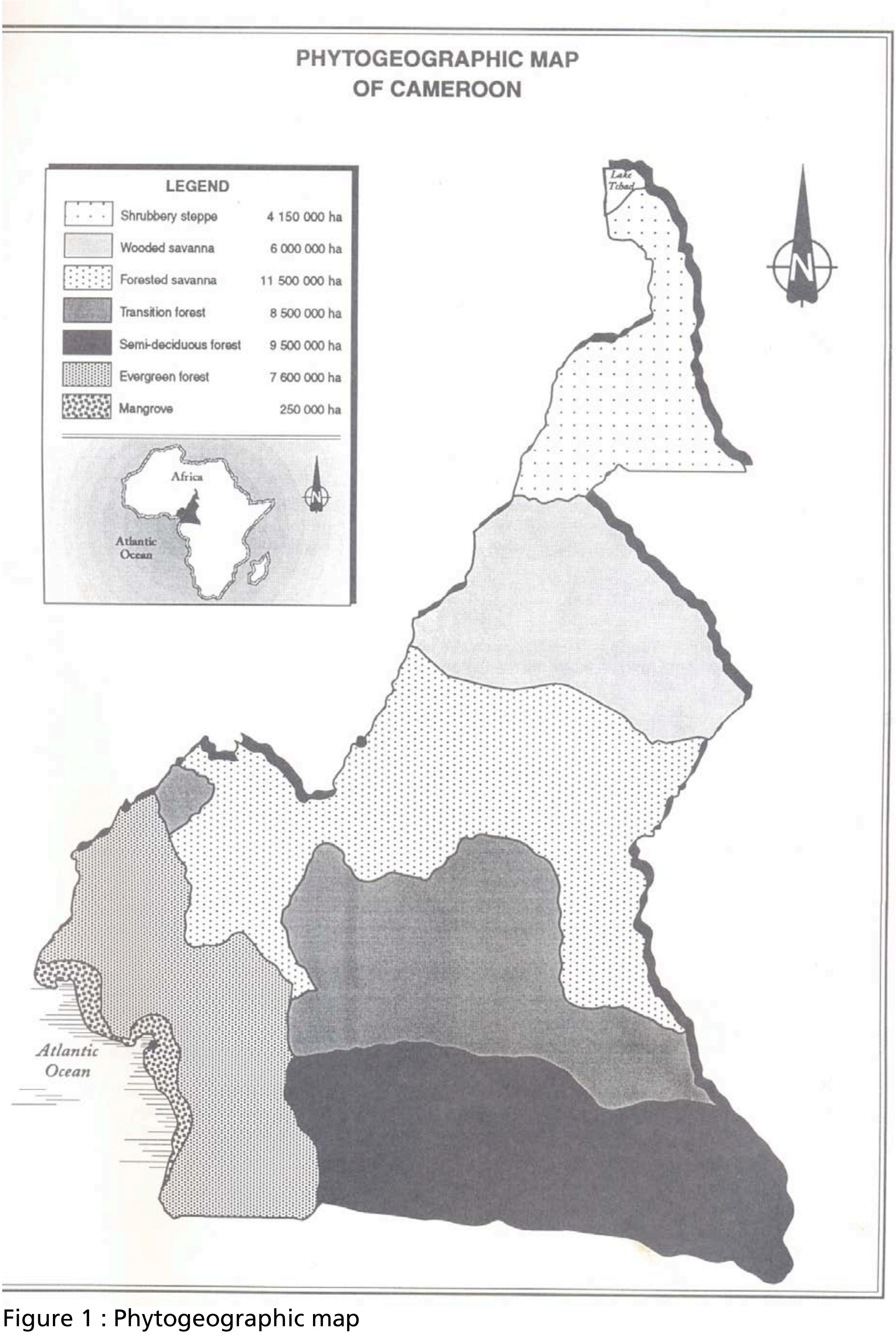

Figure 1 : Phytogeographic map

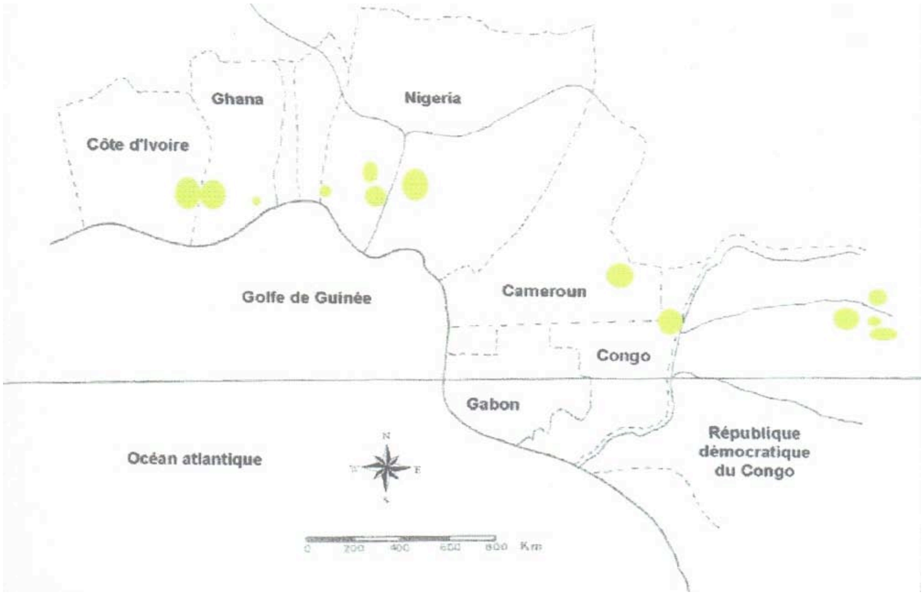

Figure 2 : *Pericopsis eleata* in Africa

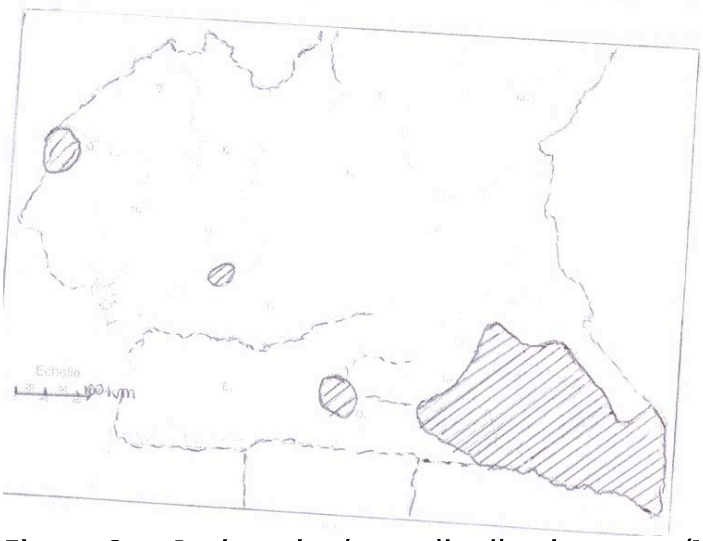

Figure 3a : *Pericopsis eleata* distribution map (**Vivien J. & Faure, 1985)**

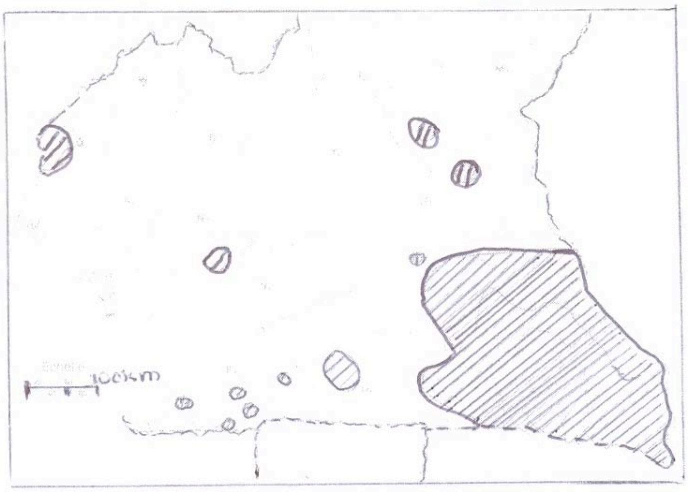

Figure 3b: *Pericopsis eleata* distribution map current data

Variation de la densité de l'Afrormosia dans les forêts du Sud Cameroun au début des années 1980

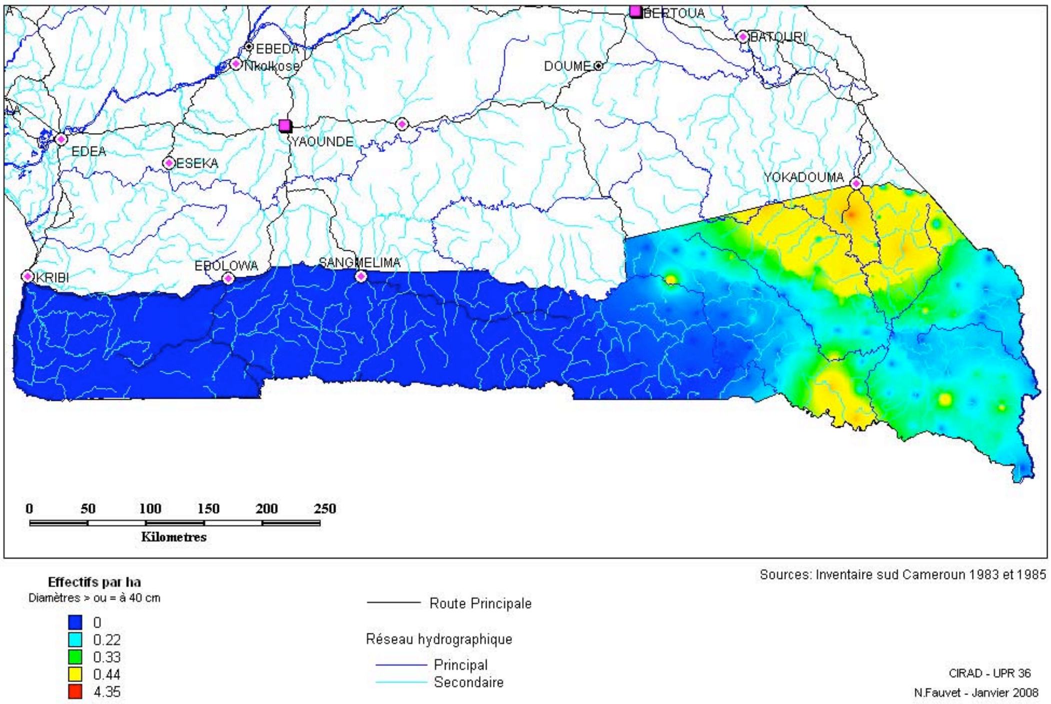

Figure 4: Variation on Afrormosia density in South Cameroon forest (early 1980)

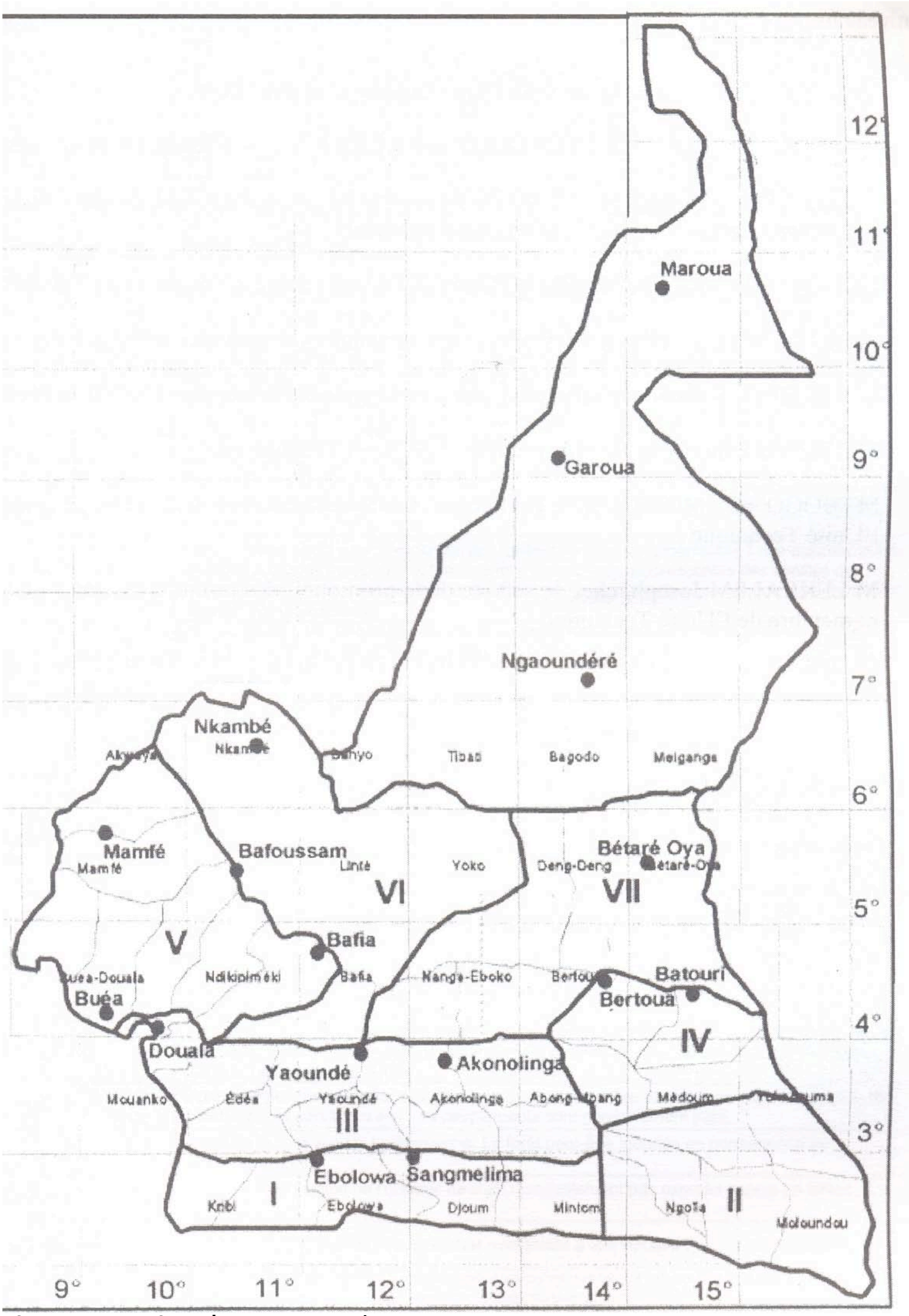

Figure 5: National Inventory phases

ANNEX 1

ABREVIATIONS

ANAFOR: National Agency for Support to Forest Development

API: Pilot Integrated Management Project

ATIBT: Association Technique des Bois Tropicaux (International Technical Tropical Timber Association)

ATFI: Association of Timber and Forest Industries of Cameroon

CENADEFOR: National Centre for Forestry Development

CIRAD: Centre International des recherches agricoles pour le Développement

CITES: Convention on the International Trade in Endangered Plants and Animal Species

CTFT: Tropical Forests Technical Centre

COMCAM: Database on trade wood

EEI: Number of stems which will be logged (exploited) during the first rotation

EER: Number of stems which will be logged (exploited) during the second rotation

EC: European Commission

EU: European Union

FAO: International organisation for Food and agriculture

FLEGT: Forest Law Enforcement, Governance and Trade

FSDF: Special Fund for Forest Development

FMU: Forest Management Unit

FSC: Forest Steward Council

GDC: General Division for Customs

IRAD: Institute for Agricultural Research and Development

ITTO: International Tropical Timber Organization

IUCN: World Alliance for Nature/International Union for Nature Conservation

MED: Minimum Exploitable Diameter

MED/ADM: Minimum Exploitable Diameter fixed by the forest administration

MED/AME: Minimum Exploitable Diameter proposed by the manager (forest company)

MINEF:	Ministry of Environment and Forest
MINEFI:	Ministry of Economy and Finance
MINFOF:	Ministry of Forestry and Wildlife
MMD:	Minimum Managed Diameter
NTFP:	Non Timber Forest Products
NDF:	Non-Detriment Findings
PCI:	Principles, Criterion, and Indicators
PSFE:	Forest and Environment Sectorial Program
PSRF:	Forest Revenue Enhancement Program
Re:	Reconstitution rate
SIGIF:	Database on timber logging
TIAMA:	Computer treatment applied to forest management
UCC:	Central Unit for Control
VER:	Volume of stems which will be logged during the next (second) rotation

RAMIN (*GONYSTYLUS BANCANUS*) IN MALAYSIA

AUTHOR:
Lillian Swee Lian Chua

The phytogeographical region for *Gonystylus bancanus* comprises Sumatra, Peninsular Malaysia (Johore, Pahang, Selangor and Terengganu), Sabah, Sarawak (Malaysia), Brunei and Kalimantan (Indonesia) in the island of Borneo. The species occurs in tropical lowland peat swamp and freshwater swamp forests, with a well-known preference for peat swamps. *Gonystylus* in Malaysia is managed by the Selective Management System, a system designed to balance sustainability of harvesting with long-term conservation. The system also incorporates Reduced Impact Logging and independent third party certification of Permanent Reserved Forests. There are several restoration trials being undertaken for Peninsular Malaysia. The legal framework and law enforcement that affect the management and harvest of ramin in Peninsular Malaysia, Sabah and Sarawak are outlined in several policies, acts, enactments and ordinances.

The criteria, parameters and/or indicators used to make the non-detriment finding for *Gonystylus bancanus* are :-

- habitat preference to peat swamp forests;
- extent of the PSF areas and demarcation of PSF into areas belonging to State and areas under private ownership;
- density and demography of the population in various Permanent Sample Plots (PSPs), Growth and Yield Plots (GYPs) and plots laid out for national forest inventories (NFIs);
- flowering phenology and reproductive behaviour;
- germination, seedling and sapling establishment, growth rates in primary and logged-over areas;
- annual coupe and harvesting regimes/limits employed under the Selective Management System and Sustainable Forest Management;
- suitability of the Reduced Impact Logging (RIL) method; and
- pattern and level of exploitation for international trade.

The main sources of data for NDF are data from the Third and Fourth NFIs, PSPs, GYPs, academic research, pre- and post-felling inventories in targeted areas. These are sample-based and field-evaluated. For the plots established under PSP, GYP and NFI, the published data is data that has been analysed. National Forest Inventories are conducted only for Peninsular Malaysia.

The evaluation of data quantity and quality for the assessment of *G. bancanus* NDF is fairly good because data quantity, particularly with respect to growth and yield and management of harvest, is not lacking. Biological aspects such as reproductive capacity and natural regeneration patterns in primary and disturbed PSFs are however not sufficiently enumerated. Quality of current analysis and assessment may somewhat be compromised due to the loss of long-term data resulting from factors such as the loss of PSPs.

The elaboration of an NDF for *G. bancanus* is, to Malaysia, a straightforward process. The taxonomy of the genus *Gonystylus* is well defined and morphological characters are reliable. What made this process complicated is that the trade in timber is undertaken by groupings and not by species. Apart from the use of sophisticated fingerprinting methods and resource-intensive tagging system and monitoring of harvest at sites, there is currently no method that allows quick and reliable identification of species used in any timber products.

MANAGEMENT MEASURES FOR *PERICOPSIS ELATA (ASSAMELA)* IN CAMEROON

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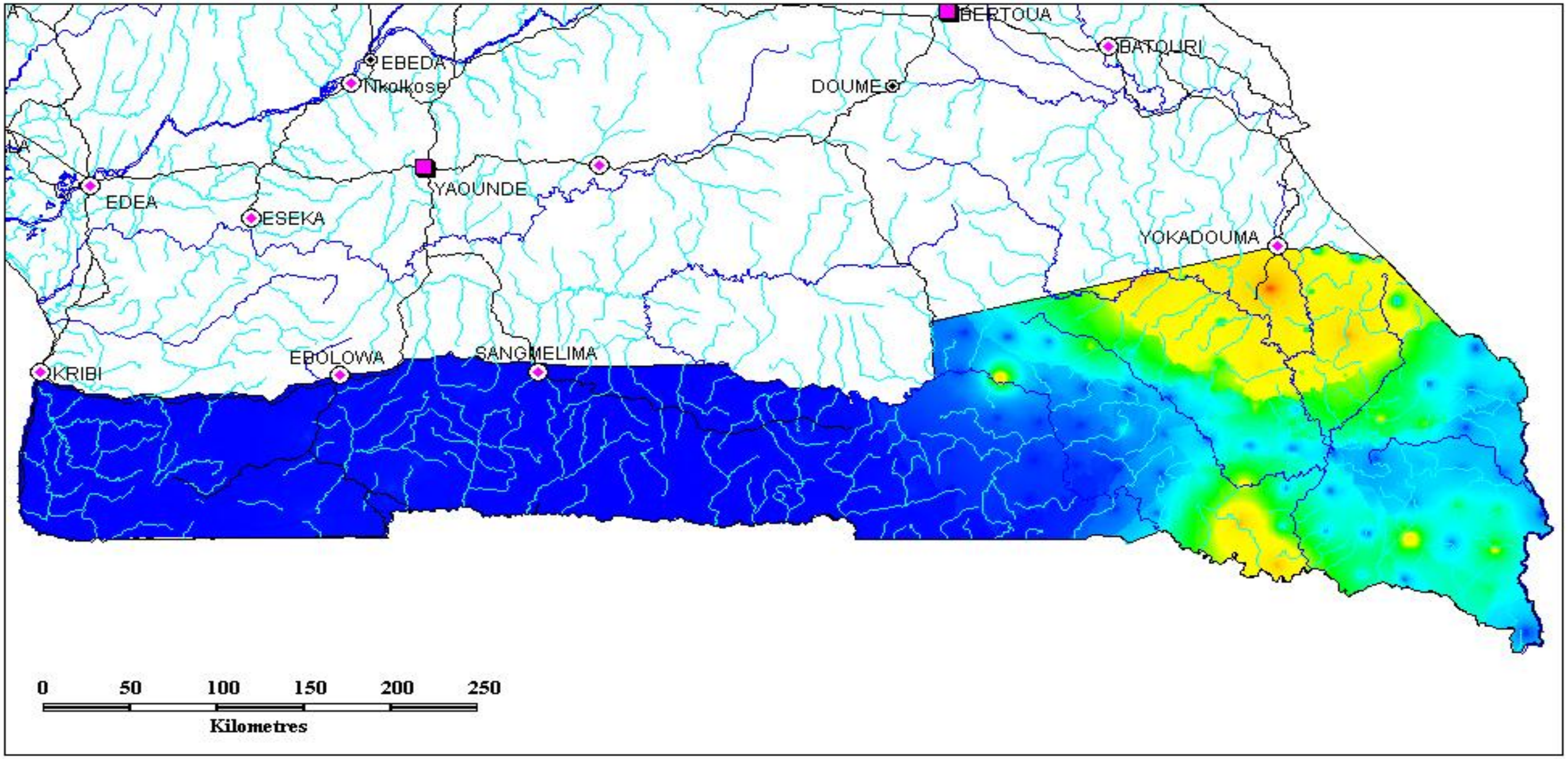
PLAN

- MANAGEMENT HISTORY
- GENERAL ELEMENTS OF THE MANAGEMENT PLAN
- CALCULATION OF THE FOREST POSSIBILITY
- OTHER ALLEVIATION MEASURES
- SPECIFIC CASE OF *PERICOPSIS ELATA*
- CONCLUSIONS

Variation de la densité de l'Afrormosia dans les forêts du Sud Cameroun au début des années 1980



Sources: Inventaire sud Cameroun 1983 et 1985

Effectifs par ha
Diamètres > ou = à 40 cm

- 0
- 0.22
- 0.33
- 0.44
- 4.35

Route Principale

Réseau hydrographique

- Principal
- Secondaire

CIRAD - UPR 36
N.Fauvet - Janvier 2008

HISTORY OF THE MANAGEMENT PLAN

- Knowledge of the resources – forest inventories in 1983, 1985
- Zoning of the country with determination of land uses in 1988 – Forest Management Units (FMU)
- Enhancement of timber and wildlife control
- Enhancement of forest revenues in 1998

GENERAL ELEMENTS OF THE MANAGEMENT PLAN

5 components in the document:

(1) Description of the natural milieu of the forest concession

(2) Mapping

(3) Management inventory

(4) Identification of soils & use rights

(5) Calculation of forest production potential

MANAGEMENT INVENTORY

- The list of tree species to assess obligatory are contained in the technical files (sheets) published by the forest administration
- Counting & measurement of stems with DBH >20 cm
- Stems are classified in 10 cm diameter classes (20-30, 30-40, 40-50, …)

MANAGEMENT INVENTORY

- Data analysis is done with a computer package validated by the forest administration: TIAMA.
- The sampling rate for the management inventory should not be < 1% for a forest concession smaller than 50,000 ha, and not < 0.5% for a concession larger than 50,000 ha.

CALCULATION OF FOREST PRODUCTION POTENTIAL

- The basis of restoration & alleviation measures is outlined in the arête *n° 0222/A/MINEF/ of 25th may 2001,* article 6, element 5;
- The production potential is the quantity of wood that can be harvested per hectare per cutting cycle

CALCULATION OF FOREST PRODUCTION POTENTIAL ('POSSIBILITY')

- The calculation of the annual production potential is an iterative process of optimization, aiming to determine the rotation length & the minimum exploitable diameter for managed trees.
- This diameter is called the managed minimum exploitable diameter = MED/AME or the minimum managed diameter = MMD)

CALCULATION OF FOREST PRODUCTION POTENTIAL

The forest management inventory distinguishes trees in 5 groups:

Group 1: principal managed species which will be used for calculation of forest production potential

Group 2: complementary principal species

Group 3: potential future commercial species

Group 4: special species subjected to particular silvicultural regimes

Group 5: remaining species

CALCULATION OF FOREST PRODUCTION POTENTIAL

- For analysis, all principal timber species are arbitrarily classified in group 2.
- The forest manager may then include in group 1 (managed species) a minimum of 20 species for which the exploitable volume is not less than 75% of the initial exploitable volume of the principal tree species.

CALCULATION OF FOREST PRODUCTION POTENTIAL

- Parameters used for this & for determination of the MED/AME include:
  - selection of the managed trees
  - rotation length
  - diameter growth rate
  - cubage factor (‘tariff de cubage’ in French)
  - damage & mortality rates

CALCULATION OF FOREST PRODUCTION POTENTIAL

- Rotation length is the period between two successive harvests = 30 years in Cameroon
- Growth rates are published in technical files by the forest administration. For *Pericopsis elata*, the growth rate = 0.4 cm/year
- Cubage factor for *Pericopsis*: $V = - 0.609 + 9.668*D^2$

CALCULATION OF FOREST PRODUCTION POTENTIAL

- The minimum exploitable diameter of managed trees (MED/AME) proposed by the forest manager may not be less than that fixed by the forest administration
- The administrative minimum exploitable diameter (MED/ADM) fixed for *Pericopsis elata* in Cameroon is 100 cm, which is the largest in the Congo basin

CALCULATION OF FOREST PRODUCTION POTENTIAL

- For managed species, stems with diameter larger than MED/ADM + 40 cm, are moved from the initial population table which serves to simulate the forest possibility.
- These stems are called the “bonus”.

CALCULATION OF FOREST PRODUCTION POTENTIAL

- Trees of the “bonus” group are subjected to technologic inventory aiming to evaluate timber quality, and to allow the selection of seed trees which will be retained during exploitation in the concession

CALCULATION OF FOREST PRODUCTION POTENTIAL

- Species recovery rates, the managed minimum exploitable diameter (MED/AME), and the rotation length interact with one another for determination of forest production potential

CALCULATION OF FOREST PRODUCTION POTENTIAL

%RE = (No (1-Δ) (1-α)T)/Np

- No: number of stems of diameter classes < MED, which are used for the reconstitution (reestablishment) of the woody resource;
- α: natural mortality (1%) per year
- **Δ** : mortality caused by logging damage
- **T** : rotation length (30 years)

CALCULATION OF FOREST PRODUCTION POTENTIAL

- **%RE = (No (1-Δ) (1-α)T)/Np**
- **Np**: total exploitable stems (MED + 3) to be reconstituted
- **%Re**: percentage of recovery (reestablishment)
- The recovery (reestablishment) is good when %Re is > 50%

CALCULATION OF FOREST PRODUCTION POTENTIAL

- The principle of the simulation consists of increasing progressively the administrative minimum exploitable diameter (MED/ADM) to achieve $\%Re \geq 50\%$.
- The new minimum exploitable diameter which provides the best simulation ($\%Re \geq 50\%$) is called the managed minimum exploitable diameter (MED/AME).

OTHER ALLEVIATION MEASURES

The forest delimitation is done on a map at scale of 1:50 000 based on the results of the management inventory, in two steps:

Step 1. The forest concession is divided into 5-year blocs to obtain a difference of less than 5% of the exploitable volume for the principal tree species (managed & complementary)

OTHER ALLEVIATION MEASURES

Step 2. 5-year blocs are then divided to allow a continuous progression of logging activity in space & time.

- Each 5-year bloc is divided in 5 logging units (‘assiette de coupe’ in French) which are contiguous & cover equivalent areas

OTHER ALLEVIATION MEASURES

- Silvicultural treatments, additional to the MED, must be conducted to ensure forest recovery (reestablishment) by the end of each rotation.
- The nature, objectives, intensity & planning of silvicultural operations are described in the 5-year & annual management plans.
- The annual operational plans describe the areas managed, the forest strata logged, and the planning of future interventions.

SPECIFIC CASE OF ASSAMELA

- Data compiled from 10 management plans tend to show that Assamela is not threatened in the eastern province of Cameroon.
- Its density is 0.53 stems/ha & is high compared to what was suggested for threatened plant species (< 0.05 stems/ha) in Cameroon.

SPECIFIC CASE OF ASSAMELA

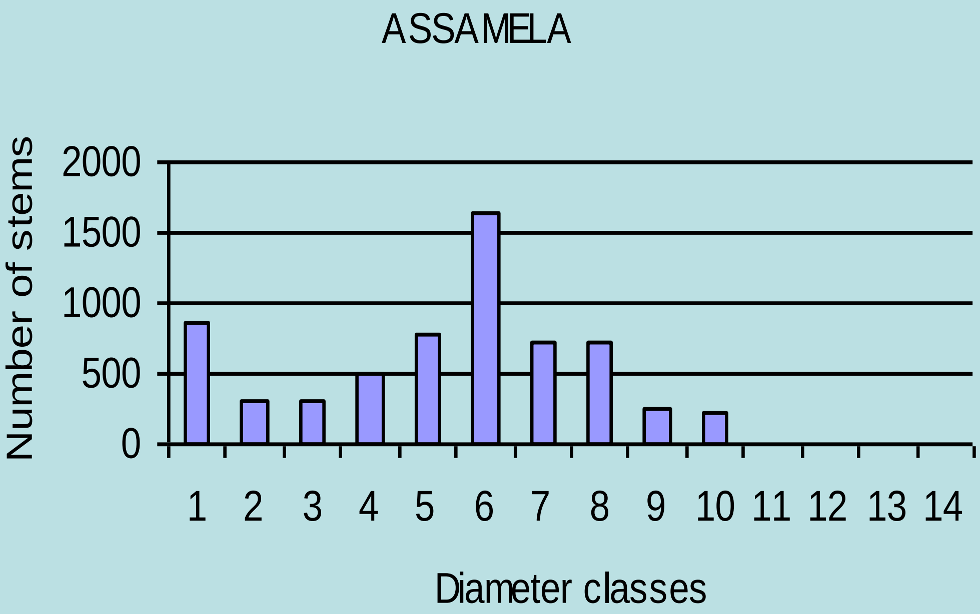
- The value of the percentage of reconstitution is too high (average 185%) compared to the limit required by the forest administration for sustainable management which is ≥ 50%.
- This high level of %Re is due to the high value of the MED which is 100 cm.

SPECIFIC CASE OF ASSAMELA

- Assamela is one of the scarce tree species for which the manager does not need to increase the MED/ADM.
- Rather, this MED is too high according to most of the forest concessionaires

SPECIFIC CASE OF ASSAMELA

class 6 = 75 cm,…,class 9 = 105 cm



SPECIFIC CASE OF ASSAMELA

- Assamela is a light-demanding tree species. Small diameter trees are less represented compared to medium size classes. This frequency distribution is characteristic of species with low regeneration levels
- Assamela is one of the scarce species for which the most abundant size class (70-80 cm diameter) is located to the left of MED/ADM = 100 cm.

CONCLUSIONS

- The restoration & alleviation measures adopted by the Cameroon Government for the development & implementation of management plans are relevant to ensure sustainable logging of *Pericopsis elata*.
- The method used to calculate forest production potential & the managed MED can be advised for a Non-Detriment Findings protocol for CITES plant species.

OTHER ALLEVIATION MEASURES

- The managed trees cannot be exploited under the MED fixed during the calculation of the forest possibility (MED/AME).
- All other tree species can be exploited in respect of the MED fixed by the forest administration (MED/ADM).

AGARWOOD (*AQUILARIA MALACCENSIS*) IN MALAYSIA

AUTHOR:

Lillian Swee Lian Chua

Forest Research Institute Malaysia (FRIM). This document is prepared only for Aquilaria malaccensis found in Malaysia. Little information is available for other agarwood-producing species in Peninsular Malaysia, Sabah and Sarawak. Apart from the geographical distribution, no stocking, harvest and trade data are available.

I. BACKGROUND INFORMATION ON THE TAXA

1. BIOLOGICAL DATA

1.1 Scientific and common names

Aquilaria malaccensis Lam. (Thymelaeaceae). Common names: agarwood, aloeswood, eaglewood. Vernacular names: gaharu, karas (Indonesia and Malaysia). Twelve other native species, belonging to the genera *Aetoxylon, Aquilaria, Gonystylus* and *Wikstroemia* (all Thymelaeaceae), are thought to produce agarwood (Appendix 1). In Sarawak, it is *Aetoxylon sympetalum* that produces the 'true *gaharu* wood' (Anderson 1980).

1.2 Distribution

The phytogeographical region for *Aquilaria malaccensis* comprises India, Myanmar, Sumatra, Peninsular Malaysia, Singapore, Borneo and the Philippines. Its geographical distribution in Peninsular Malaysia is given in Fig. 1. Although the species is widespread, it occurs at low density.

Aquilaria malaccensis is absent from Sarawak while other species of this genus are reported to be generally rare (Tawan 2004). *Aetoxylon sympetalum*, a species that is a source of gaharu, was noted as being locally frequent in the heath forests in west Sarawak (Anderson 1980) and fairly common throughout the State (Tawan 2004). *Aetoxylon sympetalum* is absent from Sabah.

1.3 Biological characteristics

1.3.1 *General biological and life history characteristics of agarwood*

Aquilaria malaccensis produces seeds after 7–9 years while some other species produce seeds only once in their life cycle. Seed viability is approximately 1 week and germination takes place between 16–63 days (Ng 1992). Germination is epigeal and of the hypogeal type. Not all mature trees produce the gaharu resin. Germination rates may reach 90% for mature fruits that are sown immediately (Chang, pers. comm.). Trial planting on the grounds of the Forest Research Institute Malaysia have shown that survival of tissue-cultured plantlets 24 months after planting was 66.3% while that of seedlings was 40.3%. The initial and final plantlet heights were 43.1 and 136.6 cm, respectively, while those for the seedlings were 27.9 and 114.8 cm, respectively (Lok et al. 1999). A 0.9-ha research plot planted with 833 trees ha^{-1} in 1928 had a density of 31 trees ha^{-1} in 1995. The mean diameter at breast height (dbh) of the stand was 38.2 cm with a mean height of 26.7 m and a mean clear bole height of 15.7 m (Lok & A. Zuhaidi 1996).

The Third National Forest Inventory (NFI-3) conducted between 1991 and 1993 for Peninsular Malaysia showed that *Aquilaria* spp. occurred in both logged and primary forests (Chin *et al*. 1997). In the 'Best Virgin Forest' category, there were 1.79 stems per hectare in size classes above 10 cm dbh (Chin et al. 1997).

The Fourth National Forest Inventory (NFI-4), conducted between 2002 and 2004 for Peninsular Malaysia, provides the *Aquilaria* spp. stocking in the virgin, logged-over and stateland forests (Table 1; Anon. 2006a). It estimated 0.62 stem ha^{-1} for size classes >10 cm dbh for all *Aquilaria* spp. These stems have an estimated timber volume of 0.311 m3 ha-1. Trees 10?14.9 cm dbh made up 48% of the total stem number while trees 15?44.9 cm dbh provided 67% of the total volume (Anon. 2008). The state of Pahang has the highest volume of *Aquilaria* while Kelantan has the highest number of stems (Mohd Paiz 2006). The above estimates are for stem number and timber volume of all Aquilaria species, noting that not all stems produce the *gaharu* resin.

Results from a long-term, large-scale demographic study indicate a poor stocking of seedlings through natural regeneration in a primary forest. In the Pasoh 50-ha tree demographic plot, at least 125 trees above 1 cm dbh were recorded in 1985 (Manokaran *et al*. 1992). The individuals were distributed evenly throughout the plot with no indication of spatial patterning (Fig. 2), occurring on wet ground, hill slopes, on sand and clay (LaFrankie 1994). 53.6% of trees had diameters <5 cm with the largest tree 41.3 cm dbh. The density of trees >10 cm dbh was slightly less than one tree per hectare and assuming a reproductive size of approximately 10 cm dbh, the juvenile to adult ratio was only 1.5. Based on a median inter-census period of 2.81 years, LaFrankie (1994) worked out the recruitment rate to be 1.42 trees year^{-1} for the entire 50-ha plot. Growth rates ranged from 0 to 1.95 cm year^{-1}. The distribution of growth rates was strongly skewed with a mean value of 0.33 cm year-1 and a median value of 0.22 cm year^{-1}.

Table 1. Stocking of *Aquilaria* spp. in the virgin, logged-over and stateland forests in Peninsular Malaysia between 2002?2004 according to dbh class.

State	DBH class 15-30 cm		DBH class 30-45 cm		DBH class >45 cm		Total	
	No. stem/ha	Volume (m^3/ha)	No. stem/ha	Volume (m^3/ha)	No. stem/ha	Volume (m3/ha)	No. stem/ha	Volume (m3/ha)
Johor	-	-	29,920	37,281	14,673	59,424	44,593	96,705
Kedah	83,869	26,502	16,282	20,624	10,855	22,795	111,006	69,921
Kelantan	1,413,067	181,084	-	-	-	-	1,413,067	181,084
Melaka	2,037	1,513	-	-	218	1,002	2,255	2,515
Negeri Sembilan	4,464	496	-	-	8,846	19,857	13,310	20,353
Pahang	570,169	310,030	377,034	392,636	25,261	101,045	972,464	803,711
Penang	5,674	2,459	-	-	-	-	5,674	2,459
Perak	106,919	60,602	160,457	149,194	41,568	60,966	310,944	270,762
Terengganu	122,873	23,566	18,853	15,711	50,437	342,650	192,163	381,927
Total	2,309,072	606,252	602,546	615,446	151,858	607,739	3,065,476	1,829,437

Source: Anon 2006a

Lee *et al*. (2002) reported approximately 278 stems of *Aquilaria beccariana* (>1 cm dbh) from a 52-ha long-term ecological research plot in Lambir Hills National Park (Fig. 3). However, Dawend et al. (2005) reported that most of the trees in this plot had been wounded by collectors and were felt to be too small to sustain the population. As for Sabah, there has been no recent study on agarwood-producing species.

1.3.2. *Habitat types*

Aquilaria malaccensis is widespread in the lowland dipterocarp and mixed dipterocarp forests at altitudes up to 270 m while *Aetoxylon sympetalum* occurs in the lowland mixed dipterocarp forest and heath forest at altitudes up to 100 m.

1.3.3 *Role of the species in its ecosystem*

The role of the species in its ecosystem is unknown.

1.4 Population

1.4.1 *Global Population size*

The Malaysian data is insufficient to extrapolate the global population size of the species since little is known about the regeneration pattern and size class distribution within the larger extent of its range.

1.4.2 *Current global population trends*

The population is decreasing. Many studies have reported a reduction in natural populations in Peninsular Malaysia (Mah *et al*. 1983, Giano 1986), Sarawak (Chin 1985, Dawend *et al*. 2005, Brookfield *et al*. 1995) and Sabah (Judeth *et al*. 2000, Henrik 2001, Anon. 2005b).

1.5 Conservation status

1.5.1 *Global conservation status* (according to IUCN Red List)

VU A1cd (ver 2.3)

1.5.2 *National conservation status for Malaysia*

VU A4c (2007)

1.5.3 *Main threats within Malaysia*

Unsustainable harvest, habitat loss/degradation (human induced).

2 SPECIES MANAGEMENT IN MALAYSIA

2.1 Management measures

2.1.1 *Management history*

Harvesting in the Malaysian production forests follows the Selective Management System (SMS). All production forests of the Permanent Reserved Forests (PRFs) in Peninsular Malaysia are managed through the SMS. This system is currently intertwined with the Malaysian Criteria and Indicators for Forest Management Certification, a market-linked tool to promote and encourage sustainable forest management as well as to provide an assurance to buyers that the timber products they purchase come from sustainably managed forests. Prior to the SMS, Malaysia had practised the Malayan Uniform System, whereby the mature stand in a primary forest was cleared in a single commercial felling followed immediately by systematic silviculture treatments to release natural regeneration obtained from advanced growth (Wyatt-Smith 1995).

There was no specific management plan for agarwood-producing species under the SMS. Agarwood is treated as a minor forest product.

Global demand prior to 1975 was specific to niche markets and harvesting was done selectively. Harvesting only became unsustainable when the price of *gaharu* escalated.

No harvesting is permitted in areas gazetted as Totally Protected.

2.1.2 *Purpose of the management plan in place*

The SMS was formulated in 1978 to recognize the importance of a balance between sustainability of harvesting with long-term conservation. It was also designed to achieve sustainability of harvest with minimum development costs and optimise harvesting under prevailing conditions.

2.1.3 *General elements of the management plan*

Since agarwood is treated as a minor forest product, harvesting of the species is not subjected to the restrictions imposed in the SMS, i.e., there is no cutting cycle and the minimum diameter limit of 45 cm is not observed.

A Standard of Procedures was developed in 2005 to control and monitor harvesting, processing and trade activities (Anon. 2005a). With regards to the harvest license, a deposit of MYR10,000 (approx. US $3,125) is imposed on each license approved. Trees <20 cm diameter and trees in flower and fruit are not allowed to be harvested. The harvest quota is set at 500 kg of wood chips per month per license and a royalty rate of 10% *ad valorem* per kg (depending on the grade) is charged on the amount of gaharu taken. Any person who contravenes any terms and conditions stipulated in the license is liable to be blacklisted or subjected to the cancellation of the license. In addition, the licensee is required to supply 3,000 seedlings per annum to the State Forestry Department and to submit a monthly shuttle return. With regards to licensing for the purpose of processing and trade, manufacturers and traders must have a valid license, are required to maintain a log book indicating the amount of *gaharu* processed and traded, and to submit monthly shuttle returns. Where export is concerned, a CITES permit is required. The exporter is also required to register with the Malaysian Timber Industry Board (MTIB).

2.1.4 *Restoration or alleviation measures*

Trial planting of *Aquilaria malaccensis*, as part of both government and private sector initiatives, is being conducted in Peninsular Malaysia, Sabah and Sarawak (Mohd Paiz 2006, Dawend *et al*. 2005, D. Alloysius, Yayasan Sabah, pers. comm.). Research attempts are being carried out on inoculation, chemical analysis of the resin, growth performance under plantation conditions, and large-scale planting in

Malaysia. Experimental planting of this species has not yet expanded to commercial scale because of several reasons. Not all inoculated trees develop the resin which indicates a significant degree of phenotypic variation with regards to disease resistance in natural populations. Genotypes differ in their behaviour as host when attacked by pathogens. Different genotypes of the same pathogenic species may be successful to different degrees as parasites on different host genotypes. Certain strains or land races may be more sensitive or responsive to fungal attack than others. Other factors that limit large-scale planting are the scarcity of planting materials and low seed viability. Research efforts are currently underway to mass-propagate plantlets containing desired traits.

2.2 Monitoring system

2.2.1 *Methods used to monitor harvest*
As mentioned in section 2.1.3.

2.2.2 *Confidence in the use of monitoring*
As will be seen in section 3.3., the regulation of harvest, processing and trade through licenses requires improvement. There are inherent difficulties in attempting to regulate harvesting activities undertaken by indigenous communities and foreign collectors. In view of the lucrative nature of the trade, Nicholas (2000) and Lim *et al*. (in. prep.) observed that personnel from enforcement agencies have also been engaged in the trading of agarwood.

2.3 Legal framework and law enforcement

Malaysia has general laws that include the governing of agarwood collection (protection of flora), cultivation, processing and manufacture, domestic and international trade. The laws for the protection of agarwood-producing species include two aspects, i.e., the establishment of protected areas and the regulation of harvest. Laws that address both of these aspects include the *National Forestry Act 1984* (amended 1993), *Sarawak Forests Ordinance 1958* (amended 1999), *Sabah Forest Enactment 1968* (amended 1992), *Protection of Wildlife Act 1972*, *Sabah Wildlife Conservation Enactment 1997* and *Sarawak Wildlife Protection Ordinance 1998*.

The Customs Act 1967 and the *Sales Tax Act 1972* regulate the sale and export of *gaharu* in Malaysia by imposing a 5% sales tax and a 10% export duty on '*gaharu* wood chips' (*Customs Duties Order 1996*, HS Code 1211.90 200). The export duty was however removed in 2003 *(Customs Duties (Amendment) (No. 5) Order 2003). The Customs*

(Export Prohibition) Order 1998 and the *Customs (Import Prohibition) Order 1998* both require that all exporters and importers of logs (HS Code 44.03 which includes logs of agarwood-producing species) obtain a license from MTIB. In addition, the *Customs (Prohibition of Imports) (Amendment) (No. 4) Order 2006*, which came into operation on 01 June 2006, requires that all imports of agarwood into Malaysia be accompanied by an import permit as stipulated under CITES, issued by or on behalf of the Director General of MTIB (Sch 4, 51(5)(b); 52(5)(b)).

The *Sale of Drugs Act 1952* regulates the sale of gaharu oil, perfume and medicine while the *Control of Drugs and Cosmetics Regulations 1984* made under this Act requires that these products be registered with the Drug Control Authority and that all manufacturers, importers and wholesalers be licensed. Also of some relevance is the *Local Government Act 1976* which has provisions for the licensing of the retail sales of goods.

Peninsular Malaysia and Federal Territories

The National Forestry Act 1984 (amended 1993) regulates the collection of minor forest produce through the application of licenses. There is no specific category for agarwood in the State *Forest Rules* made under the Act. In Peninsular Malaysia, wood chips, powder and oil are classified as minor forest products in accordance with Section 2(b) of the Act and a license is required for collecting. However, for the purpose of the collection of royalties, *gaharu* comes under an open clause of the Royalty Rate List that states 'Minor Forest Produce: Miscellaneous – Forest produce not mentioned above' (e.g. Pahang *Forest Rules 1987* Sch II (ii) 2.11 (d)). Such harvest requires a license or permit issued by the State Forestry Department. There is no provision in Peninsular Malaysia that declares agarwood-producing species as totally protected. Any individual caught without a license will be charged and on conviction will be fined not more than MYR 500,000 (approx. US $156,250) or imprisoned for not less than one year but not more than 20 years or both.

Sabah

The Sabah *Forest Rules* 1969 fix the royalty rate on gaharu at 10% of the value (Sch II, Pt A, s(h) 'Minor Forest Produce (Damar, Fossil, Gums, *Gaharu*, Cinnamon, Sticks, Tengkawang, etc)'). The *Rules* originally listed *Aquilaria malaccensis* as a Commercial Species, Class J, with a minimum felling diameter of 60 cm dbh (Sch I). However, effective 02 January 2004, the Sabah Forestry Department has classified *A. malaccensis* as a prohibited species to be retained inside Forest Reserves (Sch C;

Clause 1(31) of the *Standard Sustainable Forest Management Licence Agreement* – s 15(1) *Forest Enactment* 1968). In addition, the *Sabah Wildlife Conservation Enactment 1997* requires a permit for harvesting any species listed in Appendices I and II of CITES. Beginning in 2004, Sabah imposed a ban on *gaharu* extraction from its Forest Reserves while the local CITES Management Authority has been requested to verify extraction permits with the State Forest Department.

Sarawak

Although the State *Forest Rules* made under the *Forest Ordinance* 1958 contain detailed prescriptions governing the collection of royalties and fees, as well as collection of latex and resin from a number of tree species, there is no specific provision for agarwood. Provision for the collection of royalties on *gaharu* harvested in Sarawak under license is set out in section 52(2). Sch I, Class III, Miscellaneous, 'Other forest produce not specified above', with the rate specified as 10% *ad valorem*. Fee to collect is set at MYR1.00 per month (Sch 2 H. 'Other forest produce') payable at the time of the issue of the permit (s 52(4)).

The key agarwood-producing species in Sarawak, *Aetoxylon sympetalum, Aquilaria beccariana* and *A. microcarpa*, are specifically listed as 'protected plants' under the Sarawak's *Wildlife Protection Ordinance 1998* (Part II of the Second Schedule). A permit from the Controller of Wildlife is required to harvest and trade in these species as well as any plant species included in CITES Appendices I and II. The application fee for such permits is MYR100 per year. Any party that contravenes this Ordinance will be charged and on conviction a fine of MYR10,000 (approx. US $3,125) or one year imprisonment. In addition, the *Sarawak National Parks and Nature Reserves Ordinance 1998* makes it an offence for any person to collect or remove gaharu from any national park or nature reserve.

There is an apparent disregard for these laws as seen from the increase in illegal harvest activities. Numerous attempts have been made to control the illegal collection of *gaharu* undertaken either by foreigners or extracted from areas protected by law. Between 1992 and 2005, at least 197 *gaharu*-related arrests were reported (Lim *et al*. in prep.). Enforcement agencies have worked together to address the problem of illegal harvest by foreign collectors. Police and the Armed Forces are regularly assisting the State Forestry Departments, State Departments of Wildlife and National Parks (DWNP), Johor National Parks Corporation and other agencies in charge of protected areas. Army patrols have been sent into national and state parks to investigate incursions by illegal collectors while DWNP and the Police have established 'round-the-clock patrols' in Taman Negara and along the

East-West highway in Peninsular Malaysia (Anon. 1995). In 1999, the Perak State Government announced an informant reward system to curb *gaharu* smuggling (Anon. 1999). In addition, crack-down operations are intermittently conducted in the respective states. Despite the close cooperation between all enforcement agencies, reports indicate that illegal *gaharu* collection continues to escalate (Anon. 2004a).

The International Trade in Endangered Species Act 2008 *[Act 686]* was passed by Parliament on 24 December 2007. The Act provides for the administration and management of international trade in endangered species to ensure that the trade does not threaten the survival of any species of wild fauna and flora. The Act will be gazetted soon and regulations are being drafted to ensure its smooth implementation.

3 UTILIZATION AND TRADE FOR MALAYSIA

3.1 Type of use (origin) and destinations (purposes)

Agarwood is used for medicinal, aromatic and religious purposes in Buddhist, Jewish, Christian, Muslim and Hindu societies. The centuries-old trade was initially confined to very specific markets but has increased dramatically since the 1970s with economic growth, especially in the Middle East and northeast Asia consumer markets.

Historically, *gaharu* uses in Malaysia included the aromatic range (i.e., perfumery, fragrance, pharmaceutical (medicine and aromatherapy)), religious, ceremonial and spiritual rituals (burnt offerings, idols, rosary), and decorative carvings. The use of a piece of agarwood largely depends on its grade and the ethnicity of the user.

Agarwood-producing species are traded in a variety of forms ranging from whole plants (seedlings) and logs to chips, flakes, oil and spent powder wastes. The terms ‘agarwood’ and ‘*gaharu*’ are usually taken to refer only to resin-impregnated pieces of wood (Grade C and above) that have been at least partially shaved of non-impregnated wood (the CITES terminology for these pieces is wood chips). Most forms of semi-processed or raw *gaharu* in trade only reach about 10 cm in length and can be accurately referred to as chips, fragments, shavings and splinters, even breaking down to tiny particles of powder and dust.

Major importing countries include the Middle East, Taiwan, Japan and Korea while the minor markets are the US and Europe. Singapore is a major entrepot. All derivatives are derived from wild specimens.

3.2 Harvest

3.2.1 *Harvesting regime*

Being a commodity that only in 1975 saw an increase in consumer demand, there are no operating provisions within the SMS imposing a harvesting regime on agarwood-producing species in natural forests except for the recently established Standard of Procedures (see section 2.1.3).

There are two main methods of harvesting *gaharu*: fatal harvest and sub-lethal harvest. The more commonly reported method is fatal harvest, whereby the whole tree is chopped down to harvest the *gaharu*. Early reports indicate that fatal harvests of *Aquilaria* in Peninsular Malaysia were already occurring in Johor (Bland 1886) and Selangor (Skeat 1900) during the 19th Century. Although such harvest generally kills the tree, many trees are able to coppice profusely (Green 1999). Corner (1978) found that the bark of *Aquilaria malaccensis* coppiced 7–8 months after being damaged. This allows the sub-lethal harvesting method to be employed. A report by the Thailand-based WildAid Foundation found that *Aquilaria* trees are relatively robust and can be tapped by chipping or cutting the infected part for over 10 years before they die (Anon. 2004b). Local communities involved in collection in Peninsular Malaysia routinely practise this harvest method on a rotation of 2–3 months where trees are still alive after 15 years of coppicing (Yamada 1995).

3.2.2 *Harvest management/control* (quotas, seasons, permits, etc.)

The commercial harvesting of *gaharu* requires a license and removal pass issued by the State Forestry Departments in Peninsular Malaysia and Sabah and the Sarawak Forestry Corporation. The removal pass is issued as proof that all fees have been paid and that the logs were harvested from a licensed area. The Forestry Department has not reported the issuance of licenses for the collection of *gaharu* in Peninsular Malaysia.

Malaysia subscribes to the setting of a harvest quota and permit requirement of CITES. The harvest and export quota for 2007 and 2008 have been submitted to the Secretariat. In Sabah, official records indicate that agarwood is extracted only for its timber and not for other purposes. However, the production and trade of agarwood oil in Malaysia is not well monitored. The Malaysian Management Authorities for agarwood are MTIB (Peninsular Malaysia and Sabah) and Sarawak Forestry Corporation (Sarawak).

3.3 Legal and illegal trade levels

During 1995–2005, 6,092,024 kg of *gaharu* were exported from Malaysia (Anon. 2006b). During the same period, CITES permits were issued only for c. 3,000,000 kg of *gaharu*. In 2003 and 2004, the volume stated in CITES permits actually exceeded the volume of exports reported officially. The switch between declaration under HS Chapter 12 and Chapter 44 is the main cause of this large discrepancy.

As national stocks rapidly declined, collectors began to illegally harvest agarwood in neighbouring countries. Foreign nationals have been reported to be involved in illegal harvesting in Malaysia since 1987 (Anon. 2004a). These foreigners are predominantly from Thailand, Cambodia, Indonesia and the Philippines. The harvesting took place both in the Permanent Reserved Forests and totally protected areas. Notable cases of illegal harvesting took place in Taman Negara and Endau Rompin National Park, a National Park and State Park respectively, with totally protected status. Collection of *gaharu* by local communities has been impeded by the presence of foreign collectors (Faezah 1995, Anon., 2004c), many of whom are equipped with firearms (Anon. 2002).

Collectors from Thailand were also reported to be active in Sabah in 1999 and in Sarawak in 2005 (Dawend et al., 2005). Given the extensive border shared between Indonesian and Malaysian Borneo, Indonesian collectors have probably been active in Sabah and Sarawak for many years. In addition, collectors from the Philippines have also been reported to be collecting gaharu in Sabah and Sarawak. Several arrests had been made in Sabah and Sarawak since 2000.

II. Non-detriment finding procedure (NDFs)

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

The NDF is preliminary.

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED. BIOLOGICAL CHARACTERISTICS OF THE SPECIES, REGULATION OF HARVEST AND TRADE STATISTICS.

The criteria, parameters and/or indicators used to prepare the non-detriment finding for *Aquilaria malaccensis* are:

- density and demography of selected populations occurring in the various Permanent Sample Plots (PSPs) and plots laid out for national forest inventories (NFIs);
- harvesting limits employed under the Standard of Procedures; and
- pattern and level of exploitation for international trade, including trade statistics.

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

The data for density and demographic patterns are obtained from field evaluation on the above-mentioned plots and plots established for academic research. For the plots established under PSP and NFI, the published data is data that has been analysed. National Forest Inventories are conducted only for Peninsular Malaysia. Also see literature cited.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

None.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF

The major problems include:

- Very little is known about *Aquilaria malaccensis's* population distribution patterns, demography, ecology, flowering phenology, reproductive behaviour, fruit production, recruitment and regeneration patterns, natural mortality, and mortality/regeneration caused by stem damages. Its widespread but low density occurrence exacerbates this problem.
- Little information is available on the response and rate of infection in naturally occurring trees, on the quality of infected resinwood, and on recovery rates (volume) of chips, particularly those used for oil production. The grade of the *gaharu* resin in trees cannot be easily determined with full certainty and infected trees lack definitive external signs indicating resin grade. This leads to indiscriminate harvesting which poses many problems to sustainability and regulation of legal harvests. In cases where the resin is absent, felled trees and stumps are left standing in anticipation that a resin-producing reaction will take place.
- The scenario for other species of *Aquilaria* is even more acute. The discord between taxon recognition and the inability of the industry/trade to segregate harvest products according to taxon as

required by CITES should be addressed. Any procedures that aim to control harvests must recognize the above limitations.
- Current procedures to control harvesting, manufacturing and trade need to be reviewed for effective monitoring.
- As different agencies are tasked with managing the same forested areas where agarwood occurs, a coordinated approach towards monitoring is crucial.

There have been some management interventions such as licensing and establishment of cultivated *Aquilaria*. Malaysia has yet to produce agarwood from these cultivated trees.

6. RECOMMENDATIONS

Recommendations must be relevant to the major problems outlined above. In view of these, the criteria, parameters and/or indicators currently used to prepare the non-detriment finding for *Aquilaria malaccensis* are deemed to be appropriate. The data quantity and quality for NDF can only be evaluated with respect to current stocking.

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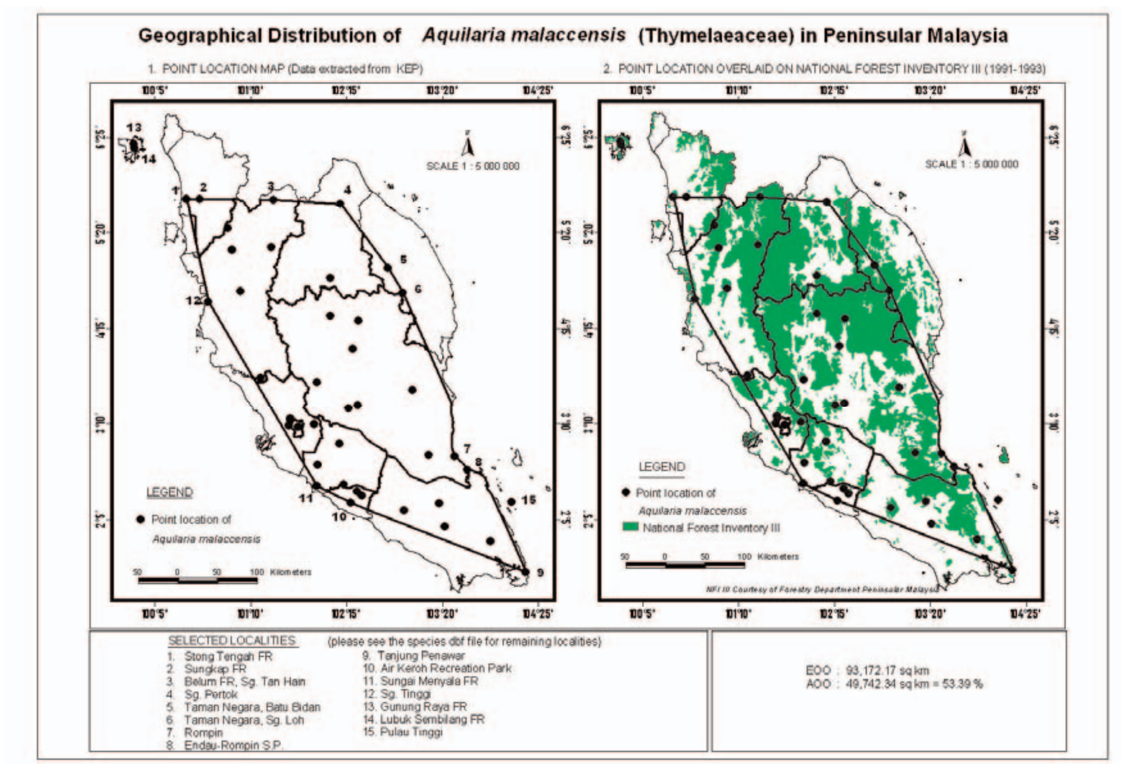

Figure 1. The geographical distribution of *Aquilaria malaccensis* in Malaysia.

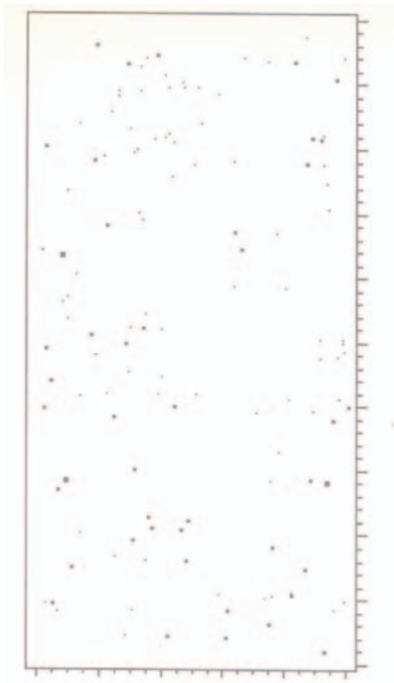

Figure 2. The distribution of *Aquilaria malaccensis* in the Pasoh 50-ha tree demograhic plot.

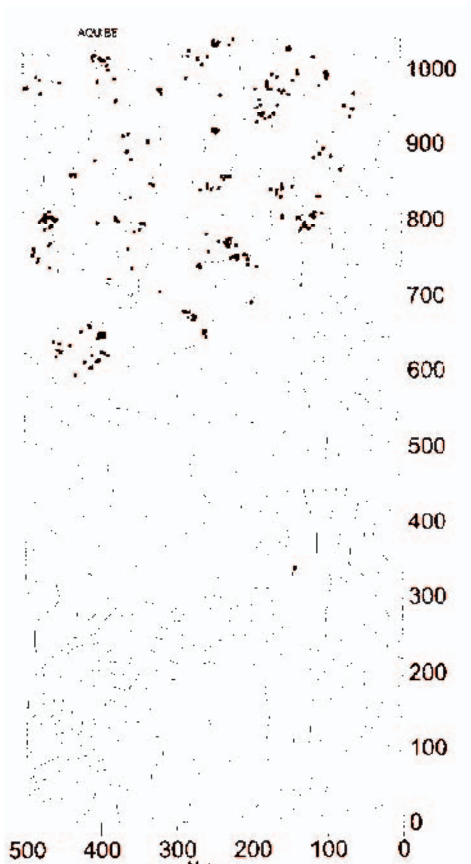

Figure 3. The distribution of *Aquilaria beccariana* (>1 cm dbh) in the 52-ha plot in Lambir Hills National Park.

Appendix 1. Major agarwood-producing species native to Malaysia.

Species	Distribution in Malaysia (State)
Aetoxylon sympetalum Airy Shaw	Sarawak
Aquilaria beccariana Tiegh.	Johor, Sabah, Sarawak
Aquilaria hirta Ridl.	Peninsular Malaysia (Terengganu, Pahang, Johor)
Aquilaria malaccensis Lam.	Peninsular Malaysia, Sabah, Sarawak
Aquilaria microcarpa Baill.	Sabah, Sarawak
Gonystylus brunnescens Airy Shaw	Peninsular Malaysia, Sabah, Sarawak
Gonystylus confusus Airy Shaw	Peninsular Malaysia
Gonystylus macrophyllus (Miq.) Airy Shaw	Peninsular Malaysia, Sabah, Sarawak
Wikstroemia androsaemifolia Decne.	Peninsular Malaysia, Sabah, Sarawak
Wikstroemia polyantha Merr.	Peninsular Malaysia, Sabah, Sarawak
Wikstroemia ridleyi Gamble	Peninsular Malaysia (Kelantan, Terengganu, Pahang)
Wikstroemia tenuiramis Miq.	Sabah, Sarawak

NON-DETRIMENT FINDINGS REPORT ON *PERICOPSIS ELATA* (FABACEAE) IN CAMEROON

AUTHOR:
Dr Jean Lagarde Betti

Pericopsis elata, known under its trade/pilot name as Afrormosia or Assamela is a tree species of the close, Guinean-Congolese forest type. *It* is classified by the World Alliance for Nature (IUCN) as endangered species, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). To ensure its conservation, the Government has fixed its minimum girth limit at 100 cm: this is called the administrative minimum exploitable diameter (MED/ADM).

In Cameroon the distribution of *Pericopsis elata* is largely restricted to the East province, particularly in the semi-deciduous forests of Boumba & Ngoko and Haut-Nyong divisions where it occurs with densities of 0.67 stem/ha for diameter classes ≥ 20 cm.

The basis of restoration and alleviation measures is outlined in element 5, article 6 of the arête *n° 0222/A/MINEF/ of 25 May 2001:* calculation of the forest possibility and the determination of the managed minimum exploitable diameter (MED/AME). The parameters used for calculation include: the choice of the managed trees, the rotation, the growth rate in diameter of trees, the mortality rate, the logging damage rate. The principle of the simulation consists of increasing progressively the MED/ADM as to get a fair reconstitution rate (Re). The new MED which gives the best reconstitution (Re ≥ 50) is called the MED/AME.

Pericopsis elata is one of the scarce species for which the manager does not need to increase the MED/ADM. The summit of the specific curve is at 75 cm of diameter, which is less than the MED/ADM. This means that, it is almost dead individuals of Assamela which are logged. The individuals of diameter ≥ 100 cm are wilting, and stems of many of them are rotten. They are therefore often abandoned in the forest, which lead to an economic loss for both the forest company and the Cameroon government. Data gathered in ten management plans, tend to show that Assamela is not threatened in Cameroon, at least in the East province where it is logged. The average density is 0.53 stem/ha while the average value of the reconstitution rate is 185, which is too high compared to the limit required for sustainable management. This high level of Re is due to the high value of the MED/ADM.

Control of timber exploitation, trade and exportation is the main responsibility of the forest administration Three major provisions can be considered as specific to CITES implementation: (1) the signing in 2005 of an enactment decree to implement some provisions of the CITES, (2) one Ministerial Order issued in 2006 on the organizational and operational procedures of the Inter-ministerial Coordination and Monitoring Committee to Implement CITES, and (3) the designation of a CITES Scientific Authority for Endangered plant species. But the current monitoring system faces many problems in the field, the most important being the lack of financial and logistical resources to appropriately conduct forest monitoring and achieve the several tiers of objectives ascribed to sustainable forest management (SFM). However, Cameroon is currently engaged in negotiations with the European Union to reach a Voluntary Partnership Agreement (APV/FLEGT) to improve the governance and transparency of the timber trade between the two partners. This will contribute to reinforce the control and monitoring system in the timber sector.

The method used to calculate the forest possibility and the managed minimum exploitable diameter can be advised for a NDF protocol for CITES plant species for a specific country or specific production forest. The Cameroon case suggests that a NDF report should address a specific production or under management forest.

This report was dressed based mainly on available information found in the forest administration at Yaoundé. Some recommendations are made for a complete Non-detriment Findings report on *Pericopsis* elata in Cameroon

CASE STUDY ON NDF OF AGAR WOOD (*Aquilaria* spp. & *Gyrinops* spp.) IN INDONESIA

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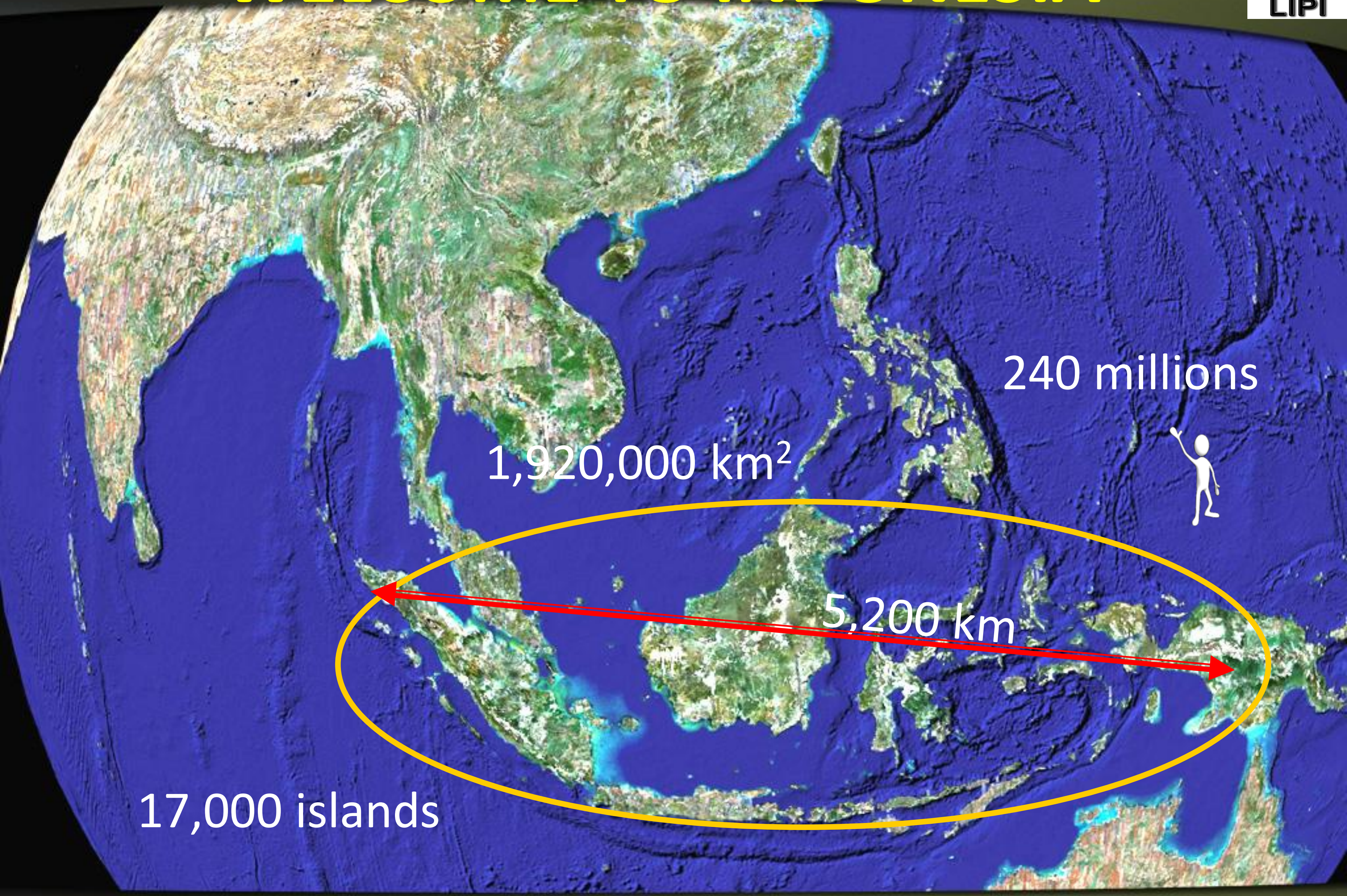
WELCOME TO INDONESIA



Forest area by forest category across the seven main islands in Indonesia

No.	Land forest coverage (status)	Size (thousands of ha)	%
1	Conservation forest areas	14,365	15.3
2	Protected forest areas	22,102	23.5
3	Production forest divided into 3 categories		
3.a	Limited Production Forest (HPT)	18,180	19.4
3.b	Production Forest (HP)	20,624	22.0
3.c	Production Forest subject to be converted (HPK)	10,693	11.4
	Sub Total	49,497	52.7
4	Other land use	7,967	8.4
	Total	93,924	100

Data sources: *Rehabilitation of Land Forest Cover in Indonesia year 2005, BAPLAN 2005)*

Agar wood producing species in Indonesia

Species	Ecology (m asl) *	Distribution
A. beccariana van Tiegh.	Up to 825: primary forets	Sumatra, Borneo/Kalimantan, common
A. cumingiana (Decne) Ridl.	Medium altitude: in primary forest	South Borneo, Moluccas (Morotai & Halmahera),
A. fillaria (Oken) Merr.	Up to 130: open swamp forest	Celebes, Moluccas: Morotai, Seram& Ambon, West New Guinea: Sorong & Babo)
A. hirta Ridl.	Up to 300: in hill slope from lowland forest	Riau, South Sumatra, Bangka, Belitung & other neighboring small islands (Bintan, Batam).
A. malaccensis Lamk.	Up to 270: common in primary forest	Sumatra, Borneo/Kalimantan &its surrounding small islands
A. microcarpa Baill.	Up to 200 at primary forest	Sumatra, Bangka-Belitung,Borneo/Kalimatan & other neighboring small islands)
G. decipiens nov. sp.	At 100 m, primary forest	Central Celebes (Warotoli, Palarabi)
G. ladermanii Domke	0 – 200 m: virgin forest – slope area, dense	New Guinea (Mt. Prince Laderman)
G. moluccana (Miq.) Baill.	$\pm$ 100	Moluccas (Halamahera & Buru)
G. podocarpus (Gilg.) Domce	Up to 750, in primary forest	West Papua (Sorong, Monep)
G. salicifolia Ridl.	At 300 m, in fringing rain forest	Western New Guinea (Utakwa & Nabire)
G. verstigii (Gilg.) Domke	Up to 900	N.E. Celebes, Lesser Sunda Islands (Lombok, Sumbawa, Flores, Sumba) & West New Guinea)

Source of data: *Ding Hou, 1972, Wiriadinata, 1995, Soerhartono & Newton, 2001, Oyen & Nguyen Xuan Dung 1999.*

Density estimation of adult tree (> 10 cm dbh) of *Aquilaria* spp. in Sumatra and Kalimantan based on the analysis of NFI sample plots

Location	No. of plots	Total area (ha)	Density per ha
SUMATRA			
Low land	15	135	0.47 ± 0.30
Up land	3	27	0.36 ± 0.17
KALIMANTAN			
Low land	24	216	0.83 ± 0.73
Up land	11	99	1.17 ± 1.09

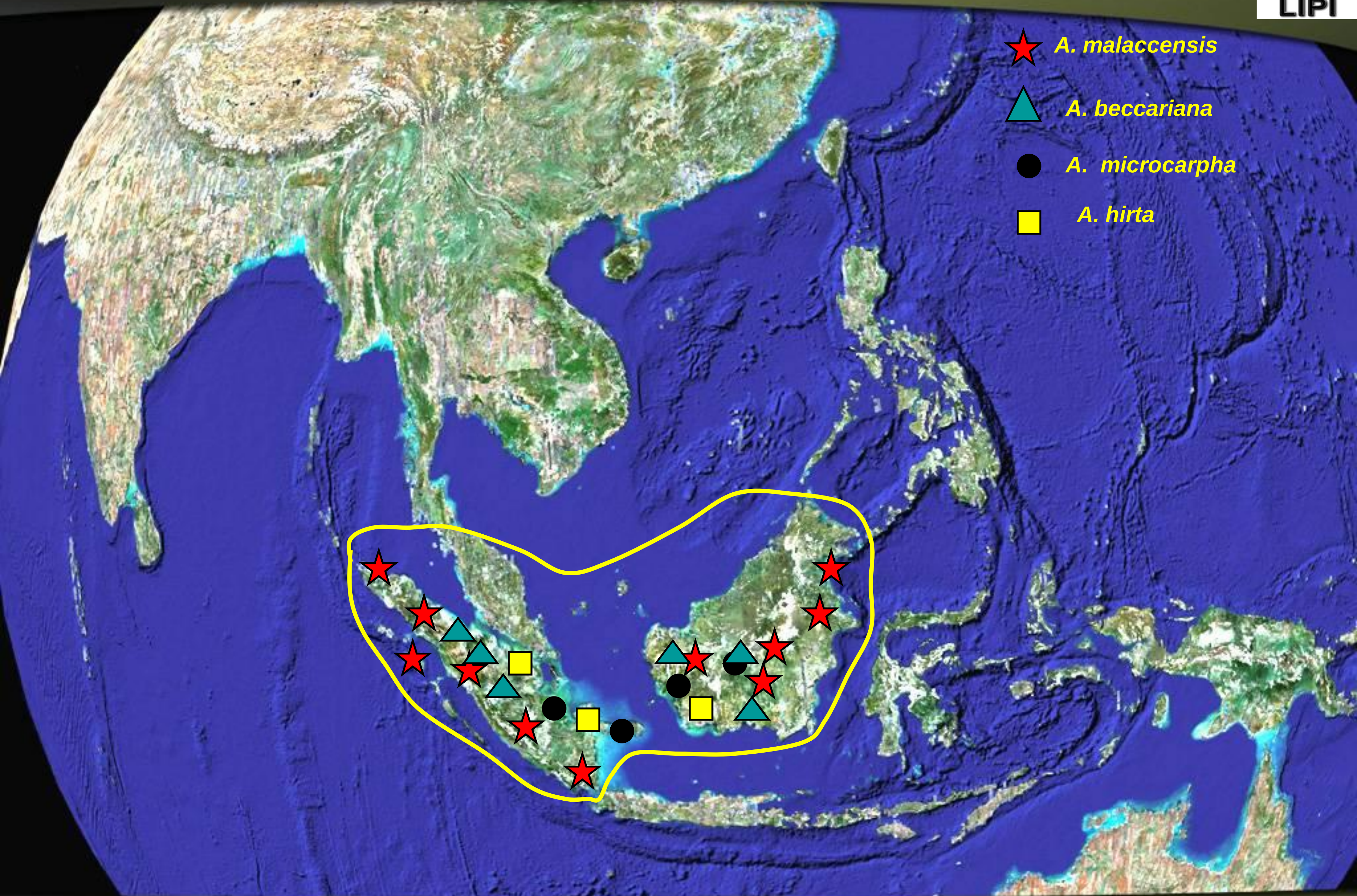
Source data: ***Soehartono & Newton, 2000*.**

Estimate of the total population of adult trees (> 10 cm dbh) of *Aquilaria* spp.in Sumatra and Kalimatan based on density estimation from NFI sample plots

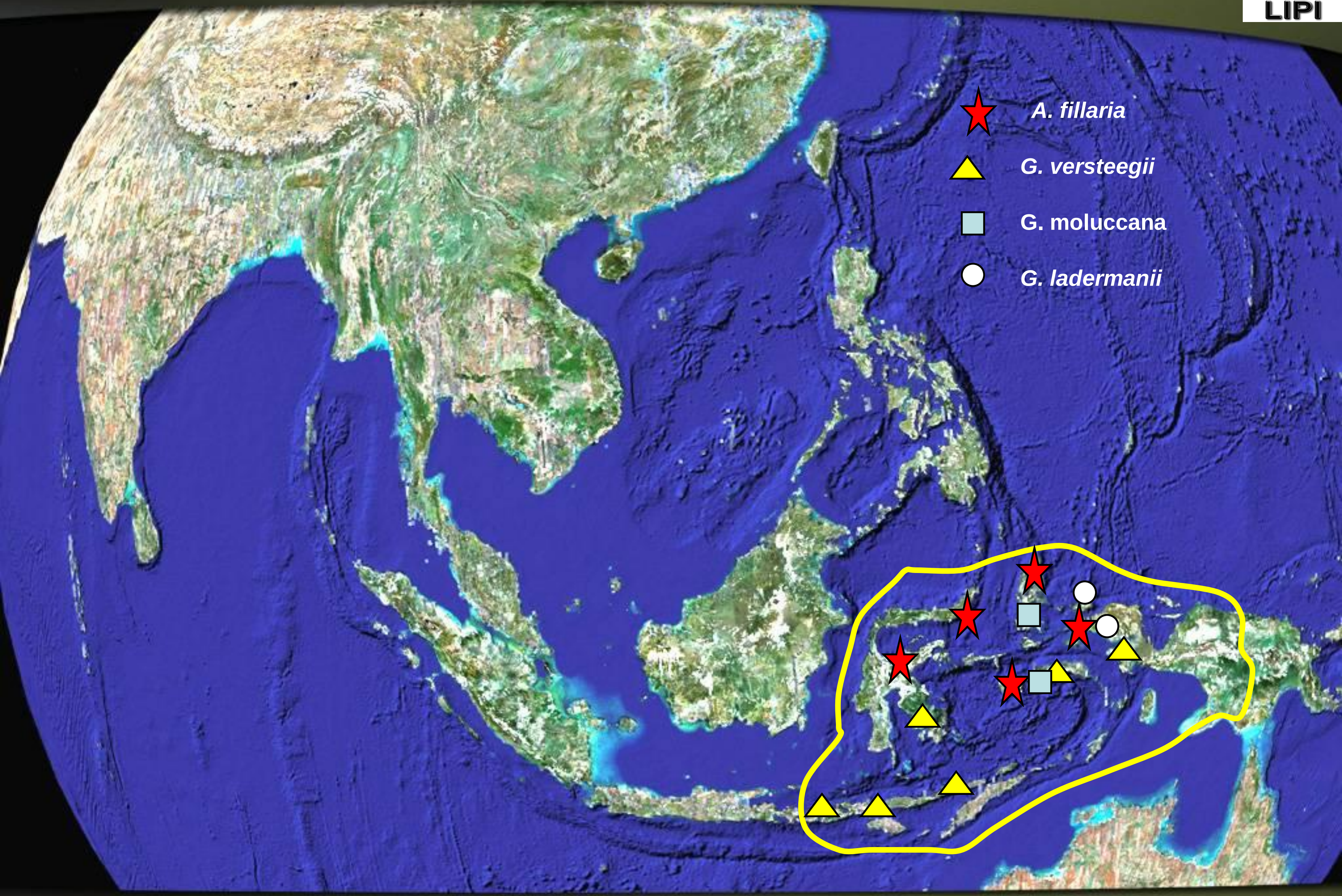
Location	Forest area (x1000 ha)	Population size (a) (x 1000)	Population size (b) (x 1000)
SUMATRA			
Low land	13,934	6,548.9 ± 4,180.2	418.0 ± 418.0
Up land	3,348	1,205.3 ± 569.1	133.9 ± 133.9
KALIMANTAN			
Low land	31,199	25,995.2 ± 22,775.6	1,559.9 ± 1,559.9
Up land	1,790	2,094.3 ± 1,951.1	483.3 ± 129.6

Source : *Soehartono & Newton, 2000*

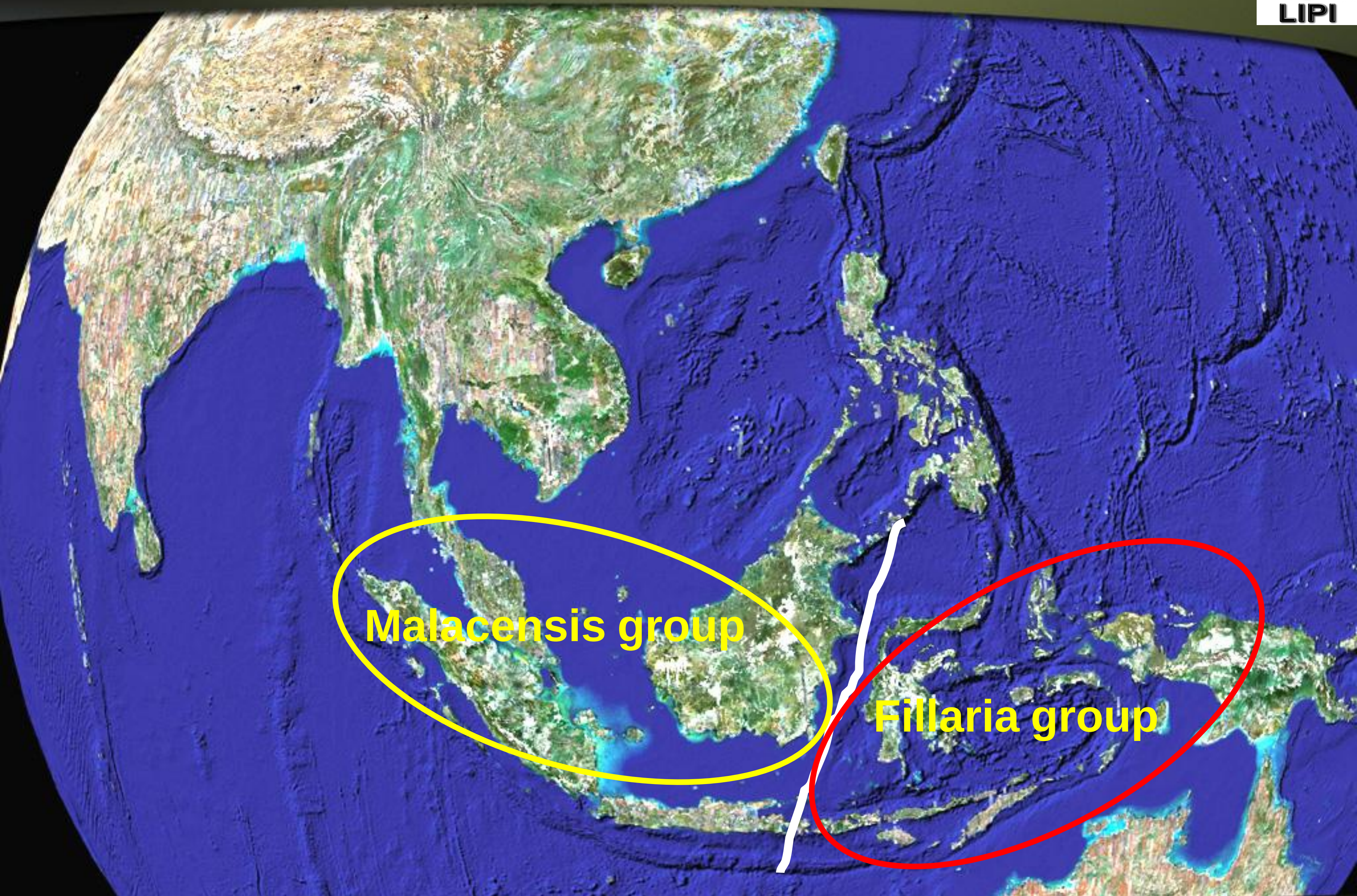
Distribution of malaccensis group



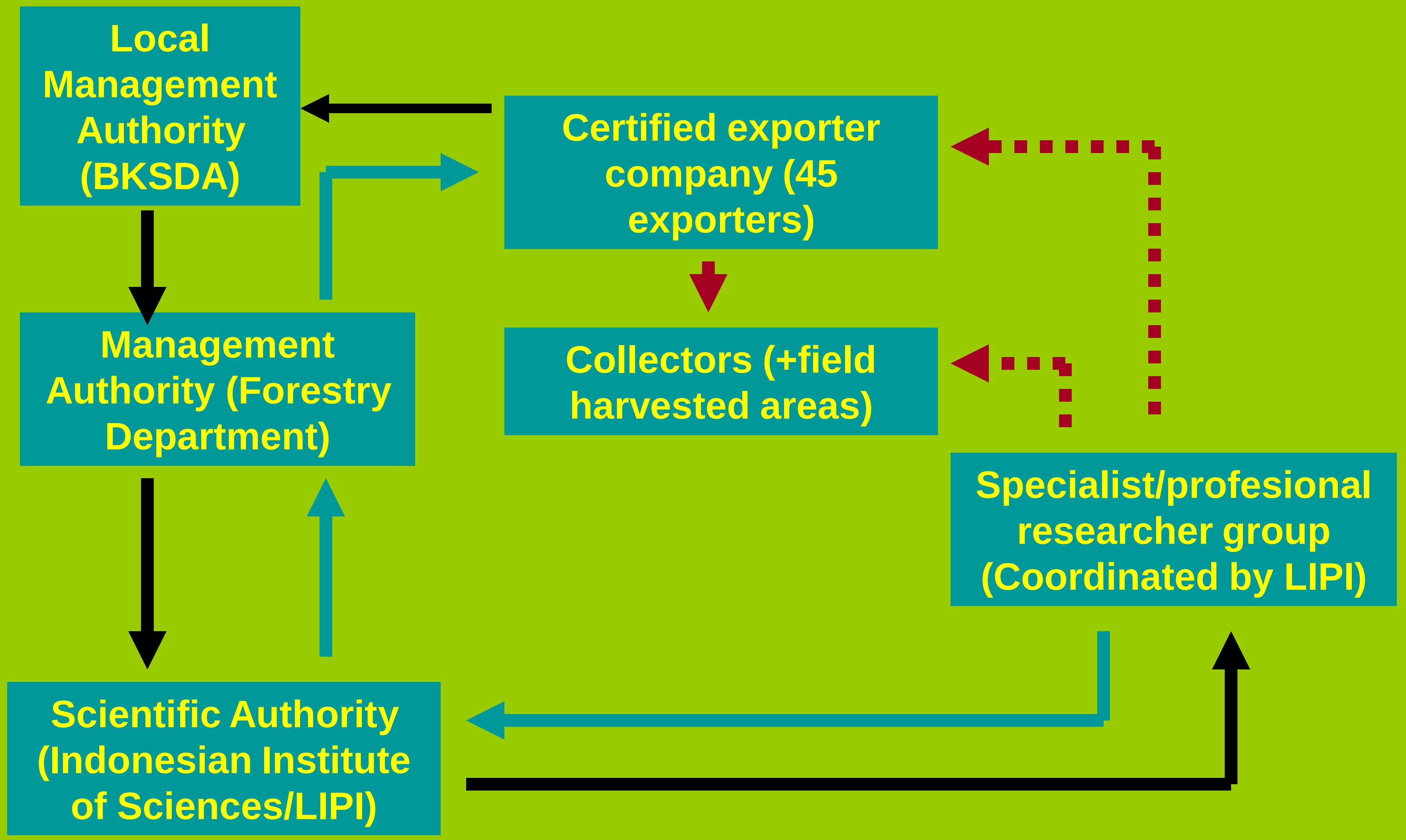
Ditribution of fillaria group



Agar wood quota setting area in Indonesia



PROCEDURE FOR DETERMINING QUOTA OF AGAR WOOD BASED ON NON DETRIMENT FINDING

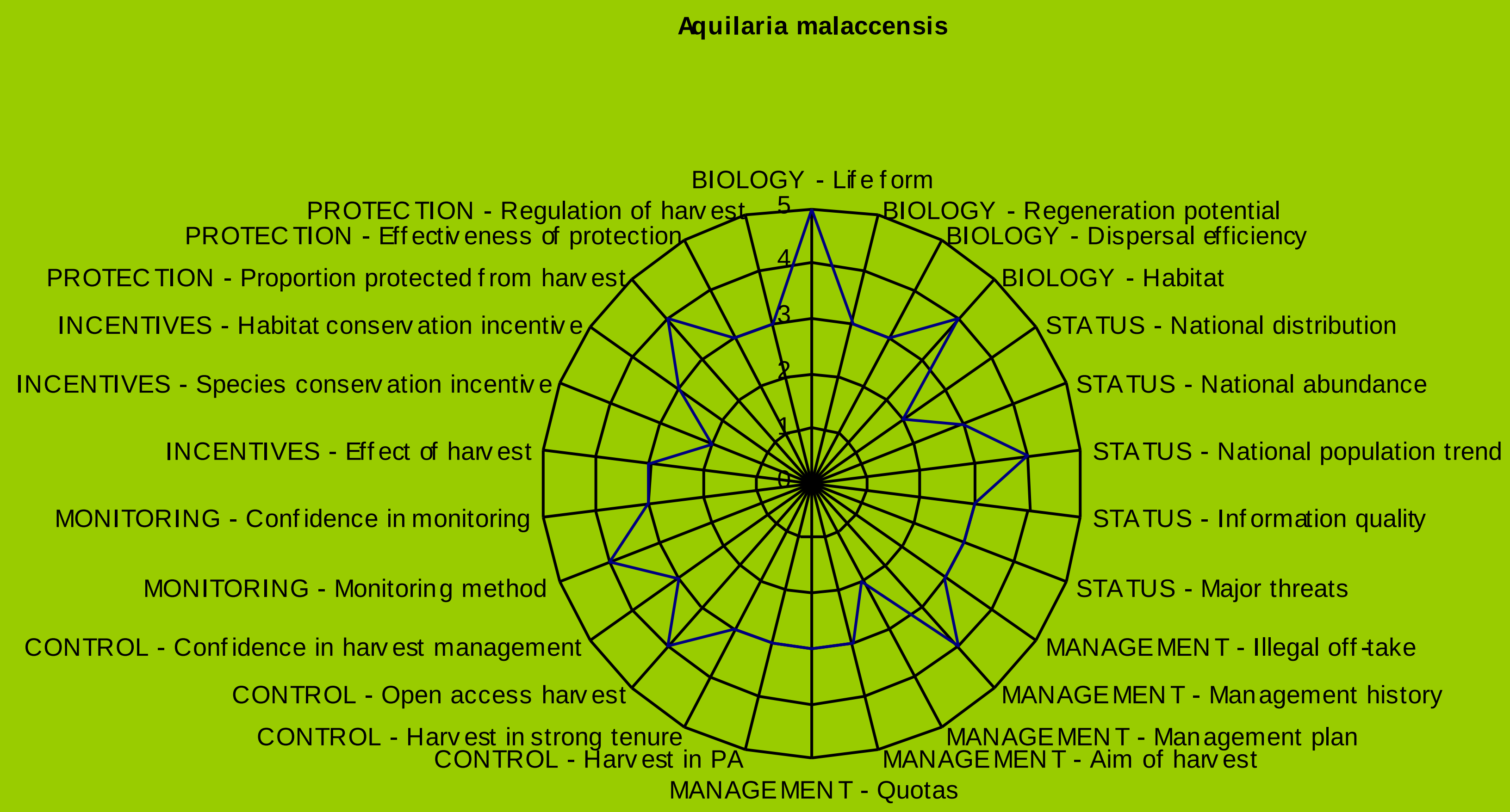


SOURCES OF AGAR WOOD POTENCY DATA FOR QUOTA SETTING

- **Field sampling by working group of agar wood in main producing areas**
- **Actual production data of Agar wood from exporters, forestry district offices, association, local traders, farmers**
- **Report data on target and realization of annual export**

Mother tree of *A. malaccensis*

NDF diagram of *A. malaccensis*



Source: Indonesia CITES document

NATIONAL QUOTA OF *A. malacensis*

Year	Quota	Realization
1996	300000	29953
1997	300000	287002
1998	150000	148238
1999	300000	81079
2000	225000	81377
2001 (App.II)	75000	74826
2002	75000	49546
2003	50000	50000
2004	50000	50000
2005	50000	50000
2006	50000	50000
2007	35000	35000
2008	30000	---

Source of data: S.A., 2008.

NATIONAL QUOTA OF *A. filaria*

Year	Quota	Realization
1998	70000	No data
1999	250000	232570
2000	200000	163773
2001 (App II)	125000	144946
2002	125000	104699
2003	125000	125000
2004	125000	125000
2005	125000	125000
2006	125000	125000
2007	65000	65000
2008	60000	---

Source of data: *S.A., 2008.*

TRADITIONAL MANAGEMENT OF AGARWOOD (*A.malaccensis*) IN EAST KALIMANTAN

Seedling of *A. malaccensis* under the mother tree

Nursery by local people

Traditional inoculation method

Mother tree grown in traditional garden

Agar wood products from traditional inoculation

UTILIZATION AND MANAGEMENT OF AGARWOOD (*A.malaccensis*) IN SUMATRA

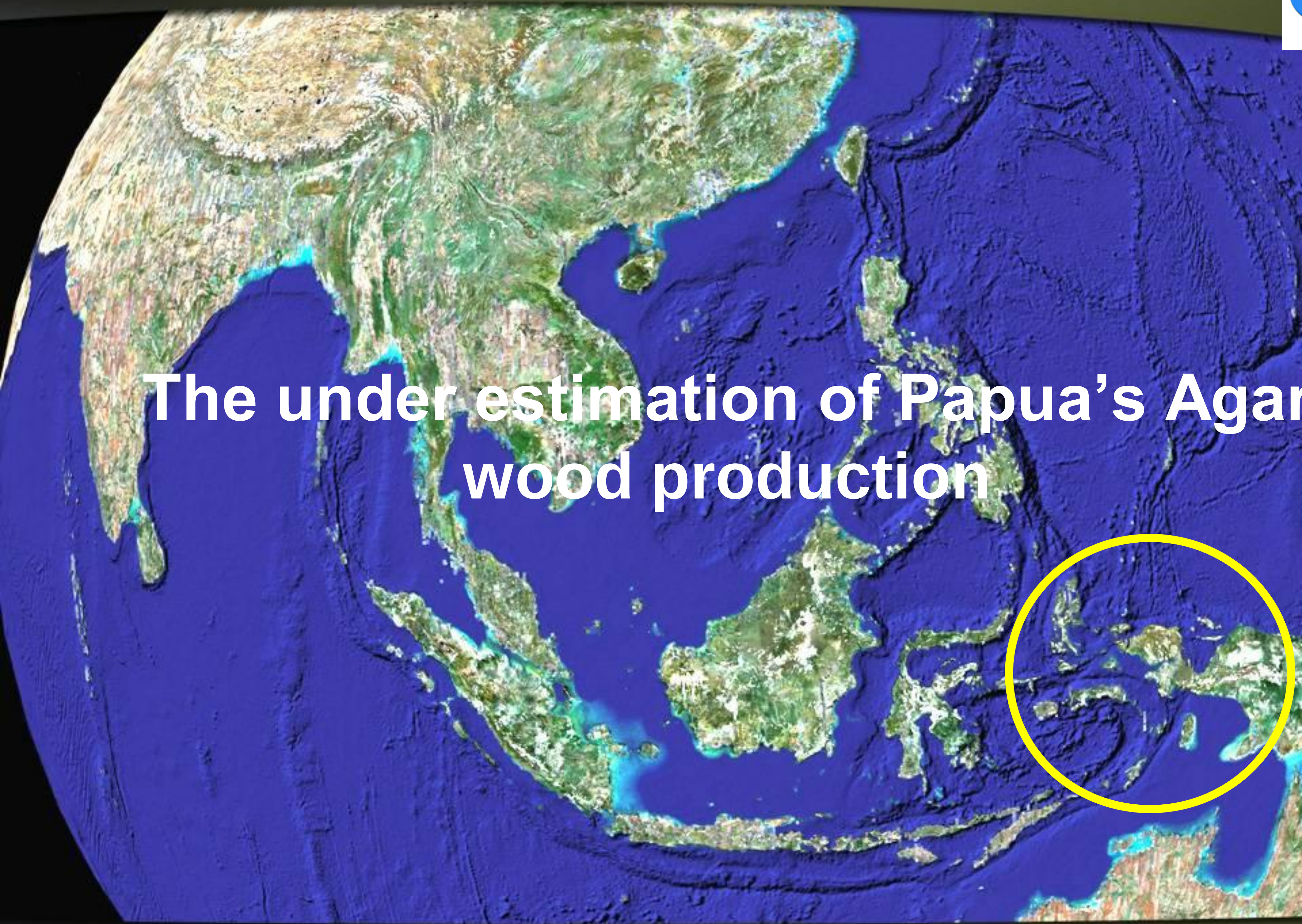
Agarwood pilot project plantation

Natural population of *A.malaccensis* in old traditional rubber plantation

***A.malaccensis* nursery in Bengkulu, Sumatra**

A big mother tree of *A.malaccensi in the village of Tasik Betung - Sumatra, with > 80 cm in diameter*

The under estimation of Papua’s Agar wood production



Forest area by forest category of the Papua Indonesia

No.	Land forest coverage (status)	Size (thousands of ha)	%
1	Conservation forest areas	7,316.76	18.07
2	Protected forest areas	9,853.44	24.33
3	Production forest divided into 3 categories	17170.02	42.40
3.a	Limited Production Forest (HPT)	3,571.33	8.82
3.b	Production Forest (HP)	9,971.66	24.63
3.c	Production Forest subject to be converted (HPK)	8,528.90	21.06
	Sub Total	22,071.89	54.51
4	Other land use	1,245.79	3.08
	Total	40,487.88	100

Data source: ***Forestry Department 2005***

Asmat & Mappi Districts (One of the potential area of huge agar wood production)

Development of extractive agar wood harvest in Papua Island (Indonesia)

- ***Circa 1994-1998 (much earlier according some qualitative data)***
  - **Gaharu were harvested by cutting the trees**
  - **Only high quality of gaharu were collected (gubal), chips were left**
  - **Local people involvement very low, only by traders**
- ***Circa 1999-2003***
  - **Local people understand the high value of gaharu, starts to collect**
  - **Kamedangan is becoming more saleable**
  - **Re-visited & re-collected on the past harvested areas (chips & fallen woods) (circa 1994-1998) by local people**
- ***Circa 2004-present***
  - **NO CUTTING trees**
  - **Agar wood gather is by collection under the mud & soil from first era harvest period**
  - **Collection site areas are close to the village (1-2 days by boat)**
  - **Gubal & kamedangan have high production**

MAIN PRODUCT OF CURRENT PRODUCTION IN PAPUA

LIPI

LOCAL PRODUCTION CENSUS IN 2007 by BBKSDA PAPUA (1-4 weeks collection)

Region	Estimated weight stored by local people (ton)
Kabupaten Asmat	
Distrik Atsy	
Kampung Sagoni	±10
Kampung Bine	±10
Kampung Comoro	±15
Kampung Atsj	±5
Kampung Waganu	±15
Kampung Fos	±5
Kampung Bipim	50
Distrik Suator	
Kampung Jinak	±10
KampungWaganu II	±15
Kabupaten Mappi	
Distrik Eci	
Kampung Asgon	±10
Kampung Amagon	±15
Kampung Kanami	±25
TOTAL STOCK IN 2 WEEKS	±140

Field verification 2007 by Forestry District (BKSDA) Merauke

LIPI

Final packaging

Final destination for trading in Java

Traditional nursery supervised by Forestry District office

OFFICIAL GAHARU PRODUCT FROM PAPUA

(recorded by BKSDA PAPUA)

Year	Gubal (kg)	Kemendangan (Kg)	National Quota - Kg (Local)
2006	105	112,500	65,000 (25,000)
2007	190	99,110	65,000 (25,000)
2008 (Sept)	220	119,825	65,000 (25,000)

Note: Potential local trade some where 2 x of those values

MISSCONCEPTION ON GAHARU TRADE FROM INDONESIA

- Gaharu trade is utilizing the WHOLE TREE
  - Bole, branch, twigs, roots
  - 1 tree (dbh.108 cm, H: 22.5 m)= 1.2 ton dry weight (8.89 ton wet weight)
- Gaharu harvest from western part (Sumatra & Kalimantan) remains from cutting the trees of the ***wild population*** (include from old traditional rubber plantation)
  - **selected trees (forest, encroachment areas, rubber plantation, yard, etc)**
- Gaharu harvest from eastern part (Papua) by utilizing the past harvested areas(1993-2003)
  - **No trees cuted (Asmat, Agats, Asgon, Atsi, Senggo & Mappi)**
  - **Could be by cutting tree system in 1 region (not yet done due to isolation area-- Region Yahokimo, requested by the District Mayor)**
- Cultivation the species has been conducted since 1989 (Sumatra, Kalimantan, NTB) and 2007 in Papua
  - Regulation for the export traders (min 2 ha)
  - Part of national re -forestation program
  - Exceed 600,000 plants has been planted (2-16 years) and > 320,000 seedling

SCIENTIFIC POINT OF VIEW

- We considered on re-evaluate the quota setting for gaharu especially in Papua:
  - Lack of accurate field data
  - Undervalued the real potency & production level
- Local production of INDONESIA gaharu would not be detriment, due to the new paradigm of utilization
  - Collected from past remaining harvested production areas
  - Harvested from controlled "wild population" areas
  - Cultivation activities throughout the potential areas
- Evaluate the scientific production level by next 3 years (starting 2009)

Conclusion

- INDONESIA still has high agar wood potency
  - What is being extracted is only a fraction of what is available
- With the supervision of MA, SA and Association the agar wood trees population is being controlled
  - Cultivation
  - Selected harvest
  - Regulations on the harvest system
  - Traditional harvest system will not damage ecosystem
  - Strict control combating illegal trade through travel document of origin
  - Mutual commitment to control the harvest & trade systems (MA, SA & Association)
- Current Indonesia era on wildlife related utilization is toward law enforcement
  - Association initiate the collaborative actions with central government on establishment of sustainable harvest to local collectors, farmers, traders & local governments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02/02/2006

NDF Workshop Case Studies
WG 1 - Trees
Case Study 4
Swietenia macrophylla
Country: Peru, Brazil and Bolivia
Original Language - English

BIG-LEAF MAHOGANY (*SWIETENIA MACROPHYLLA*) IN PERU, BOLIVIA AND BRAZIL

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I. BACKGROUND INFORMATION

The debate over bigleaf mahogany’s commercial and conservation status across its neotropical range has dominated CITES deliberations over timber species since the early 1990s (OIMT 2004). Mahogany was first proposed – unsuccessfully – for listing on Appendix II at CoP8 (Kyoto) by Costa Rica and the USA. Similar proposals met similar fates in 1994 (CoP9, Fort Lauderdale) and 1997 (CoP10, Harare). In 1995

Costa Rica included the species on Appendix III, followed by Bolivia, Brazil, and Mexico in 1997 and Colombia and Peru in 2000 (CoP11, Gigiri). The Bigleaf Mahogany Working Group was established following discussions at CoP11 (decision 11.4) and convened for the first time in 2001 (MWG1, Santa Cruz de la Sierra, Bolivia). A proposal by Guatemala and Nicaragua to uplist mahogany to Appendix II, covering only logs, sawn timber, veneer and plywood, was finally adopted at CoP12 (Santiago) by a vote of 68–30. The listing went into effect on 15 November 2003. At CoP12 the Mahogany Working Group's mandate was revised for subsequent meetings in 2003 (MWG2, Belém, Brazil) and 2006 (MWG3, Lima, Peru) (Blundell 2004).

As the world's most valuable widely traded tropical timber species, mahogany has faced commercial exploitation since the Spanish first discovered its unique properties in the 16th Century. While early exploitation focused on accessible Caribbean populations of the congeneric *Swietenia mahagoni* (listed since 1972 on Appendix II) and Central American populations of *S. macrophylla*, large-scale industrial logging shifted to vast South American stocks by the mid to late 20th Century as overland transportation networks penetrated previously inaccessible *terra firme* forests across southern Amazonia (Lamb 1966, Grogan *et al*. 2002). Mahogany's extraordinary value made single-species logging in previously unlogged primary forest profitable to hundreds of kilometers from the nearest sawmill. These were typically mining operations that removed trees as small as 20 cm diameter so long as they could pay their way out of the forest (Veríssimo *et al*. 1995). Particularly controversial were consistent reports of post-logging regeneration failure, attributed to mahogany's reliance on large-scale disturbance (as opposed to small-scale single-tree logging disturbance) for population renewal (Snook 1996, 2003, Gullison *et al*. 1996).

Moreover, mahogany's association with seasonally dry tropical forests puts it in conflict with competing land uses, especially agriculture and livestock grazing. Thus it faces severe habitat pressure: forests have been cleared from more than 63% of mahogany's range in Mesoamerica and 26% in South America (Blundell 2004).

From the early 1970s to the late 1990s, the major source of internationally traded mahogany was Brazil. As stocks there declined and the international controversy over the illegal origin of much of this supply grew, Brazilian exports fell until the government ban on harvest, transport, and commercialization in 2001. Bolivian supplies flooded the market during the early 1990s, until commercial stocks neared exhaustion and a new regulatory environment halted widespread illegal harvests. As Brazilian mahogany largely vanished from international trade in the early 2000s, Peruvian supplies spiked in response to increased demand and price, peaking at 52,000 m^3 of sawn timber in 2002 (Grogan & Schulze 2008). Since mid-2003, internationally traded mahogany sawn wood has been largely from Peru. After export quotas were imposed by Peruvian authorities in 2005, and as commercial stocks neared exhaustion, exports declined to 20,407 m^3 in 2006 (Phumpiú 2007) and below 5000 m^3 in 2007 (Grogan & Schulze 2008).

To support CITES Appendix II implementation, the 16th Meeting of the Plants Committee established 10 conditions as a framework for developing non-detriment findings (NDF) for three tree species including mahogany (Van Damme 2006). At the International Workshop of Experts on NDF for Big-leaf Mahogany (Cancún, Mexico, 2007) it was agreed to facilitate NDF by preparing, adopting and implementing management plans and developing and conducting forest inventories and monitoring programs (CITES 2007); measures to be taken by range nations were contingent on government approval.

This case study reviews mahogany life history, management, trade, and NDF procedures in the three principle South American range nations, **Peru**, **Bolivia**, and **Brazil**. In sections where information differs among nations, we indicate this by highlighting the applicable range nation in **bold**.

1. BIOLOGICAL DATA

1.1. Scientific & common names

Swietenia macrophylla King is classified in the family Meliaceae and order Sapindales. It is called big-leaf, Brazilian, or Honduras mahogany in English; caoba, aguano or mara (Bolivia) in Spanish; mogno (Brazil) or aguano (Acre) in Portuguese; and mahogani grands feuilles in French.

1.2. Distribution

Mahogany's natural range stretches from Mexico at 23° N of the equator down the Central American Atlantic coastal strip into South America, continuing in a broad southeasterly arc from Venezuela through the Colombian, Ecuadorian, Peruvian, Bolivian, and Brazilian Amazon regions to points as far south as 18° S (Lamb 1966, Pennington *et al.* 1981). Mahogany's South American historical natural range has been estimated as 278 million hectares, of which 57% occurred in Brazil and 21% were deforested in 2000 (Martinez *et al*. n/d; **Fig. 1**). Its distribution generally corresponds to forests classified as 'tropical dry', with annual temperature averages of greater than or equal to 24° C and 1000–2000 mm annual precipitation (Holdridge 1967). While primarily found in South America along aseasonal tributaries of the Amazon River and seasonal streams feeding them, mahogany also grows in humid and subtropical zones, at elevations ranging from sea level in Central America up to 1400 m in the Andean foothills of Ecuador, Peru, and Bolivia, in a wide variety of soil types and conditions (Lamb 1966).

Mahogany's natural range in Peru, Bolivia and Brazil is restricted to southern Amazonian forests. In Peru it covers an estimated 54.8 million hectares of which approximately 4% have been deforested. Its historic range in Bolivia covers an estimated 29.9 million hectares in the departments of Beni, Cochabamba, La Paz, Santa Cruz and Pando, of which roughly 8% has been deforested. In Brazil, mahogany's natural range covers approximately 153.6 million hectares of which an estimated 24% has been deforested. Mahogany's range is less fragmented in Peru and Bolivia than in Brazil due to lower rates of deforestation, land-use change, and overexploitation (Kometter *et al*. 2004, Martinez *et al*. n/d).

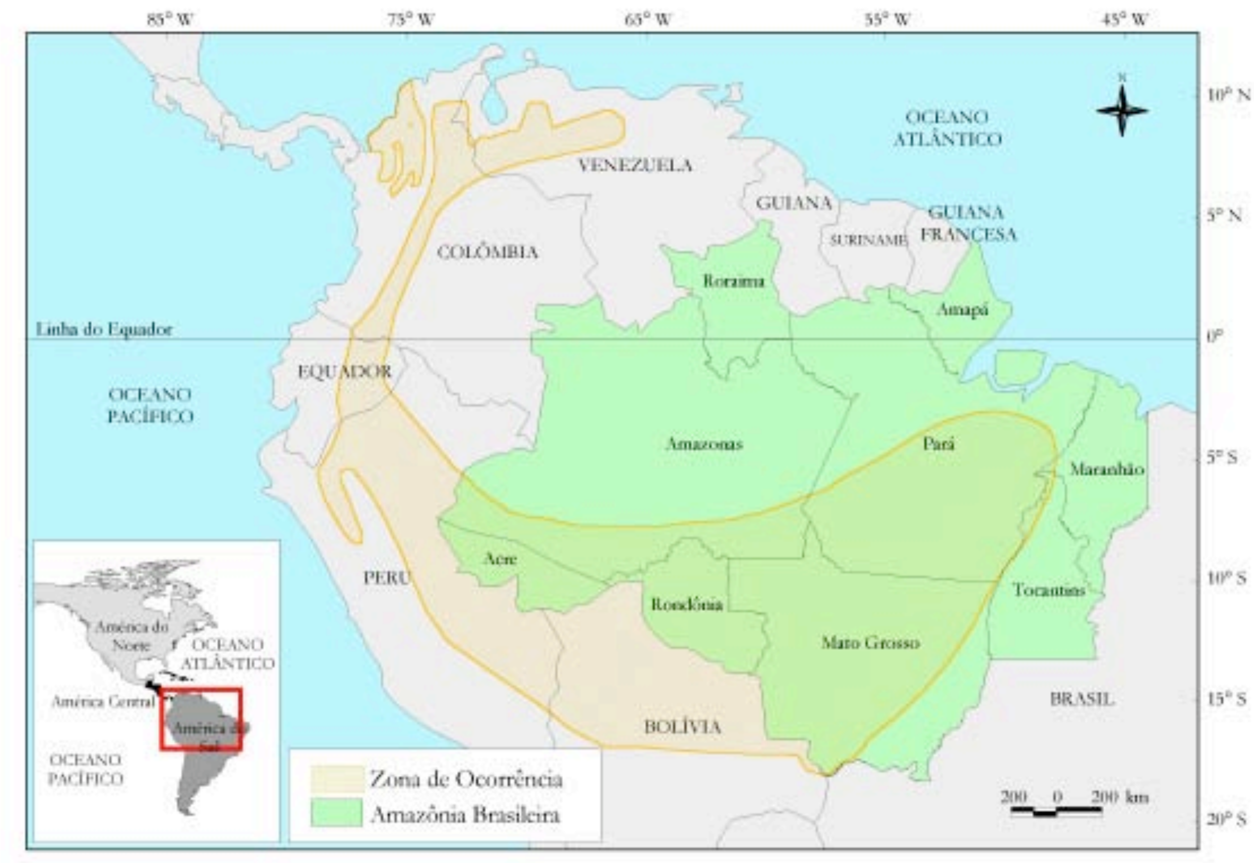

Fig. 1. Mahogany's natural range in South America. From Grogan *et al*. (2002) based on Lamb (1966) and field observations.

1.3. Life history

1.3.1. General biological & life history characteristics

Table 1. Mahogany life history characteristics based on field studies carried out in Mexico, Bolivia, and Brazil as well as on extensive descriptive literature, including Cornelius *et al*. 2004, Grogan 2001; Grogan & Galvão 2006, Gullison *et al*. 1996, Günter 2001, Lamb 1966, Norghauer *et al*. 2006, Pennington 2002, Pereira & Fredericksen 2002, Rocas n/d, Snook 2003, Verwer *et al*. 2008.

General characteristics	• Emergent deciduous tree to >2 m diameter & 50 m height • Light demanding but may tolerate partial shade depending on local forest conditions • Occurs in groups along watercourses or at lower density in low-lying terra firme forest
Reproduction	• Monoecious, flowering during mid to late dry season • Minimum diameter of reproduction is 20–30 cm depending on location • Reproductive maturity attained by trees 70–80 cm diameter;

	fecundity peaks at ~130 cm
	• Mature trees produce up to 800 fruit capsules 10–20 cm long containing ~50 seeds each
	• Seeds are wind dispersed during early to mid dry season
	• Dispersal mainly to within 32–36 m from seed tree but >150 m also possible
Regeneration & recruitment	• Seeds germinate at the beginning of the rainy season • Germination under controlled conditions = 80–90% • Germination under forest conditions = 10–68% but varies with year, precipitation & forest type • Seedling growth depends on light availability but survival is possible in the understory in more open forest • Requires large disturbances (stochastic) for regeneration but possible in the forest understory in more open semi-deciduous forests • Regeneration failure after logging has been widely documented, with exceptions
Survival rate	• Increases with stem size & varies with logging intensity • <1.3 m height: 10–40% per year depending on size & growing conditions • >1.3 m height: >60% per year • >50 cm diameter: close to 100% per year
Growth rate	• Few studies have been done • Variables affecting growth rate: • light conditions & degree of crown liana coverage • plant size: poles & adults grow faster than seedlings & saplings • logging intensity • geographic location: higher in transitional forests than in pre-Andean forests • Responds to silvicultural treatments with increased growth rate
Pests	• *Hypsipyla grandella*, the mahogany shoot borer, a larval caterpillar that feeds on growing apical meristems (leaders), destroying stem form or killing the growing sapling/pole • *Steniscadia poliophaea*, a larval caterpillar that defoliates seedlings & saplings; so far observed only in South America

1.3.2. Habitat types & degree of habitat specificity

Mahogany has a broad distribution in terms of precipitation, altitude, and soil types. It attains greatest stature in rich, deep, well-drained riparian or seasonally moist soils, while also tolerating dry conditions in open forests. In **Peru**, **Bolivia** and **Brazil** it occurs in three ecoregions: Amazon, pre-Andean Amazon, and the Chiquitano-Amazon transition (Bolivia, **Fig. 2**). Within these ecoregions it occurs in various forest types, including seasonal, moist semi-deciduous, and evergreen forest; non-flooded and temporally flooded alluvial plain forest in Bolivia; and dry upland inselberg ('island mountain') forest especially in Brazil. Mahogany's occurrence in a wide range of eco- and habitat types across a vast natural range suggests adaptability and phenotypic plasticity.

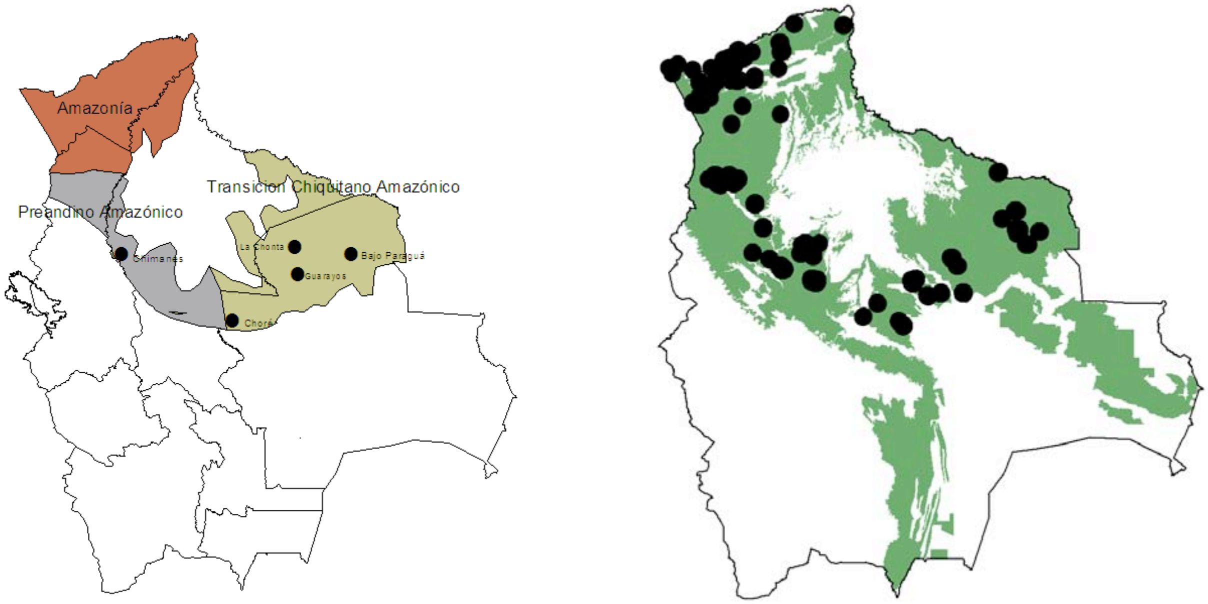

Fig. 2. Geographic distribution of mahogany in Bolivia. **Left:** Ecoregions and study sites mentioned in the text. **Right:** Circles indicate areas under forest management where mahogany has been found. Data are from the Superintendencia Forestal and figures are from Peña-Claros *et al*. (2004) & Mostacedo *et al*. (in prep).

1.3.3. Role of the species in its ecosystem

In seasonally dry tropical forests where mahogany typically occurs, it is one of a small number of emergent canopy tree species that play important structural and biological roles in the ecosystem. Mahogany's enormous stature and life cycle spanning two or more centuries combine to create persistent habitat for animals and insects adapted to life in the high forest canopy. Mahogany's tendency to form hollow boles as it ages provides an essential service to cavity-nesting birds like toucans and macaws. Its annual massive flowering generates pollen and nectar for a wide diversity of small butterflies, moths, and bees. Macaws and large parrots consume maturing fruit capsules while still on the tree crown during lean rainy season months. Several species of ground-dwelling rodents, including pacas and cutias, consume seeds on the ground in the vicinity of parent trees after dispersal in the late dry season. Other specialized insect predators depend on mahogany seedlings and saplings to complete their life cycles, including one moth (*Steniscadia poliophaea*) with no other known food source. Finally, as a fast-growing but long-lived late successional tree species, mahogany carries a wide variety of woody vine species into the forest canopy whose flowers and fruits provide life support for canopy dwelling animals and insects.

The key structural and biological roles that mahogany plays in forest ecosystems where it occurs are thus contingent on the presence of large, reproductively mature individuals. According to Lambert *et al*. (2005), even low-offtake, highly selective logging may dramatically impact mahogany's role in forest ecology and ecosystem function; data on the effects of such logging are urgently needed.

1.4. Population

1.4.1. Population size

Determining historical and current stocking levels of mahogany in South America has not been possible due to logistical and financial difficulties associated with inventorying its vast natural range across remote Amazonian regions, and due to rapid exhaustion of commercial stocks beginning in the early 1970s by a largely unregulated logging industry. Only remote populations that so far occur beyond the reach of mechanized overland logging operations survive intact. The geographical extent and size of these populations remains largely speculative (Kometter *et al*. 2004, Martinez *et al*. n/d). While many forests selectively logged for mahogany across southern Amazonia have been converted to pasture, agriculture, or degraded by fire, where forests persist mahogany also likely occurs at low densities compared to pre-logging populations, with most surviving individuals <45 cm diameter (i.e., sub-commercial at the time of logging; Grogan *et al*. 2002).

Little empirical data on mahogany populations is available from **Peru**. Preliminary data from an ITTO-sponsored national inventory project to describe mahogany's natural distribution and quantify remaining commercial stocks has been used to develop a distribution model (FloraMap) to predict mahogany's natural range based on climatic variation. The model predicts that most remaining populations occur in the southern Amazon region of Ucayali, Madre de Dios and Loreto (**Figs. 3 & 4**), beyond the reach of mechanized logging (Lombardi & Huerta 2007). Inventory data indicate landscape-scale density ranges from 0.003 to 0.164 trees per hectare, with a 40/60 proportion for trees <75 cm and >75 cm diameter, the legal minimum felling size for mahogany in Peru. That is, large mature trees dominate current population structures. However, detailed understanding of population structure necessary for projecting yields and planning sustainable management does not yet exist (INRENA 2007). As accessible populations have been commercially exhausted, illegal loggers have moved into ever more remote regions in search of unexploited populations (Rojas 2007).

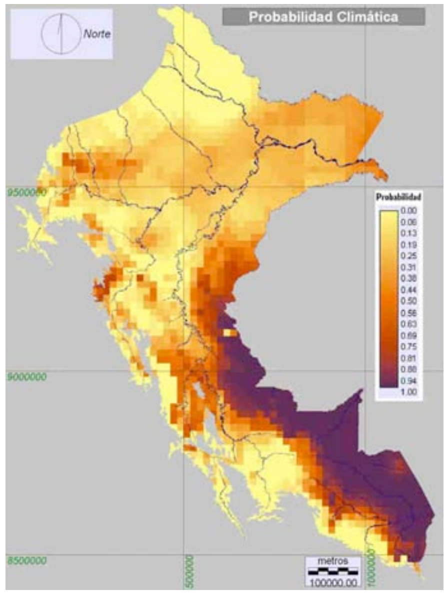

Fig. 3. Mahogany's frequency in Peru according to the climate probability model (Lombardi & Huerta 2007).

Píxel: 465 m (21,6 ha)

Densidad de árboles (árb/ha)
Nivel de probabilidad de ocurrencias de árboles de caoba, según el modelo climático.

Factores como cuerpos de agua (valor 0) y zonas pantanosas (valor 0,2) determinan un densidad menor o nula

Clases	Superficie (ha)
< 0.0002	< 5000
0.0002 – 0.001	5000 - 1000
0.001 – 0.005	1000 - 200
0.005 – 0.025	200 - 40
> 0.025 (árb/ha)	> 40

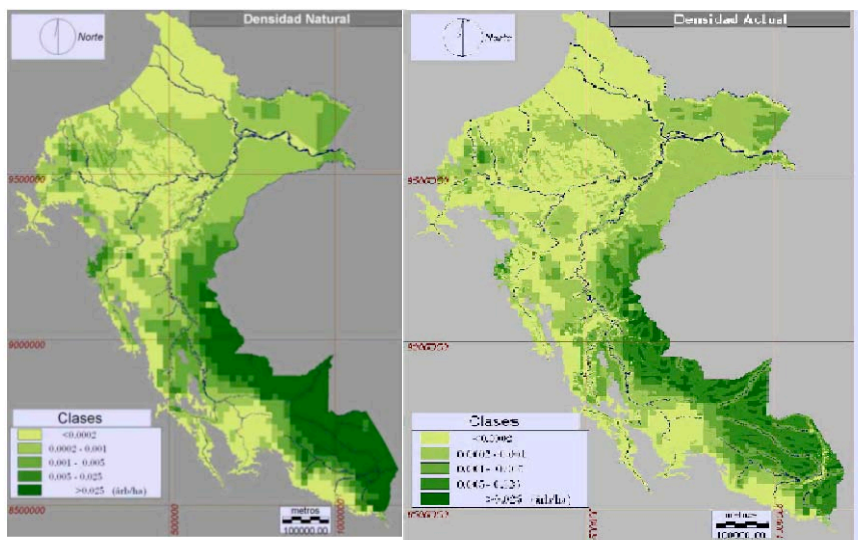

Fig. 4. Maps showing natural and adjusted density (Lombardi & Huerta 2007).

Insufficient information exists to calculate the population size of mahogany in **Bolivia**. Field studies have been local, with variable sampling methodologies. Another problem is that density of the species varies among forest type. Consequently, more detailed information at the forest type level is needed. Density data from forestry inventories and permanent sample plots (**Table 2**) demonstrate that mahogany population structures vary along its distribution range and according to exploitation history. In unlogged forests mahogany population structures show multiple peaks (i.e., density does not decrease continuously as size increases but is high in certain size classes), with trees reaching a maximum size of 200 cm diameter. This population structure suggests that cohorts of individuals recruit episodically, followed by periods of reduced recruitment (Gullison *et al*. 1996). In areas like La Chonta and Lago Rey where mahogany was exploited for about 20 years, population structures show decreasing density as size increases (**Fig. 5**), with very few trees >60 cm diameter. It is difficult to know whether these overexploited populations also showed multiple peaks in size classes before logging, indicating episodic recruitment.

Table 2. Mahogany population density in different ecoregions in Bolivia. Data are number of individuals per ha. Forest inventory data are from Dauber *et al*. (2001). Data from permanent sample plots are from the Instituto Boliviano de Investigación Forestal database (unpublished).

Ecoregion	**Subregion**	**Density (>20 cm diam)**	**Permanent sample plots (>10 cm diam)**
Amazon		0.07	0.03
Pre-Andean Amazon		0.35	0.64
Amazon	Choré	0.46	
Chiquitano-Amazon transitional	Guarayos	0.44	0.56
	Bajo Paraguá	0.53	

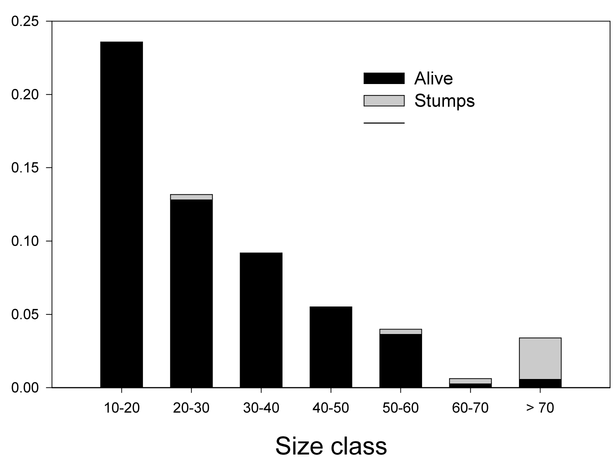

Fig. 5. Population structure of mahogany by size class in the Long Term Silvicultural Research Program plots in a tropical moist semi-deciduous forest in Bolivia. Original

population structure reconstructed using observed stumps (trees logged during 1970–1995).

In **Brazil**, large-scale inventories conducted in logged and unlogged forests across southern Amazonia indicate landscape-scale densities ranging from 0.014 – 1.18 trees >20 cm diameter per hectare where mahogany occurs (Grogan *et al*. 2008). Historical densities were highest in southeast Pará and Rondônia, but few populations survive within the so-called Arc of Deforestation that largely coincides with (and to some extent was fueled by) mahogany's occurrence in southern and southeastern Amazonia (Grogan *et al*. 2002). Mahogany's vast range in Brazil, and its extraordinarily rapid commercial exploitation since the early 1970s coinciding with the completion of north-south and east-west Trans-Amazon highways, means that a national inventory to assess surviving stocks would be prohibitively expensive. Martinez *et al*. (n/d), based on extensive sawmill processing center and transportation data, estimate that commercial mahogany populations may survive across only 35% of its range in Brazil. Most remaining populations are located in remote regions where transportation infrastructures remain incipient, or where terrain is steep, or where seasonal rains impede access. These populations occur mostly along the northern and western limits of mahogany's range, at low or extremely low densities compared to high-density populations once common in Rondônia and southeast Pará. This estimation likely overstates the extent of surviving stocks due to methodological factors.

1.4.2. Current global population trends

___increasing **_X_ decreasing** ____ stable ____unknown

1.5. Conservation status

1.5.1. Global conservation status: IUCN Red List (2002) & others

Table 3. Classification of the conservation status of big-leaf mahogany by international organizations (Blundell 2004).

Organization	**Comment**
IUCN (2002 Red List)	Vulnerable (based on criteria A1cd+2cd)1
CITES (PC11 Doc.13.3)	Appendix II
UNEP–World Conservation Monitoring Centre	CITES Appendix II
International Board for Plant Genetics Resources	High priority for genetic conservation
International Tropical Timber Organization	High priority species
FAO Panel of Experts on Forest Gene Resources	High priority for *in situ* conservation

1.5.2. National conservation status for the case study countries

In **Peru**, mahogany's conservation status category set by IUCN (see above) is accepted (El Peruano 2006), as determined by Supreme Decree N° 043-2006-AG (Resolution Decree 002-2008). Mahogany is also considered by INRENA (National Institute for Natural Resources and CITES Management Authority) to be an endangered species (INRENA 2006).

In **Bolivia** and **Brazil**, mahogany's conservation status is principally established by its listing on CITES Appendix II. It can only be legally harvested following technical norms for forest management set by federal legislation.

1.5.3. Main threats within the case study countries

___ No threats
_X_ **Habitat loss/degradation** (human induced)
___ Invasive alien species (directly affecting the species)
_X_ **Harvesting** (logging)
___ Accidental mortality (e.g., bycatch)
___ Persecution (e.g., pest control)
___ Pollution (affecting habitat and/or species)
___ Other__________ ___ Unknown

2. SPECIES MANAGEMENT

2.1. Management measures

2.1.1. Management history

Mahogany has been commercially exploited in **Peru** since the 1920s beginning in the Iquitos region, in **Brazil** since the 1930s beginning in the western state of Acre, and in **Bolivia** since the 1950s. In all three countries riverine populations growing in clusters along tributaries of the Amazon River were logged first, felling trees into or near flowing water and floating logs downstream to urban processing centers. As the most readily accessible populations were eliminated and transportation infrastructures improved, mechanized overland logging began in the 1970s in Brazil (southeast Pará and then Rondônia), in the 1980s in Bolivia, and in the late 1990s in Peru. By 2000, mahogany had been commercially extirpated within an estimated 49% of its range in Peru, 79% of its range in Bolivia (Kometter *et al*. 2004), and 65% of its range in Brazil (Martinez *et al*. n/d). Most sawn timber has been exported to Europe and the US.

It was only during the 1990s in Bolivia and Brazil and in the early 2000s in Peru that regulatory frameworks were created to 'manage' mahogany harvests. Before then, mahogany was essentially mined from primary forests wherever loggers could access natural populations. To no small degree, new laws prescribing management criteria for mahogany were responses to the international debate about its commercial and conservation status culminating in mahogany's listing on Appendix II in 2002.

In **Peru**, mahogany could be harvested without management plans before 2000. Loggers were required to pay a fee to the Committee of Reforestation to assure that mahogany seedlings would be replanted. During 2000–2001 the Peruvian government implemented a system of annual contracts for 40-year land concessions to private enterprises, with the right to log 5% of forest area per year (i.e., 20-year cutting cycle) and requiring a management plan for approval by INRENA. Concessions smaller than 1000 hectares did not require approved management plans (INRENA 2006; The Economist 2007; Lombardi comm. in lit. July 2008). Since then, legal and administrative measures aimed at encouraging mahogany's sustainable management have included forest planning and management tools such as General and Annual Operating Plans, logging bans, and export quotas (INRENA 2007).

In **Bolivia**, mahogany was the main timber species harvested until the mid 1990s (Bascopé 1992). Technical norms promulgated by the new forestry law (MDSP 1998) defined best management practices for timber species including mahogany, but illegal harvesting persists. The importance of mahogany in terms of roundwood volume harvested declined after 1998 to 12th during the period 1998–2006 (average volume per year 16,591 m^3 representing 2% of the total harvested volume).

In **Brazil**, an estimated four million m^3 of sawn mahogany timber was exported during the period 1971–1992, much of this originating illegally from within Protected Areas and Indigenous Lands, with an additional estimated 1.7 million m^3 consumed domestically (Grogan *et al*. 2002). Mahogany's exploitation began to be regulated in the early 1990s with the imposition of export quotas and with gradually increasing scrutiny of logging industry practices by federal and state authorities, including the requirement that production originate only from legally registered forest management areas. As the logging sector specializing in mahogany continued to ignore or evade regulations governing mahogany harvests during the 1990s even while its inclusion on Appendix II was debated, the Brazilian government responded with a moratoria on new management plans including mahogany in 1996, and by suspending all commercial trade in the species in 2001. Export quotas had fallen in 2000 to 50,000 m^3, from 150,000 m^3 in 1990. In response to the Appendix II listing in late 2002, new and stricter management guidelines for mahogany were developed and signed into law in 2003 for companies intending to harvest mahogany.

2.1.2. Purpose of the management plan in place

The concessions system in **Peru** and federal regulation of forest practices in **Bolivia** aim to encourage best practices management plans. While management plans are not specifically tailored for mahogany, their overall objective is to manage and control forest operations to guarantee sustainable production and conservation of the environment and biological diversity. In **Brazil**, management plans for forests with mahogany require extra provisions explained in detail below (section 3.2.1).

The Strategic Action Plan for the Conservation and Implementation of CITES Appendix II for Mahogany in **Peru** (Plan de Acción Estratégico para la Conservación y la Implementación del Apéndice II de la CITES para la Caoba en el Perú, 2007–2011) is a management tool aiming to identify, sustainably manage, and protect all mahogany populations within concessions, native communities, Protected Areas and land reserves, thereby generating major social and economic benefits for local populations by 2011. Its main objective is to contribute to the sustainable use of natural populations of mahogany and promote plantation production. Specific objectives include:

- strengthen the development of silviculture within general and annual management plans (POAs);
- strengthen the monitoring system for better control;
- conserve genetic biodiversity in natural Protected Areas and programs of *ex situ* conservation;
- strengthen institutional capacity for implementation of the plan;
- promote forest products with added value and establish policies and norms for promoting incentives for plantations;
- monitor the Action Plan inventory with State support to secure viable populations and commitment with CITES (INRENA 2007).

2.1.3. General elements of the management plan

Forest Management Plans (PMF) in **Peru** have two required levels of planning:

- the General Forest Management Plan (PGMF) provides a framework for long-term strategic planning, formulated over the 40-year duration of private concessions;
- the Annual Operating Plan (POA) is the short-term planning tool for field operations.

In **Bolivia**, all timber species are harvested using similar practices delineated in Forestry Law N° 1700 and its technical norms. However, by applying the current technical norms, several the recommendations from the 2nd Mahogany Working Group (MWG2, Belém, Brazil, 2003) are fulfilled. MWG2 recommended that all exported mahogany should originate from areas with forest management plans including at least those elements listed in **Table 4** (next page).

In **Brazil**, the broad contours of current legislation regulating forest management include:

- basic characterization of physical and biotic environments;
- required technical capacity for planned forest operations (adequate logging practices, silviculture, post-logging recovery) according to Annual Operating Plan (POA);
- quantify commercial stocks;
- cutting cycles of 25–35 years depending on site productivity;
- limits on logwood extraction per unit area (10–30 m^3/ha) depending on site capacity and on ownership or use category;

- minimum cutting diameter that varies by species;
- 10% retention of commercial-sized trees, except 20% for mahogany (Grogan *et al*. 2005).

Table 4. MWG2 recommendations compared to the situation in Bolivia.

Recommended by MWG2	Situation in Bolivia as required by the Forestry Law & current technical norms
Commercial census	• Commercial census is carried out in logging compartments at 100% intensity. All timber species included in the commercial species list of the company are included in the census. Only trees larger than the minimum cutting diameter are included. • Census results are used to elaborate annual operational logging plans (POAFs).
Mapping of commercial & sub-commercial trees	• Maps are elaborated based on the commercial census data, including topographic features, water courses, roads, and harvestable trees. Maps are a component of POAF. • Sub-commercial trees are not mapped as they are not included in the census.
Seed tree selection & minimum post-logging density	• 20% of harvestable trees are retained, mapped and tagged. They are also clearly marked in the field to assure retention as a seed tree. • There is no selection criteria, the 5th tree encountered should be retained as a seed tree. • Minimum tree density after logging depends on the initial density.
Minimum cutting diameter (MCD)	• 70 cm for mahogany
Monitoring dynamics of future crop trees	• Monitoring is not specifically required for individual species. Although permanent plots must be established to assess the effect of logging on long-term forest dynamics & timber yields, not all companies have done so. • Mahogany is present in several established permanent plots but the number of individuals is relatively low.
Improvement of regeneration	• Not required, only indirectly done by promoting the use of other species, requiring that seed trees are left behind, and the use of cutting cycles. • Several experiments have looked at mahogany regeneration. The most promising results are coming from enrichment planting in logging gaps.

2.1.4. Restoration or alleviation measures

In **Peru**, the General Forest Management Plan must indicate silvicultural practices aimed at recuperation of forests where mahogany has been harvested. Details vary among concessions; in most cases, natural regeneration is preferred. This aspect has not yet been monitored (Lombardi comm. in lit. July 2008). In **Bolivia**, no restoration measures are required, though retention of seed trees should encourage natural regeneration. In **Brazil**, natural regeneration encouraged through retention of seed trees must be supplemented by artificial regeneration through outplanting nursery-grown seedlings into logging gaps.

2.2. Monitoring system

2.2.1. Methods used to monitor harvests

In **Peru**, INRENA monitors commercial logging of mahogany through the concession system and evaluation of POAs. More than 20 concessions and 27 permits in native communities' territories have been verified (INRENA 2007). The CITES Management Authority (MA), which resides within INRENA, applies pre-harvest verification of trees before approving POAs. The MA also conducts a post-harvest verification of stumps, suspending harvests in the case of inconsistencies. The CITES Scientific Authority (SA) has developed a database and map for mahogany's distribution at three levels: national, within forest concessions, and within forest communities (Vargas & Lombardi 2006).

In **Bolivia**, various mechanisms exist to monitor commercial timber harvests:

• Certificate of logging origin (CFO): During the production chain all timber produced must be accompanied by a CFO. The CFO is issued by the Superintendencia Forestal (SF) and different CFO types are used along the production chain. In the case of mahogany, four different types of CFO are used to track mahogany timber from the forest to the point of exportation. CFOs can be used to track wood volume along the production chain but this tracking can sometimes be cumbersome as there are too many parties involved.

• Permits for export: The CITES Management Authority (Autoridad Administrativa, AA) must approve mahogany exports. To provide export permits, the AA requires, among others, the CFO used for exporting timber. The SF, the AA, and SIVEX (organization dealing with the export of all Bolivian products) coordinate among themselves to assure that all parties have the required information to carry out their tasks. The AA checks with the SF to assure that information provided is correct.

• Forestry inspections are carried out by the SF by randomly selecting areas under forest management. There are also 'puestos de control' on main roads that compare CFO with volumes and species being transported. The SF carries out audits every five years to determine if companies will keep their concessions for 40 additional years. Not all of these mechanisms are used as much as desirable due to funding shortages.

• The GIS system managed by the SF could be used to monitor harvesting activities at the forest management unit, but currently it is mostly used to monitor deforestation and wildfires.

In **Brazil**, the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) is the government agency responsible for evaluating, approving, and regulating forest management plans. Any management plan including mahogany is first reviewed by IBAMA for compliance with broad parameters of forest legislation specific to mahogany (IN 07/2003), and then referred to the Comitê Técnico-Científico (CTC), an advisory committee consisting of forest engineers and scientists with expertise in mahogany's management and ecology. Members of the CTC conduct field audits of management plans for mahogany that potentially fulfill legal standards. CTC recommendations are in turn evaluated by the CITES Management and Scientific Authorities, which reside within IBAMA, for final approval or rejection.

2.2.2. Confidence in the use of monitoring

In **Peru**, current government policy prioritizes verification of mahogany stocks before POA approval, aiming to control mahogany use authorizations (INRENA 2007). Information collected by the CITES MA and SA is confirmed directly in the field. Annual verification depends on economic resources available when validation is required (Lombardi comm. in lit. July 2008). INRENA has encouraged the voluntary certification process (INRENA 2007). "The use of certification to assure legality of CITES timber exports appears a cost-effective approach in the case of mahogany, given that currently 55% of Peru's mahogany exports already come from certified forest management units with chain of custody" (PAEC in Del Gatto & Ortiz in press), although "communities and small-scale concessionaires, that face greater difficulties in affording the costs of certification, would be put in disadvantage by such approach, losing access to higher-value export markets" (Brown & Bird in Del Gatto & Ortiz in press). Finally, the Forest Annex of the Peru-USA Free Trade Agreement, signed in October 2007, includes steps for monitoring timber species listed in CITES, including inspection of extraction areas prior to POA approval, dissemination of POAs and verification results to the public, development of tracking systems to verify legal origin and chain of custody, and improved management of forest concessions.

In **Bolivia**, confidence in the current monitoring system is average. A black market in CFOs has been reported. Some control mechanisms of the SF, for example forestry inspections and audits, are not implemented due to lack of funding to cover staff and logistical costs. Additional issues that would help improve the monitoring system include: 1) better information on yield ('rendimiento') of the species during wood transformation from log to sawn timber); 2) better system for tracking timber during various steps of the production chain, especially after sawing; 3) better system for assessing the domestic market.

In **Brazil**, the new rules for mahogany management in 2003 coupled with the additional auditing role of the Comitê Técnico-Científico (CTC) on behalf of IBAMA as the CITES Scientific Authority has effectively limited mahogany harvests and commercialization to a fraction of levels in the 1990s. While illegal felling and transport across international borders, especially Peru, has been reported in recent years, quantities traded are unknown but likely relatively small compared to historic activity.

2.3. Legal framework & law enforcement relating to conservation

In **Peru**, a state of emergency was declared in the regions of Madre de Dios and Tahuamanu and senior government forest officials were discharged because of rampant illegal logging in 1999 through Ministerial Resolution 951-99-AG (Blundell & Gullison 2003). This law banned mahogany for 10 years in the regions of Putumayo, Yavari, Tamaya and Purus (INRENA 2006). The Forestry and Wildlife Law (Ley 27308) and its regulations were approved in 2000 and 2001, respectively, and a new national forest strategy based on an historic analysis/baseline for the forestry sector was prepared in 2002 (ITTO 2005). Ley 27308 promotes harvesting a larger number of species, optimal utilization, higher value-added and production chain integration, all with a view to contributing to sustainable forest management. Harvesting rights are granted through concessions, permits, etc., particularly in the Departments of Madre de Dios, Ucayali, San Martin, Huánuco and Loreto (ITTO 2007). More recently, Decree N° 1090 (28 June 2008) created a Forestry and Wildlife Law establishing new definitions for forestry resources and use. These changes in laws and regulations are related to compliance with the Peru-USA Free Trade Agreement. Further details on legal frameworks in Peru, and a timeline, can be found in **Appendix 1**.

In June 2007, INRENA presented the Strategic Action Plan for the Implementation of CITES Appendix II for Big-leaf Mahogany (PAEC[1]), approved by the Ministry of Agriculture via Resolution Decree in July 2008. The main objective of the plan is to contribute to sustainable management of mahogany natural populations and to encourage the establishment of plantations.

In **Bolivia**, Forestry Law N° 1700 bringing major changes to the forestry sector passed in 1996 and has been implemented since 1997. Although it does not include specific management guidelines for mahogany apart from the minimum diameter cutting limit of 70 cm, Law 1700 has had a very positive effect on mahogany conservation.

In **Brazil**, the Forest Code of 1965 anticipated rapid changes in land use set in motion by trans-Amazonian highways connecting Brasília with Belém on the north coast and Porto Velho across the western frontier (Lei N° 4771). Concepts of sustainable forest management and sustainable production were codified in 1986, defining the latter as "the yield which corresponds to forest-level [growth] increment" (Lei N° 7511, Portaria N° 486/86-P). Sustainable forest management was further defined in 1994 as "… forest administration yielding economic and social benefits, respecting mechanisms ensuring integrity of ecosystems under management" (Decreto N° 1282). As described previously, a series of legislative acts from 1996 to 2003 successively restricted and eventually banned management plans for mahogany, prohibited harvest, transport, and commercialization of mahogany, and specifically revised harvest regulations for mahogany in response to the Appendix II listing, strengthening protection of natural populations.

[1] Plan de Acción Estratégico para la Implementación del Apéndice II de la CITES para la Caoba en Perú

3. UTILIZATION & TRADE

3.1. Type of use (origin) & destinations (purposes)

Mahogany timber is well-known around the world for its strength, workability, durability and beauty. It is mostly used in furniture and decorative finishing. Because mahogany is an easily worked timber with unsurpassed resistance to insect and fungal attack, it is still the preferred construction timber for local use in Peru, Bolivia and Brazil (Pennington 2002). Mahogany's bark and seeds are also used as medicine for common ailments like diarrhea and toothache in some indigenous communities. Oil extracted from the bark is also commercialized by the cosmetic industry (CATIE n/d).

3.2. Harvest

3.2.1. Harvesting regime

In **Peru**, concessionaires previously worked with subcontractors who brought in their own equipment and personnel and were paid based on volume extracted. Extraction was selective, concentrating on high-value species such as mahogany, and basic silvicultural and operational measures that might ensure sustainable yield were generally not applied. The Forestry and Wildlife Law N° 27308 eliminated the former harvesting contracts and established long-term concessions over larger areas. Silvicultural treatments are now included in the terms of reference for management plans and are being applied in at least 40% of concessions (ITTO 2005). Law 27308 established 75 cm diameter as the minimum cutting diameter limit for mahogany, with a retention rate of 10% of commercial-sized trees as seed trees within each cutting unit (Lombardi & Huerta 2007).

In **Bolivia**, mahogany must attain a density >0.25 trees >20 cm diameter per hectare across the entire management area (not only in a given logging compartment) for harvests to be allowed. If that density is reached, the following rules apply: 1) the area under forest management must use a cutting cycle longer than 20 years; 2) the area is divided into logging compartments depending on cutting cycles, with logging compartments harvestable only once during a given cutting cycle; 3) only trees >70 cm diameter can be harvested; 4) only 80% of commercial-sized trees can be harvested, retaining 20% as seed trees which must be marked in the field and included in logging maps.

In **Brazil**, Instrução Normativa N° 07/2003 established guidelines for forest management plans specific to mahogany, including:

- 100% inventory of mahogany trees >20 cm diameter using an X,Y grid system;
- estimate sub-commercial population (10–20 cm diameter) based on stratified sampling;
- minimum density of 0.05 per hectare (5 trees per 100 hectares);
- minimum cutting diameter (MCD) of 60 cm;
- retention rate of 20% of commercial-sized trees;

- vine removal from commercial trees at least one year before harvest, to reduce damages;
- encourage natural regeneration or supplement through outplanting artificial regeneration;
- landscape mapping to identify drainage and off-limits permanent preserve areas (e.g., watercourses, steep slopes);
- planned harvest operations (e.g., roads & skidtrails, logyard locations, directional felling);
- mandatory chain of custody from stump to sawn timber in the sawmill
- mandatory field audit by technical experts to supplement the normal IBAMA evaluation process.

3.2.2. Harvest management / control (quotas etc.)

In **Peru**, the CITES Scientific Authority establishes the annual export quota for mahogany. In 2007 the export quota was 4,983 m^3, but only 3,071 m^3 were exported with leftovers of 1,912 m^3. In January 2008, Peru notified the CITES Secretariat that it had set the 2008 export quota for mahogany at 2,348 m^3. This was published on the CITES website in April 2008. A post resolution adopted by the CITES Authority of Peru (N° 097-2008-INRENA, 14 April 2008) increased the quota to 3,475 m^3 (CITES 2008).

In 2005, 1,080 m^3 of mahogany were produced from concessions that are now closed (for not being able to justify where they obtained this volume) and 2,892 m^3 were produced from forest concessions that are currently being investigated. In 2006, corresponding volumes were 855 m^3 and 2,622 m^3, respectively. This means that during the years 2005 and 2006, 3,972 m^3 and 3,477 m^3 of mahogany were commercialized, respectively, from concessions whose owners could not verify legal origin (Rojas 2007).

In **Bolivia** and **Brazil**, no quotas or additional control measures apply to mahogany.

3.3. Legal & illegal trade levels

Peru became the largest mahogany exporter after the Brazilian harvest and export ban in 2001, and due to the high price of Bolivian mahogany. Export volumes increased to almost 53,000 m^3 in 2002, valued at more than US$ 55 million. Export volumes decreased in 2003 to less than 43,000 m^3, valued at more than US$ 47 million (OIMT 2004). Export levels had fallen by 2007 to 3,071 m^3.

Mahogany's high value encourages illegal activities. INRENA has reported that 90% of illegally traded logs corresponded to mahogany in 2003. There are also indications that mahogany and other high-value species are being obtained illegally from Protected and Indigenous Areas (ITTO 2005). In 2005, 12.45% of the total volume of mahogany exported came from illegal logging, while 83% of companies exporting mahogany from Peru sold quantities originating from illegal logging. This figure is the minimum quantity calculated, using documented data; the volume of illegal exports could be much greater (Rojas 2007).

Mahogany in legal trade may originate from illegal sources. The government has developed a control system (based on data collected by INRENA) which indicates that all mahogany timber commercialized and exported is legal (see **Appendix 2**). However, it is very difficult to quantify the real exported volume, especially because mahogany exports have shown a gradual decrease in recent years according to ITTO. In 2007, the number of exported, harvestable trees was 715 from 16 forestry units with legal authorization to export (Lombardi comm. in lit. July 2008). From 2005–2006, only approved national quota volumes were exported (23,621 and 23,239 m^3, respectively; INRENA 2007).

In **Bolivia**, the Superintendencia Forestal (SF) approved average harvests of 16,590 m^3 of roundwood per year during 1998–2006. The average mahogany volume exported with CITES certificates during 1998–2003 was 9,786 m^3. As only certain mahogany products (sawn wood, 'laminas', 'chapas') require a CITES certificate for export, it is necessary to add as well the volume of mahogany timber that leaves the country as 'producto elaborado' or value-added. Reported export volumes have been less than volumes approved for harvesting by the SF since 1998. Several factors help explain this apparent discrepancy. The volume approved represents standing volume based on commercial censuses. However, actual volumes harvested are normally much less because companies do not harvest all commercial-sized trees, because estimation errors are made when calculating harvestable volume based on field data, and because sawmill processing efficiency is believed to be about 50% in the best-case scenario. Taking into account all these factors it seems that the total mahogany volume being exported should be less than 50% of the approved volume. Yet export volumes consistently exceed this amount.

Domestic demand is difficult to quantify. Probably a portion of the harvested volume is consumed in-country as mahogany is highly valued in Bolivia.

Since the 2001 moratorium on harvest, transport, and commercialization in **Brazil**, legally traded volumes of mahogany have been severely restricted by new management regulations and heightened scrutiny of field operations by the CTC acting on behalf of the Scientific Authority within IBAMA. Since 2003, approximately 10 management plans including mahogany have been reviewed by IBAMA, and only one approved for harvest in 2006 in the state of Rondônia. At present, one management plan in the state of Amazonas is under review, but harvest during 2008 at this point is unlikely. As mentioned previously, it is impossible to quantify illegal trade.

II. NON-DETRIMENT FINDING (NDF) PROCEDURES

Several international meetings have been held since mahogany's inclusion in CITES Appendix II, with emphasis on implementation and recommendations regarding NDF, including the Mahogany Working Group and the CITES Plants Committee Meetings, among others. General guidelines formulated for NDF address either its development for each export or the establishment of national export quotas (Rosser & Haywood 2002). IUCN (2004) recommended establishing gradual measures as range nations develop and implement policies oriented towards sustainable management, test different approaches, and as more information is gathered on the species. Three basic components of this approach include:

- evaluate mahogany stocks at national or regional levels as a basis for defining export quotas, and as a requirement for:
- management plans, including measures towards sustainable planning of the forestry unit and mahogany stocks as a prior condition to defining export levels non-detrimental to the species' survival; and
- control of mahogany harvests within planned forestry units, and of mahogany exports based on export quotas.

Technical recommendations from the 2nd Mahogany Working Group (MWG2), held in Belém, Brazil, are outlined in section 2.1.3.

In 2004 ITTO with support from INRENA organized a workshop in Pucallpa, Peru to develop capacities to implement CITES Appendix II for mahogany (OIMT 2004). Exporters, importers, and representatives from governmental and non-governmental organizations participated in this meeting. Focusing on the main South American exporting countries (Peru, Bolivia, Brazil), the workshop's objective was to stimulate the adoption of practical measures for making NDF. The premise was that countries are responsible for determining criteria to making NDF based on national forestry policies and laws, including control activities, private sector measures, institutional coordination, and regional cooperation in terms of financial resources and technical advice. Workshop participants recognized the planned forest management unit as the most appropriate level for NDF implementation. Participants further recommended that only mahogany harvested under specific mahogany zoning plans including specific management components for mahogany should be accepted for international trade (OIMT 2004).

The 3rd Mahogany Working Group (MWG3) meeting in 2006 (Lima, Peru) noted that field-based inventories, distribution statistics, and age-class information critical to making NDF remain unavailable in spite of the fact that some range nations had compiled trade information to estimate existing mahogany stocks. Other findings included that range nations had not developed effective mechanisms or a standardized approach to making NDF for mahogany. Among others, recommendations emphasized that no mahogany export should take place without NDF made by the Scientific Authority of the State; and that importing countries should refuse mahogany shipments accompanied by CITES export permits issued under a court order unless the importing country can confirm that NDF was made by the Scientific Authority of the country of origin (CITES 2006).

1. Is the methodology used based on the IUCN checklist for NDFs? __yes **_X_ no**

The answer is no for all three countries. According Lombardi (comm. in lit. July 2008), the UICN check list must be adapted for tree species and implemented under rigorous and periodic field work.

2. Criteria, parameters and/or indicators used

In **Peru**, parameters used include mahogany population size within commercial concessions and native forest communities; population size-class distributions and estimated production volumes; bark thickness; and defective or hollow trees. In the coming years additional parameters will include control and monitoring of silvicultural practices to estimate population recovery (Lombardi comm. in lit. July 2008). Scientific Authority recommendations are listed in **Table 5**.

The timber yield coefficient was identified in 2008 as a potential loophole through which illegally acquired timber may be laundered. This technical issue has become controversial and politicized. As a result, INRENA created a commission to undertake a technical study to confirm or discard the current timber yield coefficient. This commission is chaired by INRENA and comprises the CITES Scientific Authority, eight representatives of the private sector, two NGOs, and other ministries (Resolution Decree No 075-2008-INRENA). The commission was given 180 days to provide its findings and should submit its report before the end of 2008 (CITES 2008).

Bolivia has not yet defined NDF procedures for mahogany because information upon which these should be based remains lacking.

In the absence of clear NDF procedures for timber species, **Brazil** has relied on recommendations from a series of Mahogany Working Group meetings within IBAMA and the Ministry of the Environment (MMA) during 2002 and 2003. Outputs from these meetings were incorporated into Instrução Normativa 07/2003 which regulates mahogany harvests as described in section 3.2.1. The Brazilian government additionally directly or indirectly supports on-going applied research on mahogany ecology, genetics, and management through projects in Acre, Amazonas, and Pará.

Table 5. Recommendations by Peru's CITES Scientific Authority compared to measures taken by INRENA with respect to the annual export quota for mahogany in 2007 (Rojas 2007).

Recommendations by the CITES SA	**Measures taken by INRENA**	**Agreement between authorities?**
Consider bark thickness, stem hollows (heartrot) & taper coefficient in volume estimates	Volume estimates only account for height & diameter	No
Allow extraction of mahogany only in areas with more than 2000 trees	Only regions with more than 2000 individuals approved	Yes
Allow extraction of mahogany only in areas where population density >0.005 trees per hectare (1 tree per 200 hectares)	Only regions with a population density >0.005 trees per hectare approved	Yes

Prohibit the export of mahogany coming from agricultural estates, public auctions, or rewards	Export volumes from agricultural estates, public auctions, or rewards prohibited	Yes
Raise the minimum cutting diameter (MCD) to 120 cm	MCD remains 75 cm	No
Annual export volumes should not originate from >1200 individuals	2007 export quota equal to a harvest of 1600 trees	No
Annual export quota should not exceed the sum of volumes declared in field-verified POAs	Volumes declared in 2007 POAs were not considered in establishing the 2007 export quota	No
Only mahogany originating from managed forests should be exported	Only forestry concessions & native communities with general management plans & approved or to be approved (upon verification) POAs considered	Yes
Verification of planning & execution of forestry operations within POAs should be obligatory	Implementation of forestry activities within POAs is not supervised	No

3. Main sources of data, including field evaluation or sampling methodologies & analysis used

In **Peru**, data from the on-going project 'UNALM-ITTO PD 251/03' is being used to develop NDF procedures for mahogany (INRENA 2007). This project focuses on assessment of current commercial stocks and strategies for sustainable management. It has provided basic information for mahogany population status and ecosystem characters for NDF. The CITES Scientific Authority in Peru has information from inventories and POAs including data on volume, form coefficients, bark thickness, species associations, and natural regeneration status for the Department of Madre de Dios. The Departments of Ucayali and Loreto are currently under study (INRENA 2007).

The annual export quota (yield coefficient) established in 2005 was based on mahogany inventories from POAs (Ortiz in Del Gatto & Ortiz in press), reference of origin information, and on anticipated growth rates. The coefficient will be adjusted according to information obtained from silvicultural treatments within forest management units. This information is being used to create a database containing all mahogany trees (seed trees and harvested trees), allowing continued monitoring even after harvests and development of a behavioral model to study population changes over time. To validate the system it will be important to monitor all individuals in the field and to establish reference populations of commercial mahogany within zones where mahogany occurs (Lombardi comm. in lit. July 2008).

Data obtained from a recent study in permanent production areas indicates that remaining mahogany stocks consist of 144,203 trees <75 cm diameter and 82,296 trees >75 cm diameter. With this information the SA established a volume per commercial tree of 12.5602 m^3, and a cutting cycle of 100 years based on a growth rate of 0.75 cm/tree/year. Under these conditions, Peru must restrict annual harvests to 1442 m^3 or approximately 216 trees (INRENA 2007). Based on the population size, the Scientific Authority considers mahogany's population status in some regions to be too low for commercial exploitation and recommends limits or bans on harvests coupled with restoration programs.

In **Bolivia**, recent research results may provide information useful for NDF (Verwer *et al*. 2008). These results, from the Long-term Silvicultural Research Project established in La Chonta, which includes the monitoring since 2002 of an overexploited mahogany population, are from simulation models constructed to assess different harvesting scenarios. Results indicate that mahogany could be sustainably harvested if:

- the minimum cutting diameter is at least 70 cm diameter;
- cutting cycles are >25 years;
- harvest intensity is reduced to 50% of commercial-sized trees;
- silvicultural treatments are applied to the species (liana cutting, liberation from competing trees) and its surrounding forest (logging and liberation of other timber species) so that optimal growing conditions are created and maintained throughout the cutting cycle.

If these conditions are not maintained and the forest is allowed to return to normal (pre-harvest) conditions, then no combination of management practices makes sustainable harvesting of mahogany possible.

In **Brazil**, results from basic and applied research programs on mahogany, especially in southeast Pará and Acre (e.g., André *et al.* 2008, Baima 2001, Brown *et al*. 2003, Grogan *et al*. 2003, 2005, 2008, Lemes *et al.* 2002, 2003, 2007, Norghauer *et al*. 2006, 2008a, 2008b, Oliveira 2000), have contributed to public policy on management and conservation of mahogany. Whether this open exchange between governmental, regulatory, and academic sectors will continue as on-going research results are disseminated remains to be seen. For example, simulations based on large-scale inventories and long-term growth data indicate that current 20% retention rates for commercial-sized trees are unsustainable except at rare historical sites (that is, already logged) where population structures were heavily weighted to sub-commercial size classes (Grogan *et al.* 2008).

4. Evaluation of data quantity & quality for the assessment

In **Peru**, the national quota process has been considered weak due to poor verification of timber stocks from inventories and to the overestimation of sawn timber yield per tree. These issues may have allowed the laundering and export of thousands of cubic metres of illegal mahogany (Ortiz in Del Gatto & Ortiz in press).

Projections from the project 'UNALM-ITTO PD 251/03' are being evaluated by the Scientific Authority through field inventories. Information on mahogany populations is monitored and under continual adjustment (Lombardi comm. in lit. July 2008). Maps of ecosystems where mahogany occurs, establishment of annual export quotas, and a national strategy for implementation of management plans for mahogany are key outcomes anticipated from this project (INRENA 2007).

5. Main problems, challenges or difficulties found in elaboration of NDF

In **Peru**, main problems continue to be related to the lack of information on mahogany distribution, stocks, ecology and regeneration. Authorities lack the capacity and resources to monitor and control harvests and commercialization, and transparency, communications and information systems need to be improved (OIMT 2004). The principal difficulties according Lombardi (comm. in lit. July 2008) are delays in information flows which prevent updating databases; the lack of economic resources for timely fieldwork for developing new indicators to analyze mahogany population status; and the lack of recognition of the SA's opinions by other government agencies.

There remains no dialogue between the CITES Scientific and Management Authorities. Not all of the recommendations made by the Scientific Authority (UNALM) to the Management Authority (INRENA) are taken into account even though the SA considers some of these key to the survival of mahogany within Amazonian forest ecosystems. For example, in October 2006, in a letter to INRENA the SA recommended raising the minimum cutting diameter (MCD) for mahogany from 75 to 120 cm based on the estimation that 34% of remaining trees are smaller than 75 cm. The SA's position is that, given this population structure, logging practices under the current MCD are unsustainable; the MCD must be raised in order for sufficient sub-commercial trees to survive harvests. The SA's recommendation would designate 62% of the population as sub-commercial, thus guaranteeing the long-term sustainability of harvest practices. INRENA has not followed this recommendation (Rojas 2007).

In **Brazil**, management guidelines for mahogany are broadly consistent with current understanding of best practices for the species, and controls on new management plans are stringent. The main challenge will be to update guidelines as more information regarding sustainable management comes available.

In contrast to Peru, CITES Management and Scientific Authorities in Brazil reside within the same office in IBAMA and overlap to large extent. This arrangement runs counter to the usual division of labor whereby the MA verifies legal origin and the SA – a separate and independent entity – verifies non-detriment for Appendix II species.

6. Recommendations

See section 2.1.3. and **Tables 3** & **4** for recommendations from MWG2 and the Scientific Authority in Peru, respectively. The OIMT (2004, Section 5) report lists recommendations addressing problems mentioned above for the implementation of CITES Appendix II for mahogany.

In **Peru**, the Mahogany Action Plan (INRENA 2007) contains the full set of recommendations from CITES regarding Appendix II implementation including mahogany zoning and planning at national and subregional levels; conditions on export based on proven legal origin of timber and NDF determined by the SA; and establishment of quotas based on scientific and valid information.

According to Lombardi (comm. in lit. July 2008), the criteria and parameters necessary for formulating NDF must be reviewed; costs and monitoring time associated with NDF must be discussed; and a clear position on whether NDF will be based on forest management at the level of forestry units or on export quotas must be determined. Further, it is crucial to define whether management plans must contain provisions specific to mahogany, and whether any management plan for forests within mahogany's natural range must include these provisions regardless of its current status. Integral management plans must protect both mahogany and its habitat.

In **Bolivia**, although significant advances have been made towards developing a sustainable model for mahogany harvests and therefore towards NDF, the question of how mahogany regeneration can be promoted requires further examination. It will also be necessary to assess whether silvicultural treatments applied at La Chonta have the same results on mahogany populations in other forest types.

In **Brazil**, as previously noted, progress towards developing NDF procedures will depend on whether new research findings can be effectively incorporated into public policy in timely fashion.

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Appendix 1. Peruvian legislation regulating forest management and conservation with timeline (**Table 6**).

In **Peru**, a national legislative reform is in process. New Law Decrees and Resolutions include the creation of the Ministry of Environment for the conservation and sustainable use of natural resources, biological diversity and protected areas; and Decree N° 1090 (28 June 2008) which created a Forestry and Wildlife Law establishing new definitions for forestry resources and use. Changes in laws and regulations are related to compliance with the Peru-USA Free Trade Agreement, and will affect forest conservation and sustainable use.

Ley 27308 defined a system of land use including Forests for Permanent Production (BPP) which encompass the concessions system. Concessions are subject to approval and implementation of Management Plans; harvests must observe minimum diameter cutting limits established by INRENA (OIMT 2004). Ley 27308 established the creation of a control organism for timber resources (OSINFOR, Organization for the Supervision of Forest Resources & Wild Fauna) to monitor the compliance of Management Plans in forestry concessions at the national level. This provision has not yet been implemented, however, and INRENA remains the controlling agency. Legislative Decree 1085 (28/06/2008) re-established the creation of OSINFOR, with legal authority to supervise and control the sustainable use and conservation of the forest and wild fauna resources and natural services from forests.

According to new proposed decrees, the Ministry of Agriculture (MINAG) is the unique National Forest Authority and together with Regional Governments is in charge of the management of forestry resources and wild fauna, generating an overlap with the Vice Ministry of Strategic Planning and Development of Natural Resources in the Ministry of Environment. Regarding modalities of use, concessions, permits and authorisations, Decree 1090 does not specify requirements for approving and implementing General Management Plans and Annual Operative Plans (POAs), nor criteria for intensity of use. Relevant passages include:

• Art. 11 on forest management requires verification of stocks only for CITES-listed species, including mahogany.

• Art. 22 prohibits exports of logs (Equipo del Proyecto Transparencia y Gobernabilidad Forestal – Perú 2008).

• Art. 41 allows legality of products of controversial origin, to be in force from 01 January 2009 for CITES species and from 01 July 2009 for all other species; according to legal analysts, this provision will legalize products of illegal origin, permit their trade in 2008, and postpone control measures. This articles opposes the FTA forestry agenda (Equipo del Proyecto Transparencia y Gobernabilidad Forestal – Perú 2008) and contradict CITES requirement of legal origin (Foro ecológico del Perú, Foro ciudades para la vida, Colectivo forestal de la sociedad civil, 2008).

Final complementary dispositions mentions that the Ministry of Agriculture (current CITES Management Authority), in coordination with the CITES Scientific Authority (Universidad Nacional La Molina), will progressively develop technical studies to determine timber yields to calculate conversion factors, technical analysis and periodic updating of inventories of forestry species, prioritizing CITES species and yield studies, which will be public. It states that participation of CITES Scientific Authority shall also be related to the sustainable use according regeneration/recuperation status of natural populations. The establishment of an annual export quota is an optional decision of the Minsitry of Agriculture (Equipo del Proyecto Transparencia y Gobernabilidad Forestal – Perú 2008).

Decree 1090 has generated controversy around several issues. Environmental organisations have objected that some provisions run counter to commitments made by Peru under the FTA, especially Annex 18.3.4 regarding illegal timber trade and use rights, because it does not require inventories or silvicultural practices, nor does it strengthen control and concessions supervision systems, while the FTA obliges verification of timber origin through chain of custody. Decree 1090 does not address required changes in the concessions system. No consultation period was granted for Decree 1090, and the process is considered non-transparent (Chávez 2008, Pulgar-Vidal & Sandoval 2008). Further, it does not clearly define the institutional functions of the Ministry of Environment regarding conservation of forest resources and in relation to the role of the Ministry of Agriculture. Finally, it does not recognize the competences and roles of regional governments in forest control and fiscalisation (Foro ecológico del Perú, Foro ciudades para la vida, Colectivo forestal de la sociedad civil, 2008). Civil society concerns on Decree 1090 (based in Foro Ecológico del Perú *et al.* 2008) are summarized in Del Gatto & Ortiz (in press).

Some of the commitments from Peruvian and US governments under the Peru-USA Free Trade Agreement (FTA) include: improve law enforcement, forest management and control to combat illegal logging and trade through developing a plan against corruption; increase criminal penalties and suspend the right to export products associated with illegal logging and trade; develop a plan and policies to implement and monitor Appendix II implementation, including chain of custody and tracking systems; support community-based forest management; strengthen the legal, policy and institutional framework of the forest sector; improve management of forest concessions; and increase public participation and tranparency (Foro ecológico del Perú, Foro ciudades para la vida, Colectivo forestal de la sociedad civil 2008; Del Gatto & Ortiz in press).

Sustainable use of biological resources is dicussed in Chapter 18 of FTA. Appendix 18.3.4 outlines elements of Forest Sector Governance (analysed in Del Gatto & Ortiz in press). It stipulates the necessity to elaborate a Strategic Plan related to the implementation of the listing of big-leaf mahogany in CITES Appendix II. The plan (PAEC-PERU 2008–2012) was developed and approved through Resolución Suprema N° 040-2008-AG in July 2008.

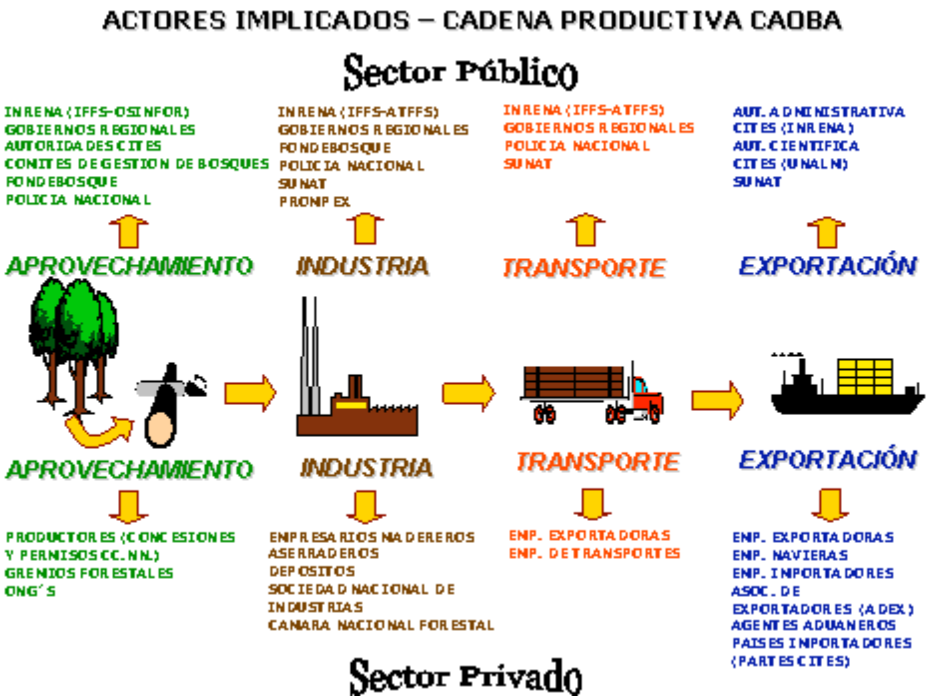
Table 6. Peruvian legal framework for conservation and forest management.

Legislation	**Regarding**
CITES, 30/12/1974	Peru joined CITES.
Law N° 21080, 21/01/1975	Ratifies inclusion of Peru in CITES.
The International Tropical Timber Agreement (ITTA), 03/09/1995	The ITTA was signed to improve control of the tropical timber market with Peru as a member.
Organic Law N° 26821, 10/06/1997	Gives the right to the Nation to use natural resources in a sustainable manner. Establishes conditions and modalities of use. Article 5: gives citizens the right to be informed and participate in the definition and adoption of policies related to conservation and sustainable use. Article 12: conservation & use in & out of protected areas, threatened species, bans. Art. 16: supervision of sustainable use, including measures for adequate supervision of use in areas of difficult access. Art. 28: sustainable use shall take into account regeneration availability, avoid overexploitation, & qualitative & quantitative recovery. Art. 29: compliance with management plans.
Law N° 26834, Natural Protected Areas, 30/06/1997	Monitoring, use & regulation for all natural resources within Protected Areas.
Law N° 27308, Forestry & Wild Fauna, 05/10/2001 & Decreto Supremo N° 014-2001-AG	Within the Transitory Complementary Dispositions of this law, N° 7 defines mahogany as a species forbidden for exploitation. For 10 years no timber originating from territories inside of the Putumayo, Yavari, Tamaya & El Purus watersheds could be traded. N° 8 prohibits all exports of mahogany wood from regions mentioned in N° 7, except for value-added products, pieces or parts.
Law N° 28611	General Environmental Law & International Agreements; modified by Legislative Decree 1055.
PERU-USA Free Trade Agreement (FTA), 05/10/2007	Chapter 18 discusses sustainable use of natural resources. In article 18.8 regarding biological diversity, Appendix 18.3.4 stipulates the necessity to elaborate a Strategic Plan related to the inclusion of big-leaf mahogany in CITES Appendix II.

Law Nº 29157	Grants the legislature 180 days to regulate PERU-USA FTA implementation. A set of normatives on several important issues were approved.
Resolution Decree Nº 075, 18/03/2008	Approves harvesting percentages for mahogany & *Cedrela odorata*.
Legislative Decree Nº 1013, 14/05/2008	Approves creation, organization & functions of the Ministry of Environment. Obligations include ensuring the constitutional mandate regarding conservation & sustainable use of natural resources, biological diversity, and natural protected areas.
Supreme Resolution Nº 040-2008-AG, 14/06/2008	Approval of the Strategic Plan for the implementation of mahogany's listing in CITES Appendix II (PAEC-PERU 2008–2012).
Legislative Decree Nº 1055, June 2008	Modifies Law Nº 28611 regarding information obligations & citizen participation. Makes the Ministry of Environment the focal point for environmental issues derived from Peruvian commitments under trade agreements.
Legislative Decree Nº 1056	For compliance with Regime for Trade origin in the framework of Trade Agreements signed by Peru.
Legislative Decree N° 1079, 27/06/2008	Establishes measures to be taken to guarantee patrimony of Natural Protected Areas. Provides mechanism for management of resources confiscated inside natural areas.
Legislative Decree N° 1085, 8/06/2008	Creates the Organizaiton for the Supervision of Forestry Resources & Wild Fauna (OSINFOR) with legal authority to supervise & control sustainable use & conservation of forests, wild fauna & natural forest services.
Legislative Decree Nº 1090, 27/06/2008	Approves Law of Forestry & Wild Fauna for sustainable use & conservation. Derogates Law Nº 28204 for transfer of seizured timber. Makes the Ministry of Agriculture the national authority in charge of designing, executing, supervising & evaluating forest policy. In previous legislation the Ministry of Agriculture was the primary body for promoting sustainable use & conservation of forest resources & wild fauna; the National Institute of Natural Resources (INRENA) was in charge of forest management.

Appendix 2. Mahogany production chain in Peru.

The diagram summarizes stakeholders involved in use, processing, transport and export of mahogany, including producers, government agencies, CITES authorities, customs, transportation, exporters and the private sector (INRENA 2007)



NDF WORKSHOP
WG 1 – Trees
CASE STUDY 3 SUMMARY
Aquilaria malaccensis
Country – **Malaysia**
Original language – English

AGARWOOD (*AQUILARIA MALACCENSIS*) IN MALAYSIA

AUTHOR:
Lillian Swee Lian Chua

The phytogeographical region for *Aquilaria malaccensis* comprises India, Myanmar, Sumatra, Peninsular Malaysia, Singapore, Borneo and the Philippines. In Malaysia, the species is widespread in the lowland dipterocarp and mixed dipterocarp forests at altitudes of up to 270 m. This species is absent from Sarawak.

In Malaysia, agarwood is treated as a minor forest produce and is not subjected to a cutting cycle. Trees with a diameter size of less than 20 cm and trees in flower and fruit are not allowed to be harvested. A Standard of Procedures has been developed to control and monitor harvesting, processing and trade activities. Trial planting of *Aquilaria malaccensis*, both as part of the government and private sector initiatives, is being conducted in Peninsular Malaysia, Sabah and Sarawak. There are general laws that govern agarwood collection, processing, manufacturing and trade.

The criteria, parameters and/or indicators used to prepare the non-detriment finding for *Aquilaria malaccensis* are :-

- density and demography of selected populations occurring in the various Permanent Sample Plots (PSPs) and plots laid out for national forest inventories (NFIs);
- harvesting limits employed under the Standard of Procedures; and
- pattern and level of exploitation for international trade, including trade statistics.

The data for density and demographic patterns are obtained from field evaluation on the above-mentioned plots and plots established for academic research. For the plots established under PSP and NFI, the published data is data that has been analysed. National Forest Inventories are conducted only for Peninsular Malaysia.

There are several major difficulties encountered in the process of preparing an NDF. Very little is known about the population distribution pattern, demography, ecology, flowering phenology, reproductive behaviour, fruit production, recruitment and regeneration patterns, natural mortality and mortality/regeneration caused by damage to trunk of *Aquilaria malaccensis*. Its widespread but low density occurrence exacerbates the situation. Likewise there is hardly any information on the response and rate of infection in naturally occurring trees, quality of infected resinwood and recovery rates of chips particularly those used for oil production. The grade of the resin in trees cannot be easily determined with full certainty and infected trees lack definitive external signs indicating the grade of the resin. This leads to indiscriminate harvesting which poses many problems to sustainability and regulation of legal harvest.

The scenario for other species of *Aquilaria* is even more acute. The discord between taxon recognition and the inability of the industry/trade to segregate harvest products according to taxon as required by CITES should be addressed. Any procedures that aim to control harvesting must take into cognizance the above limitations.

There are some management intervention such as licensing and establishment of cultivated *Aquilaria*. Malaysia has yet to produce agarwood from these cultivated trees. In view of the above problems, the criteria, parameters and/or indicators currently used to prepare the non-detriment finding for *Aquilaria malaccensis* are deemed to be appropriate. The data quantity and quality for NDF can only be evaluated with respect to current stocking.

Bigleaf mahogany (*Swietenia macrophylla*) in Peru, Bolivia, Brazil

Elena Mejia & Ximena Buitrón, IUCN

Marielos Peña-Claros, IBIF

James Grogan, Yale University

International Expert Workshop on CITES Non-Detriment Findings
November 2008

The species

- *Swietenia macrophylla* (Meliaceae)
- Emergent tree, wide distribution in the Americas
- Reproductive maturity attained at 70-80 cm diameter
- Growth varies with light condition, plant size, liana cover, geographical location, logging intensity
- Survival rate varies with size, light availability, forest type and logging intensity
- Used for timber production, overexploited
- Habitat loss

Mahogany & CITES

- Included in Appendix II of CITES in 2002 (after 7 years in Appendix III)
- Mahogany Working Group created, with 4 meetings (2001, 2003, 2006, 2008)

- 2007 Expert Workshop generated guidelines for making NDF
- guidelines have not been fully implemented

Mahogany & CITES

- Basic components of guidelines:

1. **<u>Evaluate mahogany stocks</u>** at national or regional level as basis for defining export quotas and as requirement for:
2. **<u>Population parameters</u>** such as structure & dynamics
3. **<u>Management plans</u>** including measures towards sustainable planning of the forestry unit
4. **<u>Silvicultural practices</u>**
5. **<u>Control of mahogany harvests</u>** within planned forestry units, and mahogany exports based on export quotas

1. Evaluate mahogany stocks

- Historical and current stocking levels of mahogany in SA has not been possible:
  - Only remote populations survive intact: where are they? How large are they?
  - Logged areas have been converted to other land use options
  - Logged areas not converted have lower population size (most trees < 45 cm dbh)

1. Evaluate mahogany stocks

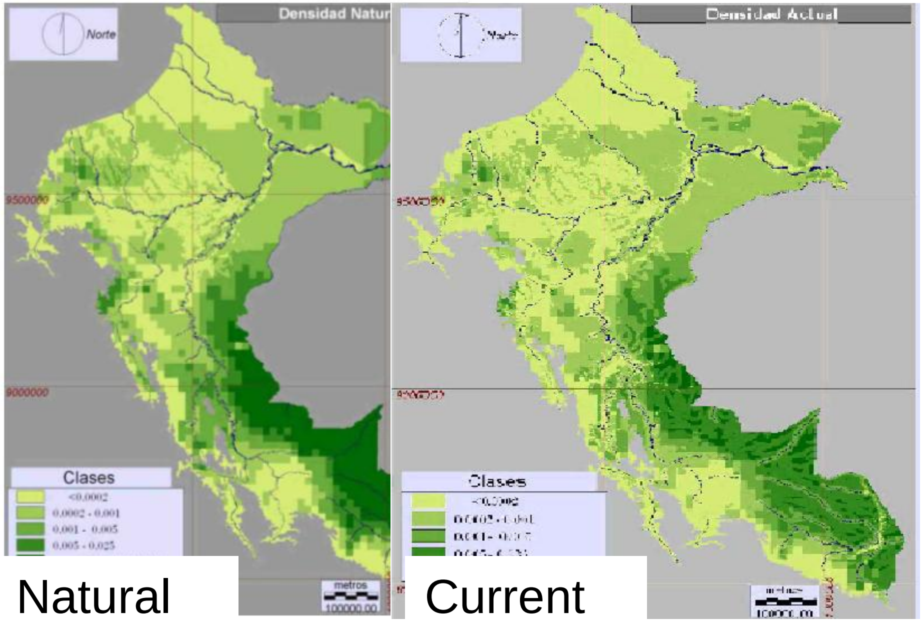
- Peru
  - ITTO project sponsored a national inventory to describe natural distribution and quantify remaining commercial stocks
  - Model used to predict distribution of the species

Píxel: 465 m (21,6 ha)

Densidad de árboles (árb/ha)
Nivel de probabilidad de ocurrencias de árboles de caoba, según el modelo climático.

Factores como cuerpos de agua (valor 0) y zonas pantanosas (valor 0,2) determinan un densidad menor o nula

Clases	Superficie (ha)
< 0.0002	< 5000
0.0002 – 0.001	5000 - 1000
0.001 – 0.005	1000 - 200
0.005 – 0.025	200 - 40
> 0.025 (árb/ha)	> 40



1. Evaluate mahogany stocks

- Bolivia
  - Data from different sources, collected using different methods
  - Data show a large variation in density depending on forest type and harvesting history
  - Need to carry out a better assessment at national level
- Brazil
  - Large-scale inventories in logged and unlogged forests across southern Amazonia
  - A national inventory to assess surviving stocks would be prohibitively expensive

2. Population parameters

- Is the rate of harvesting sustainable?

- Information needed to define harvesting levels:
  - Not much data on population dynamics
  - Very little data on logging effects
  - Very little data on silvicultural treatments required to enhance growth and survival of naturally established individuals
  - But data on forest enrichment available

- Two research-based cases: Bolivia & Brazil

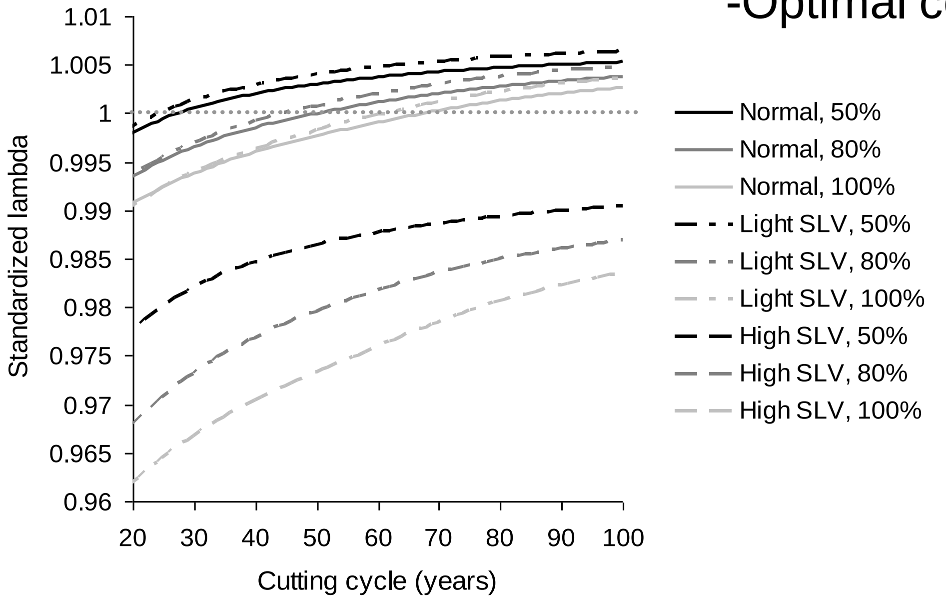
2. Population parameters - Bolivia

- 12 plots of 27 ha each, 4 logging treatments (not mahogany)
- Plants > 1 cm in diameter surveyed in all plots
- Seedlings and saplings < 1.3 m height surveyed around 58 mahogany trees
- Plants have been monitored since 2002
- Population structure
- Survival, growth and recruitment rates
- Dynamic data used to construct population matrices
- Matrices models used to:
  - Calculate population growth rate
  - Determine which vital rates are the most important
  - Different logging scenarios

(Verwer et al. 2008. Journal of Applied Ecology)

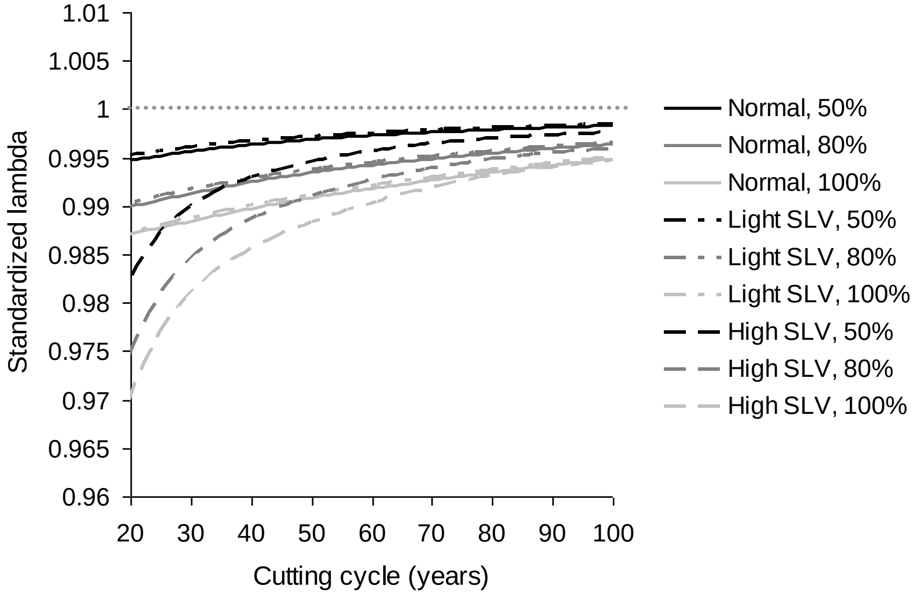
2. Population parameters - Bolivia

-MDC = 70 cm
-Different harvesting intensities (50, 80, 100%)
-Different cutting cycles (20-100 years)
-Optimal conditions are maintained over time



- Reduction of harvesting intensity, reduces cutting cycle length only for some treatments
- Conditions created by logging need to be maintained over time

2. Population parameters - Bolivia



- When forest is allowed to return to initial status, mahogany can not be harvested sustainably

2. Population parameters - Bolivia

- Current practices defined for Bolivia are sustainable (MDC > 70 cm, harvesting intensity of 80%) only when longer cutting cycles are used (> 50 years)

- If harvesting intensity is reduced to 50%, it is possible to have shorter cutting cycles (at least 25 years) but ONLY when effect of treatment is maintained over time

- Without silvicultural treatments mahogany harvesting is not sustainable regardless of cutting cycle and harvesting intensity

- More long-term data is needed to assess the long-term effect of silvicultural treatments on mahogany population dynamics, and to quantify the proper intensity of silvicultural treatments

2. Population parameters – Brazil

- Population structures for trees >20 cm dbh from large-scale (200 - 11,000 ha) inventories at 8 sites across southern Amazonia
- Simulated population recovery during 30-yr cutting cycle, based on:
  - Observed growth & mortality rates from 2 long-term research sites
  - Conventional (predatory) logging practices (~5% retention rates & removal of sub-commercial trees)
  - Legal logging practices (60 cm MCD, 20% retention rate)
  - Variable selection criteria for seed trees under legal practices

(Grogan et al. 2008 Forest Ecology & Management)

2. Population parameters – Brazil

- Density varies by 2 orders of magnitude across range
- Only 1 site with high density of sub-commercial (<60 cm) trees
- Conventional logging removed 93-95% of commercial trees (>45 cm before new regulations), 31-47% sub-commercial trees
- 30-yr population recovery highly dependent on initial population structure, especially density of sub-commercial trees
- 30-yr recovery at 7/8 sites under legal harvest scenario (20% retention) ranged from 20-51% of initial density, 23-50% of initial volume
- Seed tree selection criteria impact recovery rates (that is, maximizing 1st cut financial yield vs. long-term seed production)

3. Management plans

- Technical recommendations provided by MWG 2003 are mainly followed by countries

3. Management plans

Recommended by mahogany working group	Situation in Bolivia as required by the forestry law and current technical norms
Commercial census	- Commercial census is carried out in logging compartments at 100 % intensity. All timber species included in the commercial species list of the company are included in the census. Only trees above minimum cutting diameter are included. - Results of the census are used to elaborate the annual operational logging plan (POAF)
Mapping of commercial and subcommercial trees	- Maps are elaborated based on the commercial census data, including topographic features, water courses, roads, and harvestable trees. Maps are a component of POAF. - Subcommercial trees are not mapped as they are not included in the census.
Selection of seed trees and minimum density of trees per ha alter logging	- 20% of harvestable trees are left behind. These trees are also mapped and tagged. They are also clearly marked in the field to assure its identification as a seed tree. - There is no selection criteria, the 5th tree found should be left as seed tree. - The minimum tree density alter logging depends on the initial density.
Minimum diameter for cutting (MDC)	70 cm for mahogany
Monitoring dynamics of future crop trees	Monitoring is not specifically required for the species. Although it is required to establish permanent plots to assess the effect of logging on forest dynamics and timber yields, not all companies have done so. - Mahogany is present in several permanent plots established but the number of individual is relatively low.
Improvement of regeneration	- Not required, only indirectly done by promoting the use of other species, requiring that seed trees are left behind and the use of cutting cycles. - There are several experiments that have looked at the regeneration aspects of mahogany. The most promising results are coming from enrichment planting in logging gaps.

3. Management plans

- Technical recommendations provided by MWG 2003 are mainly followed by countries
  - Several aspects already included in the existing forestry laws
  - Some specific aspects regarding the species have been included as requirements for mahogany harvesting (mostly in the case of Brazil, to some degree in the case of Peru)

Main problems for determining NDF

- Lack of information on the species, including long-term demographic data
- Authorities lack the capacity and resources to monitor and control harvest and commercialization
- Information flow among parties involved needs to be improved
- Lack of coordination between CITES Management and Scientific Authorities
  - Recommendations are not implemented
- Need to define sawing efficiency and other control and verification methods

Recommendations

- Incorporate recommendations of MWG into management plans of mahogany
- Criteria and parameters for formulating NDF must be reviewed
- Cost and monitoring time must be discussed
- Define if NDF will be based on management unit or export quotas
- Promote and fund research on topics required for defining NDF and for guaranteeing that mahogany is sustainably harvested

Thank you

Questions?

BRAZILWOOD (*CAESALPINIA ECHINATA*) IN BRAZIL

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I. Background information on the taxa

Brazilwood (*Caesalpinia echinata*) is the national tree of Brazil, where it is commonly known as pau brasil. After many years of harvesting, this species is on the verge of extinction. Despite Brazilwood's inclusion on CITES Appendix II and the Brazilian threatened plant species list, exploitation continues due to its extremely dense hardwood ideal for making bows for stringed musical instruments (Global Trees 2008). Available information on the use of *C. echinata* for manufacturing bows is limited. Reliable figures on volumes exported from Brazil for this purpose are lacking, and volumes used by Brazilian bow-makers is also unknown (CITES 2007).

Brazilwood is a late secondary canopy tree whose natural habitat is mainly semi-deciduous seasonal forests occurring on sandy marine soils of Brazil's coastal Atlantic Forest (Mata Atlântica). Local ecological factors lend a sclerophyllous aspect to this type of vegetation (Cardoso et al. 1998). Brazilwood's natural distribution is restricted to between Rio Grande do Norte and Rio de Janeiro (Borges *et al*. 2005).

Caesalpinia echinata was included on CITES Appendix II in September 2007 (violin bows were not included; CITES 2008). Since 1992 Brazilwood has been included on the official list of threatened Brazilian plants by IBAMA (Brazilian Institute for the Environment and Renewable Natural Resources), which has also established legislation on harvesting practices. Research on replanting opportunities is ongoing. Despite its high profile, little information exists regarding Brazilwood's ecology and life history, with limited data available on distribution, species variation, and population size (Newton, Oldfield, & Fragoso n/d).

IBAMA is the CITES Management and Scientific Authority in Brazil. IBAMA allows Brazilwood trade in material originating from property improvements such as fences, sheds, and houses so long as a license has been issued to this effect by the appropriate environmental agency. IBAMA may then authorize these materials for export (CITES 2007).

According to the CITES proposal for Brazilwood, information was gathered on international trade and use of *C. echinata* for the production of bows in 1997 (FFI 1997). Timber merchants are reluctant to divulge this information, but annual worldwide demand is estimated at around 200 m^3. Principal importing nations include the United Kingdom, France, Germany, China, Switzerland, Korea, Japan and the USA (CITES 2007). Within this importers framework the International Pernambuco Conservation Initiative (IPCI) was created, represented mainly by the USA and Germany along with members of other importer nations. The IPCI has supported the 'Pau-Brasil Program' through CEPLAC (Executive Commission of the Cocoa Planting Plan) with assistance from IBAMA and the Rio de Janeiro Botanic Garden since 2004. The Program's objectives include promoting conservation actions, production research, environmental education, and sustainable use of Caesalpinia echinata (Chaves & Mello comm. in lit. July 2008).

1. BIOLOGICAL DATA

1.1. Scientific & common names

Caesalpinia echinata Lam. is classified in the family Fabaceae and order Fabales. It is called pau brasil, brasileto, ibirapitanga, orabutá, pernambuco, or pau rosado in Portuguese; Brazilwood in English; and palo brasil in Spanish.

1.2. Distribution

Brazilwood is confined to the Atlantic Forest, an ecosystem recognized as a global biodiversity hotspot. It inhabits coastal regions with open forest and well-drained soils. Detailed information on the present geographical distribution of Brazilwood is scarce, but in the last ten years remnant populations have been found in nine Brazilian states, including populations in reserves in Bahia and Pernambuco. Determining the previous range of the species has been problematic due to errors in the literature caused by incorrect identification and confusion with related species. Fig. 1 shows the potential distribution on the basis of historic Atlantic Forest range according to WWF Global 2000 Ecoregions data (Newton, Oldfield, & Fragoso n/d).

Pau brasil occurs principally in low-lying coastal areas and wide plains (IPCI-Comurnat 2008) in Rio de Janeiro and the southernmost part of Bahia, where it is restricted to the Mata Atlântica (Atlantic Coastal Forest), which now covers less than 100,000 km^2, or 7.3% of its original extent in Brazil (IUCN & TRAFFIC 2007, UNEP-WCMC 2008). In the 16th Century, the Mata Atlântica covered practically all of the Atlantic seaboard from south of Rio de Janeiro to Rio Grande do Norte and extended 80 to 150 kilometers inland (IPCI-Comurnat 2008).

Table 1. Locations with botanical records where Brazilwood occurs (CITES 2007).

State	Locations where Brazilwood occurs
Rio Grande do Norte (RN)	Extreme south to near Cabo de Touros
Paraíba (PB)	Mamanguape & Camaratuba
Pernambuco (PE)	São Lourenço da Mata to Vitória de Santo Antão, Nazaré da Mata
Alagoas (AL)	Tracunhaém, Pau d'Alho, Timbaúba, Goiana, Junqueira
Bahia (BA)	Porto Seguro, Eunápolis, Itamaraju, Barrolândia, Jussari, Ipiau
Espírito Santo (ES)	Aracruz, Caraíva, Camacã, Guaratinga, Pau-Brasil, Ubaitaba, Tapera
Rio de Janeiro (RJ)	Cabo Frio, Búzios, São Pedro da Aldeia, Araruama, Iguaba, Saquarema, Itaipuaçú, Rio de Janeiro

Fig. 1. The Atlantic Forest (Mata Atlântica) in the 16th and 21st Centuries (IPCI-Comurnat 2008).

1.3. Biological characteristics

1.3.1. *General biology & life history*

Pau brasil is a medium-sized leguminous tree reaching around 12 m height with a maximum stem diameter of 70 cm. Brazilwood is semi-deciduous, heliophytic or sciophytic, typical of seasonal forests. It persisted through the glacial periods, preferring an arid climate and dry soils (CITES 2007). Its growth rate is slow and depends on several factors such as soil type, climate, and geographic location (Mello 2008). Many aspects of the biology of Brazilwood and the composition and structure of plant communities in which it occurs are poorly understood (IUCN & TRAFFIC 2007).

The flowering period of *C. echinata* growing in an experimental area in the state of São Paulo over 24 years was during

August–September at the beginning of the rainy season. Flowering by individual trees lasts 10–15 days; individual flowers are receptive for less than 24 hours. Flowers give off a scent of slightly sweetened citrus fruit, and tend to cluster in small terminal racemes, rarely sprouting from branch axils. The calyx is yellowish-green, and petals are intensely yellow with faint shades of red at the base. The medium-sized petal stands out from the others with its deep red central spot that nearly covers the entire surface. Fruit maturation occurs during the late rainy season and early dry season of the following year. Fruit are woody, 6–8 cm long and 2–3 cm wide, oblique, spiny, sublunate dehiscent, and contain 2–3 brownish seeds that are 1–1.5 cm diameter. Fruit pod valves twist after dehiscence, and their surfaces are pubescent with 5 mm woody spines (Borges *et al*. 2005).

1.3.2. *Habitat types*

C. echinata chiefly occurs on coastal plains and lowlands, on sandy or sandy-clay soils. Its patchy distribution along the Atlantic coast reflects this preference (CITES 2007).

1.3.3. *Role of the species in its ecosystem*

Little is known about the composition and structure of the plant community in which Brazilwood occurs. Floristic characteristics of three areas containing the species in the state of Rio de Janeiro have been studied, but not in great detail, so these studies do not provide sufficient data to reach any generalized conclusion (CITES 2007).

1.4. Population

1.4.1. *Population size*

The Pau-Brasil Program recorded 1,754 trees. Of these, 1,669 occurred naturally and the remaining 85 had been planted. These data include presence of three morphological variants of the species —rue-leafed, coffee-leafed, and orange-leafed forms— in southern Bahia where cocoa plantations are prevalent. *C. echinata* is known to be disappearing because of habitat loss associated with deforestation and illegal logging of trees to produce violin bows and for other purposes. The Pau-Brasil Program has verified examples of regenerating populations. These results were found for individuals in a *Caesalpinia echinata* sample covering an area of 3.6 ha, within five remaining hectares of the semi-deciduous seasonal forest in the Cabo Frio Diversity Centre, and for a small population surviving in the city of Rio de Janeiro. This evidence indicates the typical inverse *J*-curve, where the highest percentages of individuals in the sample were plants at the seedling or juvenile stage (coppices; CITES 2007).

1.4.2. *Current global population trends:*
___increasing _X_decreasing ___stable ___unknown

1.5. Conservation status

Brazilwood has been listed as threatened by IBAMA since 1992 (CITES 2007). This status has been re-confirmed recently (Ministério do Meio Ambiente, Instrução Normativa No 06/23 September 2008).

Table 3. Status of Caesalpinia echinata (CITES 2007).

Organization	Comment
CITES (PC14 09/2007)	Qualifies for CITES Appendix II
World List of Threatened Trees	Endangered
IUCN (2004 Red List)	Endangered (based on criteria A1 a, c, d)1
IBAMA (Brazil) (Resolution No 37 04/1992)	In danger of extinction

1.5.1. *Main threats*

The main threats are deforestation and illegal logging for exports. Deforestation of the Mata Atlântica has been accelerated by urban sprawl, agriculture and timber harvesting. Some regions have suffered considerable impact in recent years through tourism development. Detailed figures on the proportion of deforestation in the remaining forest areas where C. echinata occurs are unavailable (CITES 2007).

___No threats
_X_Habitat loss/degradation (human induced)
___Invasive alien species (directly affecting the species)
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. bycatch)
___Persecution (e.g. pest control)
___Pollution (affecting habitat and/or species)
___Other_______________
___Unknown

2. SPECIES MANAGEMENT

2.1. Management measures

2.1.1. *Management history*

Caesalpinia echinata has been extracted from natural forests since 1500. Harvests have been illegal since 2001. No plantations are known (Mello 2008).

2.1.2. *Purpose of the management plan in place*

There is no possibility for approval of management plans for Brazilwood until a range-wide inventory is completed. Timber that is currently available for export was harvested before Brazilwood's Appendix II listing in 2007; these volumes are considered pre-convention (Mello 2008). The Pau-Brasil Program undertook a series of inventories in 2005. The objective was to gather information on the occurrence of the species by consulting with institutions and social bodies (government environmental agencies, NGOs, rural unions, forest exploration and management firms, and sawmills) as well as professionals associated with forestry activities, to identify locations where the species and its morphotypes prosper under natural and cultivated conditions. In the course of the inventory work, numerous rural properties in different edaphic-climatic and ecological regions were visited, and 1,754 individual Brazilwood trees were recorded on over 130 rural properties in the cocoa-growing region of southern Bahia (CITES 2007)

2.1.3. *General elements of the management plan*

N/A

2.1.4. *Restoration or alleviation measures*

The Pau-Brasil Program is coordinated by CEPLAC (Comissão Executiva do Plano da Lavoura Cacaueira) in partnership with several NGO and research institutions. The project, started in 2004, is financed by IPCI. The main objectives of the program are to develop conservation actions, production research, environmental education and sustainable use of *Caesalpinia echinata*. After four years of program implementation, the principal achievements have been the recognition of three different varieties of pau brasil and the establishment of a tree plantation of 140,000 plants growing under different forest canopy and soil conditions. Data obtained from the experimental plantation has provided new tools to improve the economic and environmental parameters for developing sustainable management of *C. echinata*. The Pau-Brasil Program in its new phase hopes to establish seedbanks and to recuperate legal reserves. In the medium term, the Program's principal objectives are to move Brazilwood off of the Endangered Species List, to resume its legal commercialization, and to create a new economic resource for producers and for those who will want to participate in the future. As well, on-going negotiations are aimed at establishing new strategic alliances (private sector) to extend the Program's efforts in the state of Bahia (Chaves & Mello 2008).

2.2. Monitoring system

Caesalpinia echinata cannot be legally harvested at present. All currently held material had to be declared and updated in the Forestry Origin Document (DFO). This system is used for monitoring forest-derived products; the DFO allows control of Brazilwood-derived products from point of origin until their export location. At this time, Brazilwood trade is currently permitted only for declared material (Mello 2008).

2.2.1. *Methods used to monitor harvest*

N/A

2.2.2. *Confidence in the use of monitoring*

Brazil's monitoring systems are displayed on-line. This process allows tracking all forestry products in a secure and trustworthy manner. The viability and confidence of this system is highly regarded (Mello 2008).

2.3. Legal framework & law enforcement

Brazilwood is protected under the Law for Bioma-Mata Atlântica. Its harvest is prohibited in natural forests. No plantations are known (Mello 2008). Under National Environmental Council (CONAMA) Resolution No 278/2001, all previously authorized concessions for felling and harvesting species threatened with extinction were suspended except for temporary harvesting for no direct commercial purpose, to be consumed on rural properties or holdings or on Indigenous peoples' landholdings and traditional settlements (CITES 2007).

Table 3. Brazil's legal framework for forest management & Brazilwood.

Legislation	Regarding
Law Nº 4771, 15/09/1965 –	Forestry regulations for Brazil.
Resolution CONAMA 278	Prohibits harvesting & exploration of all species under threat of extinction in the Mata Atlântica.
Decreto Nº , 10/02/1993	Regulates harvesting, exploration and suppression of primary vegetation in advanced & medium regeneration levels of the Mata Atlântica.
Law Nº 11.428, 22/10/2006	Specific law for the Mata Atlântica.
Decreto Nº 5.975, 2006	Establishes that the generation, issuance and control of documents for transportation & storage of forestry products & sub-products of native origin must be emitted through the National Electronic Integrated System.
Instrução Normativa Nº 112, 21/08/2006	Empowers IBAMA to suspend authorizations granted directly or by other bodies within the National Environmental System (SISNAMA) for harvesting species officially listed as threatened with extinction, for natural populations in the Mata Atlântica.

3. UTILIZATION & TRADE

3.1. **Type of use** (origin) **& destinations** (purposes)

In accordance with the document produced in February 2002 by the Federal Ministry of the Environment, Department of Nature Protection and Nuclear Security of the Federal Republic of Germany, evidence indicates widespread use of *C. echinata* in global production of violin bows (CITES 2007).

3.2. Harvest

3.2.1. *Harvesting regime*

No harvesting is allowed for commercial purposes.

3.2.2. *Harvest management / control* (quotas, seasons, permits, etc.)

N/A

3.3. Legal & illegal trade levels

The extent and quantity of surviving Brazilwood stocks are unknown. According to IBAMA, hidden volumes remain available for illegal trade in spite of legal requirements that timber companies declare quantities of *C. echinata* under ownership. Illegal exports have declined since *C. echinata* was included on Appendix II (Mello 2008). While illegal logging is known to occur, the extent of such practice has not been determined because timber merchants are reluctant to divulge this information. Though annual worldwide demand is estimated at around 200 m^3, it is probably higher because a considerable amount of wood is wasted during the bow-making process. A single violin bow typically requires approximately 1 kg of wood (CITES 2007).

According to Mello (comm. in lit. August 2008), all companies with timber products were required to declare their stocks through the IBAMA electronic system in 2006. The system shows that 20,388 m^3 of Brazilwood were exported from 2006 to December 2007 from these stocks. However, the electronic system cannot adequately track the timber quantities during the transformation process; that is, most timber is transformed into violin bows and then exported without registration (violin bows are not included in the Appendix II listing). IBAMA is currently trying to increase control because the black market for Brazilwood remains active. The system has registered no exports in 2008.

II. Non-detriment finding procedure (NDFs)

Brazil does not allow extraction from natural forests and no plantations are known (Mello comm. in lit July 2008). The Brazilian government recognizes the need for adequate data on surviving natural stocks and other biological information before NDF can be provided. Steps currently underway to obtain the necessary information are outlined in this case study.

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

__yes _X_no

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NDF Workshop
WG 1 - Trees
CASE STUDY 4 SUMMARY
Swietenia macrophylla
Country: **Peru, Brazil and Bolivia**
Original Language - English

BIG-LEAF MAHOGANY (*SWIETENIA MACROPHYLLA*) IN PERU, BOLIVIA AND BRAZIL

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James Grogan

The debate over bigleaf mahogany's commercial and conservation status across its neotropical range has dominated CITES deliberations over timber species since the early 1990s. A proposal to uplist mahogany from Appendix III to Appendix II was finally adopted at CoP12 (Santiago); the listing went into effect on 15 November 2003.

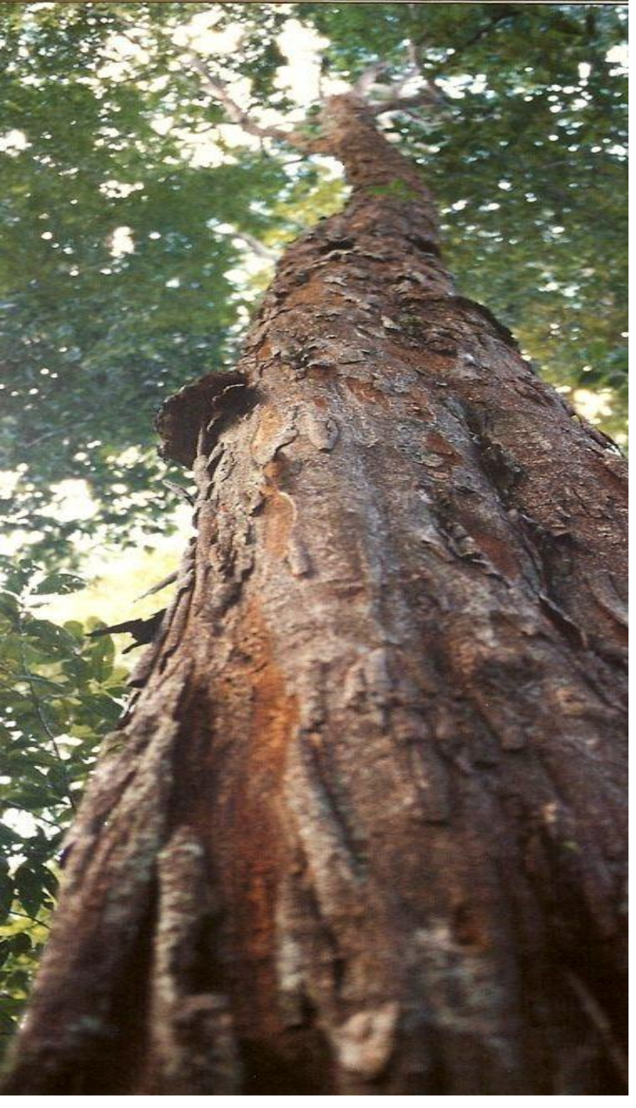
Mahogany's natural range stretches from Mexico at 23° N of the equator down the Central American Atlantic coastal strip into South America, continuing in a broad southeasterly arc from Venezuela through the Colombian, Ecuadorian, Peruvian, Bolivian, and Brazilian Amazon regions to points as far south as 18° S. Its historic range covers an estimated 238 million hectares in Peru, Bolivia, and Brazil. Mahogany is generally associated with seasonally dry tropical forests. It is an emergent tree growing to great height (45 m) and diameter (2.5 m), occurring at low landscape-scale densities, with large wind-dispersed seeds, light-demanding seedlings and saplings, and relatively fast diameter and height growth rates under ideal (high light, rich soil) conditions.

Several international meetings and workshops have been held since mahogany's inclusion in CITES Appendix II, with emphasis on implementation and recommendations regarding NDF. Technical recommendations for NDF were first proposed at the 2nd Mahogany Working Group held in Belém, Brazil in 2003, and elaborated further at the International Expert Workshop on NDF held in Cancún, Mexico in 2007. Guidelines for NDF from these and other working meetings are available at the CITES webpage (www.cites.org).

In **Peru**, national export quotas for mahogany have been set since 2005, but this process has been considered weak due to poor verification of timber stocks from inventories and to the overestimation of sawn timber yield per tree. Data from the on-going project 'UNALM-ITTO PD 251/03' is being used to develop NDF procedures for mahogany based on parameters such as population size within commercial concessions and forest areas of native communities, population size-class distributions and estimated production volumes, and the rate of defective or hollow trees. Based on preliminary data from permanent production areas, the Peruvian Scientific Authority considers mahogany's population status in some regions to be too low for commercial exploitation and recommends limits or bans on harvests coupled with restoration programs. The main issues for providing NDF continue to be related to the lack of information on mahogany distribution, stocks, ecology and regeneration. As well, authorities lack the capacity and resources to monitor and control harvests and commercialization, and transparency, communications and information systems need to be improved.

Bolivia has not yet defined NDF procedures for mahogany because information upon which these should be based remains lacking. However, recent research results from the Long-term Silvicultural Research Project established in La Chonta provide information useful for NDF. Results from simulation models constructed to assess different harvesting scenarios indicate that mahogany could be sustainably harvested if the minimum diameter cutting limit is at least 70 cm diameter, if cutting cycles are longer than 25 years, if harvest intensity is reduced to 50% of commercial-sized trees, and if silvicultural treatments such as liana cutting and liberation from competing trees are applied to create and maintain optimal growing conditions throughout the cutting cycle. Although significant advances have been made towards developing a sustainable model for mahogany harvests and therefore towards NDF, the question of how mahogany regeneration can be promoted requires further examination.

In **Brazil**, management guidelines for mahogany are broadly consistent with current understanding of best practices for the species, and controls on new management plans are stringent. In the absence of clear NDF procedures for timber species, Brazil has relied on recommendations from a series of Mahogany Working Group meetings within IBAMA and the Ministry of the Environment (MMA). Outputs from these meetings were incorporated into Instrução Normativa N°. 07 (2003) which regulates mahogany harvests. Industrial timber producers wishing to harvest mahogany must submit management plans to IBAMA. If proposed activities are broadly compatible with forest regulations, IBAMA solicits further review – including on-site verification – from a Technical-Scientific Committee composed of foresters and ecologists with specialized knowledge of mahogany. The final licensing decision rests with IBAMA. Since 2003 only one management plan including mahogany has been approved for harvest in Brazil. The Brazilian government additionally directly or indirectly supports on-going applied research on mahogany ecology, genetics, and management through projects in Acre, Amazonas, and Pará. While research results have contributed to public policy on management and conservation of mahogany, the main challenge will be to update guidelines as more information regarding sustainable management comes available.



WG 1 – Trees

CASE STUDY 5
Brazilwood (*Caesalpinia echinata*) in Brazil

Elena Mejía & Ximena Buitrón
UICN SUR

International Expert Workshop on Cites Non-Detriment Findings
Cancun, Mexico
November 17th to 22nd, 2008

Caesalpinea echinata - Fabaceae

Exploited since XVI century
Redish Dye (red resin - aniline dyes)
Source of bows for violins, violas and cellos

Pau –Brasil (national tree)
Ibira pitanga (red wood)
Pernambuco
Pau de tinta, pau ferro
Pau rosado
Palo Brasil
Brazilwood

Biological data

- Late secondary canopy medium sized tree (12m, 70cmdbh), heliophytic
- Habitat: semi-deciduous seasonal forests on sandy marine soil of Brazil´s coastal Atlantic forests (Mata Atlântica), patchy distribution
- The growth rate of Pau-Brazil (low) depends on several factors such as the composition of the soil (dry), climate (arid) or geographical location.
- Limited data available on distribution, species variation and population size (1,669 in Bahia) - decreasing
- Composition and structure of plant communities poorly understood

Distribution – harvest impact
Mata Atlântica – The Atlantic Forest

IPCI-2008

Cover less than 100,000 km2 or 7.3% of its original extent
(IUCN,TRAFFIC 2007, WCMC 2008)

" Its exploitation caused the destruction of Mata Atlantica "

Distribution – Brazil States


Rare tree in the brazilian flora

Conservation Status

- In danger of extinction (IBAMA- Resolution No 37 04/1992)
- IUCN Red List (2004) EN based on criteria A1a,c,d)1
- World List of Threatened Trees – Endangered
- CITES (PC14 09/2007) qualifies for CITES Appendix II
- In danger of extinction (IBAMA- Resolution No. 06/09/2008)

Main threats

- Habitat loss/degradation: deforestation, accelerated by urban sprawl, agriculture and timber harvesting
- Illegal logging for exports
- Turism develoment (recent years)

Pau Brazil & CITES

- Inclusion on Appendix II in 2007 (does not include violin bows)
- NDF – not required according current legislation:
  - Species protected under Law for Bioma – Mata Atlântica (2006) – harvest prohibited in natural forests.
  - Resolution No. 278/2001 previous concessions authorized for felling and harvesting species threatened with extinction suspended except for no direct commercial purposes.

Therefore No management plan, quotas, permits in place

- Timber available for export is pre-convention (only permitted for declared material), current control system cannot adequately track timber volume in transformation process that is then exported without registration.

- Illegal exports have declined since Appendix II listing, but still illegal logging and trade occurs.

Management measures conservation initiatives

Pau Brasil Program (coordinated by CEPLAC, together with NGOs and research institutions, finaced by IPCI – International Pernambuco Conservation Initiative):

- Undertook a series of inventories in 2005 through a consutation process including government agencies, NGOs, rural unions, private sector, experts).

- Purpose: identify locations where the species prosperes under natural and cultivated conditions. 1754 individuals were recorded on over 130 rural properties in the cocoa growing region of southern Bahia.

- Results: identified three different varieties, establishment of plantation (140,000 plants) under different canopy and soil conditions.

- New phase: seedbanks, legal reserves, move off Endangered species list, data on trade, strategic alliances with private sector to extend the program.

Management measures conservation initiatives

- As part of the Global Trees Campaign, FFI supports education and public awareness about the conservation of this flagship species working with the Rio Botanical Gardens and the Margaret Mee Foundation to carry out a more detailed study into the distribution and conservation requirements of this species.

Recommendations

- Complete a range-wide inventory and other studies required for management of the species and trade monitoring
- Review the IUCN Checklist and other tools
- Review legislation
- Pormote partnsership for sustainable management

Thank you

Photos http://www.globaltrees.org/reso_tree.asp

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GENUS-LEVEL APPROACH TO *TAXUS* SPECIES.

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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1. Scientific and common names, Genus *Taxus*

Classification of species in the genus *Taxus* is characterised alternately as notoriously difficult or controversial. Species have been described as discouragingly similar. Depending on the taxonomic authority consulted, the genus contains anywhere from one species with numerous varieties (Pilger, 1903) to twenty-four species and 55 varieties (Spjut, R.W. 1999).

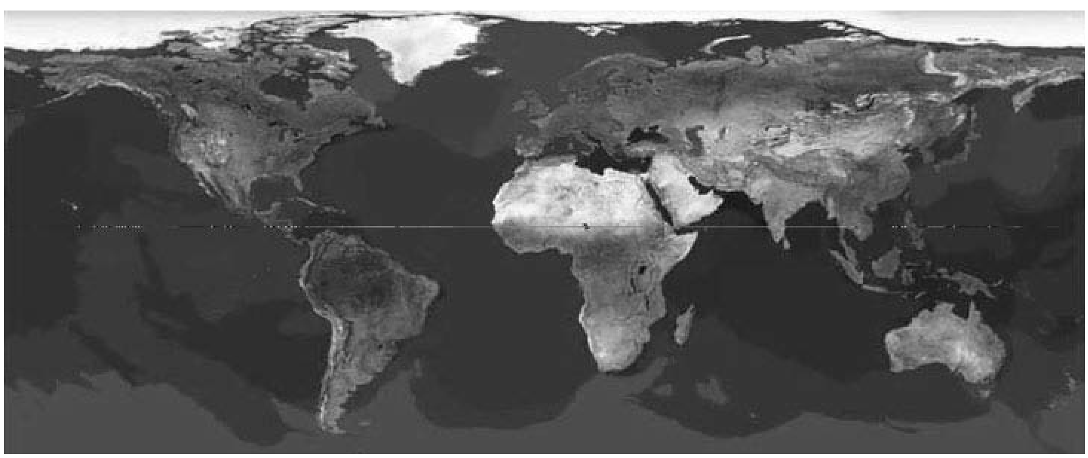
The classification adopted by CITES is that of Farjon, (2001). This treatment recognizes 10 species and 3 infraspecific taxa within the genus. Five *Taxus* species with distributions in Asia, the Philippines and Indonesia are listed in CITES Appendix II, including infraspecific taxa. An additional five species with European and North American distribution are recognized. These species are not listed in CITES appendices. (See Annex: Taxus spp. as per (Farjon, 2001) Nomenclature, Distribution, and IUCN Redlist Status).

1.2. Genus Distribution

Species of the genus are largely confined to the mid-latitudes of the northern hemisphere, with some intrusion to tropical highlands. Northernmost occurrence is in Norway, southernmost below the equator in the Southern Celebes (Indonesia). Generally, most species are found in the understorey or subdominant canopy level of moist temperate or tropical mountain forests (Earle, 2008). Elevations range from near sea level in northern stations to 3000 m in tropical forests (de Laubenfels, 1988

The genus range includes, in Europe: Britain to northern Iran. In Asia: Russia, Korea, Japan, China, Taiwan, Himal, India, Burma, Vietnam, Philippines. In North America: southeast Alaska to California, southeast Canada to northeast USA, Florida, Mexico, Guatemala, El Salvador (Earle, 2008).

The five Asian *Taxus* spp. occur from lowland to montane zones in cool climates with moderate to high, evenly distributed precipitation (Farjon 2001). The North American species (in western North America; *T. brevifolia*, in northeast North America; *T. canadensis*, in Florida; *T. floridana*, in Mexico and central America; *T. globosa*) are scattered trees of the understorey of conifer and broadleaf forests (Farrar, 1995, Harlow et. al. 2001), and along riverbanks and ravines (Earle, 2008).



Global Distribution, Genus *Taxus* (Earle, 2008).

1.3. Biological characteristics

1.3.1. *Summary of general biological and life history characteristics*

Non-resinous, evergreen gymnosperms (Pinophyta). Most yew species dioecious; *T. canadensis* (Canada yew) predominantly (not exclusively) monoecious (Farrar, 1995). Lateral branches well developed, similar to leading shoots (Hils, 1993).

Slow-growing plants, form varies from excurrent, upright and arborescent to decurrent, procumbent and shrubby. Excurrent forms often develop a decurrent shrub form following disruption of central stem development. Multi-stemmed and shrub forms often found within populations of predominantly arborescent species. Decurrent form can be sustained through frequent browsing or shearing. Many species are reported as extremely slow-growing and long lived, taking 100 years or more to attain any appreciable size (CITES, 2004).

Seeds solitary, rate of seed spread and seedling vigour reported as low for *T. baccata*. Species reported as slow-to-establish under natural conditions and in cultivation. Propagation slow (generally two years required for natural germination of seed, two to three months required for artificial propagation of rooted cuttings). Cultivation in plantations considered difficult, with individual plants slow to establish (Dirr, 1998). Establishment of plantations is reported for most species. *T. canadensis* (Canada yew) observed to reproduce vegetatively through layering (rooting of lateral reproductive branches through contact with soil surface). Connections between vegetatively reproduced plants persist for several years (Pinto & Herr, 2005).

Height of yew species varies. *T. wallichiana* (Himalayan yew) reported to reach 20 (30) m with dbh to 1 (1.5) m (NguyÔn *et al*. 2004) *T. brevifolia* (Pacific yew) height to 20 m (Farrar, 1995). Open-grown *T. baccata* (English yew) reaches height 12 to 25 m, (Krüssman 1983). *T. floridana* (Florida yew) to 5 m at maturity (Vance and Rudolf, 1974). Canada yew (*T. canadensis*) a sprawling multi-stemmed shrub rarely exceeding 2 m (Farrar, 1995).

Species generally long-lived, frequently 250 to 500 years old. Individual *T. baccata* (English yew) trees in the past were frequently reported to achieve ages as high as 3,000 years, although these figures may have been based on estimates of multiple, fused close-growing trunks individually averaging not more than 250 years old. Individual specimens planted in country churchyards are reported to have achieved ages of 1,000+ years (Vance and Rudolf, 1974).

Numerous yew cultivars exist, often showing distinct morphological variance in growth form, habit and needle form and colour (Krüssman, 1983). In horticultural use, *Taxus* spp. are noted for tolerance of close shearing. They are often displayed in shaped or sculpted forms (topiary). In particular, an extensive list of cultivars of the hybrid *T. x media* (*T. cuspidata* x *T. baccata*) has been developed for horticulture, one of which (T. x media 'Hicksii') produces strongly vertical stems particularly suited to mechanical harvest of foliage, frequently cultivated in plantations.

1.3.2. *Habitat types*:

Species in general favour moist, forested habitats, are tolerant to highly tolerant of shade. Plants are found in the understorey or canopy of moist temperate or tropical mountain forests, elevation ranging from near sea level in northern stations to 3000 m in tropical forests (de Laubenfels, 1988) ranging over 60° of latitude and a wide temperature and precipitation range.

In cultivation, Taxus spp. noted as requiring fertile soils, ample moisture and excellent drainage (Dirr, 1998).

1.3.3. *Role of the genus in its ecosystem*

Understorey trees or shrubs. Fruit-like arils are eaten by birds. Birds, bears (*Ursus* spp.) and other small mammals consume the seeds. North American species are browsed by moose (*Alces alces andersoni*) and deer (*Odocoileus virginianus*) (Pinto and Herr, 2005).

1.4. Population:

1.4.1. *Global Population size:*

Population distribution (most species) is broad, but nowhere continuous. North American species tend to occur as isolated individuals or in discontinuous populations. Asian *Taxus* spp. generally occur as scattered individuals under the canopy of other trees rather than as a dominant species.

Current information on the size and status of Asian *Taxus* spp. populations is largely unavailable. Field surveys and other supporting data referenced prior to listing of Asian species at CITES CoP13 suggested populations of *Taxus* in Asia were in decline. It is reported that all species of Taxus in China have been reduced due to over-exploitation for their medicinal properties (CITES, 2004).

Overall geographic range of the five Asian species is reported not to have changed significantly over recent history, but localized land conversion and deforestation are likely affecting the species in China, Indonesia, and the Philippines. It is suggested that the life history of Taxus in general, and intense harvest pressure is likely to affect future regeneration of these species, which may reduce their geographical distribution (CITES, 2004).

The European species *Taxus baccata* (English yew) has an extensive distribution and corresponding large population. The species is also extremely common in urban and pari-urban landscapes within and outside of its natural range. Its IUCN status is Least Concern (IUCN, 2007).

T. brevifolia (Pacific yew) is a small tree found in the understorey of primarily coastal or interior western redcedar – western hemlock forests of western North America. It is widely distributed in these areas but generally of moderate to low abundance, and is most abundant in the southern interior (Harlow *et. al*. 2001). It is broadly distributed from California to Alaska in appropriate habitats. The species has been considered at risk (lowest category of threat) as a result of destructive bark harvesting.

T. canadensis (Canada yew) is distributed throughout eastern Canada and the northeast United States. In Canada, the species occurs from southeast Manitoba, through central and southern Ontario and Quebec, and Atlantic Canada (Prince Edward Island, Nova Scotia, New Brunswick and Newfoundland). Its relative abundance and high taxane content make it highly attractive for commercial-scale biomass harvesting (Smith and Cameron, 2001).

The populations of the North American species T. globosa and T. floridana are geographically restricted.

1.4.2. *Current global population trends:*

___increasing _X_decreasing ___stable ___unknown

1.5. Conservation status

1.5.1. *Global conservation status* (according to IUCN Red List):

___Critically endangered
___Endangered
_X_Vulnerable
___Near Threatened
_X_Least concern
_X_Data deficient

Species	IUCN Status (Red List Category & Criteria) ver 2.3 (1994) assessed 1998
Taxus chinensis (Pilg.) Rehder	Lower Risk Least Concern (LR/lc)
Taxus cuspidata Sieb. & Zucc.	LR/lc
Taxus fuana Nan Li & R.R.Mill	Vulnerable (VU D2)
Taxus sumatrana (Miq.) de Laub.	LR/lc
Taxus wallichiana Zucc.	Data Deficient (DD)
Taxus baccata L.	LR/lc
Taxus brevifolia Nutt	Lower Risk Near Threatened (LR/nt)
Taxus canadensis Marsh.	LR/lc
Taxus floridana Nuttall ex Chapman	Critically Endangered CR B1+2c
Taxus globosa Schlectendahl	LR/nt

1.5.2. *Conservation status or species in the genus* Taxus

Three *Taxus* species native to China (*T. chinensis, T. cuspidata*, and *T. fuana*) are reported listed under the National First Category Protection, which prohibits the collection of Taxus spp. without the authorization of the National Forest Bureau. Forestry policy and regulations under the Native Flora Protection Act of the People's Republic of China outline the rules regarding native flora protection and management (CITES, 2004).

All native species of Taxus in China are listed Class I, which prohibits the collection of yew without the authorization of the Chinese Government. *T. wallichiana* is listed as endangered in the China Plant Red Data Book – Rare and Endangered Plants. All native species of Taxus in China are included in The Manual of the Monitored and Administered Species of Wild Fauna and Flora for Import and Export of the People's Republic of China (CITES, 2004).

Among North American *Taxus* species, *T. floridana* is listed critically endangered and is registered on the endangered plant list of the State of Florida. *T. globosa* is considered a plant of least concern, near threatened (IUCN, 2007). Both species are under pressure as a result of restricted geographical distribution and habitat loss.

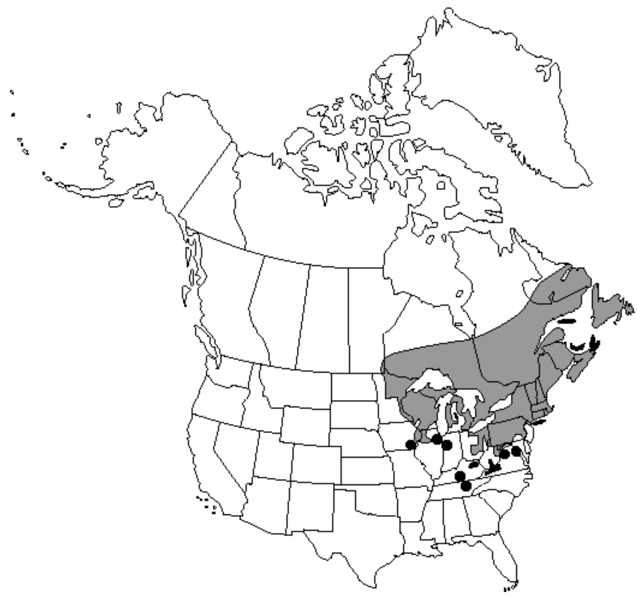
In 2002, the Scientific Authority of the United States of America consulted with range countries on a proposal to include all species of *Taxus* in CITES Appendix II. The study determined that the bulk of the trade was in Asian species of Taxus, and that listing these species in Appendix II would help regulate trade and prevent unsustainable and destructive harvest of these species for the international pharmaceutical industry. Based on trade and information on species status obtained from range countries and a review of the genus, European Taxus baccata and North American species (*T. brevifolia, T. canadensis , T. globosa, T. floridana*) were eliminated from further investigation (CITES 2004).

T. wallichiana, was listed in Appendix II of CITES in 1994. In 2004, the remaining four species of Taxus with Asian distribution were listed in Appendix II.

1.5.3. *Main threats within the case study countries*

___No Threats
_X Habitat Loss/Degradation (human induced)
___Invasive alien species (directly affecting the species)
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
___Pollution (affecting habitat and/or species)
___Other_______________
___Unknown

2. SPECIES MANAGEMENT (EXAMPLE): *T. CANADENSIS*



Distribution of Taxus canadensis (eFloras, 2008).

Explanation:

Management information here presented is specific to the non-CITES listed species *T. canadensis* (Canada yew, also referred to as "ground hemlock"). In Canada, T. canadensis has not historically been considered a forest species having commercial value. As a result, it rarely appears in forest resource inventories, silvicultural manuals or prescriptive harvesting guidelines. However, the distribution and ecology of the species have been studied in detail (e.g. Scoggan, 1978; Soper & Heimburger, 1982) as has the species' ecological profile in forest site classification (e.g. Meades & Moores, 1989). *T. canadensis* is cited as a moderate indicator plant for fresh to moist and organic soils associated with seepage zones (Ringius and Sims, 1998).

Identification of *T. canadensis* as a commercially viable source of harvestable biomass has resulted in development of harvesting guidelines and principles with a specific objective of ensuring that sustainable (i.e. non-detrimental) harvesting methods are employed by commercial harvesters.

Acknowledging that specific biological factors, growth rates and harvest responses vary from one *Taxus* species to another (as they do within geographically diverse populations of *T. canadensis*), it is probable that the general theory regarding sustainable harvest of leaf and twig biomass of *T. canadensis* can inform determination of non-detrimental harvest and trade procedures for similar *Taxus* species. Harvest of bark of *Taxus* spp. (e.g. in the past, for *T. brevifolia*) is by definition destructive. E.g. for *T. wallichiana*, it is reported 7272 kg of bark are required to produce one kilogramme of paclitaxel, requiring 10 000 kg of bark or approximately 3000 trees (PC17 Inf.10). Sustainable harvest of *Taxus* spp. for bark is appears problematic and, based on available information, is not recommended.

2.1. Management measures

2.1.1. *General*

Interest in *T. canadensis* biomass as a novel non-timber forest product, and as an alternative source of income for rural communities in Canada, arose in the latter part of the 1990's along with awareness by multinational pharmaceutical companies that wild populations of *T. canadensis* in eastern Canada and the north-eastern United States represented a relatively abundant and untapped source of *Taxus* biomass with relatively high taxane content. This interest lead, initially, to excessive and biologically unsustainable harvesting practices (Canada Yew Association, 2008).

While much of the population of *T. canadensis* within its natural range is remote and inaccessible, early experience suggested unlimited harvesting in the accessible parts of its range could result in localized commercial extinction (Cameron and Smith, 2004).

2.1.2. *Purpose of the management plan in place*

In response to increasing harvesting pressures, and in order to establish a sustainable *T. canadensis* industry in Canada, an ad hoc Working Group comprising Canadian Federal and Provincial forestry officials, private sector growers, harvesters and paclitaxel producers together established a set of voluntary harvesting guidelines and a list of principles and corresponding criteria and indicators, aimed at ensuring sustainable biomass harvesting. Harvesting guidelines were developed based on field trials and research carried out by the Canadian Forest Service and the Prince Edward Island Department of Agriculture and Forestry (Smith and Glen, 2000).

2.1.3. *General elements of the management plan*

The harvesting guidelines and principles developed by the Working Group were intended to address adherence to applicable Canadian provincial and federal legislation, regulations, and international treaties; conservation of biodiversity, soil and water on harvest sites; monitoring and tracking to ensure that harvesting meets sustainability guidelines; and access to information by harvesters and landowners regarding the sustainable harvest of *Taxus* biomass.

Several revisions to the guidelines occurred over time, reflecting increased knowledge and familiarity with *T. canadensis*. In early versions of harvest guidelines, removal of more than three years of annual growth was deemed acceptable, provided the amount harvested did not exceed a certain portion of the total green biomass of individual branches. The rationale for the initial guidelines was that removal of up to 4 or 5 years of growth was 'biologically' acceptable provided that the same plants were not re-harvested for period of time equal to, or slightly longer than the number of years of growth extensions removed (Smith and Glen, 2000).

Measurements from subsequent research and harvest trials suggested that plant recovery (regrowth) following removal of 5 or more years of growth was adversely impacted, and that plants would require a period of time significantly longer than 5-6 years to recover before a repeat harvest could be undertaken. Guidelines reflecting results from field harvesting trials, discussions among harvesters and harvest contractors, and general observations of responses to harvesting in Quebec and Atlantic Canada were therefore revised to advocate harvest of significantly shorter stem sections with a removal limit of 3 years of annual growth (Canada Yew Association, 2008).

Current harvest guidelines (Canada Yew Association, 2008) are applied on Crown (publicly owned) lands in two Canadian provinces (as legislation in Prince Edward Island, as part of an pilot study in New Brunswick), and are accepted as an alternative method on private lands in the province of Quebec, which has developed its own harvesting guidelines. Policies specifying harvesting guidelines have not yet been determined in other Canadian jurisdictions within the range of *T. canadensis.*

A management system for *T.canadensis* in eastern Canada has been considered. An integrated program of this type should incorporate protocols for protecting the resource (conservation and sustainable harvesting) with methods of not only sustaining the industry, but for helping it to grow such as through establishing a domestication program. Verifying that any and all harvesting is done sustainably by an independent third-party will be an integral part of managing the resource (NRCan and P.E.I. Dept. Ag., 2002).

(i) *Taxus canadensis* Harvesting Guidelines (Canada Yew Association, 2008)

I. *Timing of Harvest*

Harvesting can be undertaken throughout the year, but a number of factors will affect quality of material harvested, costs of harvesting, and how plants will respond after harvesting.

Taxane yields are generally higher in dormant shoots than in those that are actively growing. If a purchase arrangement is based on taxane content in biomass, then the recommended time to harvest is likely to be from late August to March and April, times at which the plants are dormant.

II. *Selection of Plants for Harvest*

Harvest should be limited to branches from plants (stems) in excess of 1 metre in height. This limit to harvestable plant size is recommended to ensure harvested plants possess a minimum required vigour prior to harvest. (Adopting the minimum size guideline increases the likelihood that heavily browsed or recently harvested plants will be excluded from harvest).

III. *Quantity of Biomass to Harvest*

a) Limit harvest to the terminal shoot and the two or three most vigorous lateral shoots located closest to the top of the plant.
b) Remove up to, but not more than, three years of growth (i.e. the three most current seasonal growth extensions). On a moderately 'vigorous' branch and plant, current-year growth will measure approximately 7 to 10 cm. Harvesting three years of growth will typically yield a stem or branch with total length of 20 to 25 cm but the cut length can range from 15 to 40 cm depending on plant vigour. For this reason, an age- rather than length-based criterion is recommended.
c) *T. canadensis* shoot surfaces typically remain green for up to three years. Cuts should be limited to sections with green surfaces. Do not make cuts into brown woody stems below (older than) the third year growth extension.
d) Harvested sites should not be re-harvested for a minimum of 4 years (i.e. the number of annual growth extensions growth removed +1).

Additional Notes: Following pruning, new buds (and the shoots that are produced from these buds) will develop adjacent to the cut surface. On plants that are heavily pruned, e.g., in cases where 4 to 6 years or more of growth is removed, the new shoots will take longer to develop than where only 3 years growth is removed. Although large numbers of new shoots may develop on heavily pruned plants, these shoots typically are 'weak' and grow slowly. Measurements from research plots indicate that where more than three years of growth is harvested, new or replacement growth will be greatly reduced (Cameron and Smith, 2009).

IV. *How to Harvest*

a) Use secateurs (hand pruners). Do not break or tear branches.
b) Regardless of how much growth is removed up to the maximum of 3 years of growth extension, make cuts immediately above (distal to) lateral branches. This practice encourages lateral branches below the cut to rapidly extend and 'replace' the removed shoot. As new shoots originate from the tissue located at nodes, regrowth will be rapid, and more vigorous than regrowth from an internode.
c) Leave Every Fifth Stem Unpruned. (In previous harvest guidelines, it was recommended to leave at least one stem in every 'clump' intact. This method remains valid. However, identifying individual clumps can be very difficult in locations where *T. canadensis* is particularly dense. Leaving at least 1 in 5 stems unharvested is practicable and accomplishes the same goal).
d) Do Not repeat harvesting on a site for a minimum of 4 years (= number of years of growth removed +1).

(ii) *Taxus canadensis* Harvesting Principles (Canada Yew Association, 2008)

a) Harvesting of *T. canadensis* will follow all applicable provincial and federal legislation, and international treaties.
b) Harvesting of *T. canadensis* will not diminish the viability of natural populations and will conserve the quality and quantity of *T. canadensis* biomass through the use of appropriate harvesting practices. On-site impacts associated with the harvesting of *T. canadensis* will be minimized.
c) Harvesting practices must ensure the conservation of biodiversity, soil, water and other ecosystem attributes of harvested areas.
d) Handling and transport of the resource will be done in such a way as to maintain the quality of harvested biomass.
e) Monitoring and tracking shall be conducted to ensure that harvesting adheres to sustainability guidelines acceptable to the Association. Auditing will be an integral component of the system. Although independent third party auditing is normally required, an equivalent internal system (e.g. provincial) can be acceptable provided said system is demonstrated to provide the level of objectivity and accuracy necessary to evaluate adherence to all of the principles, criteria and indicators within these guidelines.
f) Harvesters and landowners must have access to information regarding the sustainable harvest of *T. canadensis*. Harvesters

must be trained and supervised sufficiently to ensure adherence to the guidelines.

g) Economic and social benefits from harvesting and processing Canada yew will be fairly distributed and focused on the long-term well being of forest workers, landowners, and local communities while respecting the rights of individuals/agencies to conduct business.

h) Exemptions from sustainable harvesting practices may be appropriate where land-use conversions will result in the permanent elimination of a population(s) from a given site.

2.1.4. *Restoration or alleviation measures*

Assuming harvest guidelines and principles are followed, restoration or alleviation measures are not required.

2.2. Monitoring system

2.2.1. *Methods used to monitor harvest*

In Canadian jurisdictions, independent third party auditing is not legislated, but is required by the harvesting principles of the Canada Yew Association. An equivalent internal system is acceptable, provided the system is demonstrated to provide the level of objectivity and accuracy necessary to evaluate adherence to all of the principles, criteria and indicators within these guidelines.

2.2.2. Confidence in the use of monitoring

Specific to *T. canadensis* harvesting, the development of a trade association that includes, and facilitates communication among the majority of involved stakeholders, including harvesters and processors, has contributed greatly to confidence in, and adherence to, monitoring procedures.

In eastern Canada, the number of commercial-scale harvesting companies is small, a condition which greatly facilitates monitoring of operations. In 2005, the largest *T. canadensis* harvesting company (Chatham Biotec Ltd.) reported its operations ensured full chain-of-custody control and monitoring of harvested biomass through the use of a “closed loop” tracking system. In this approach, all harvest sites were registered, pre-inspected, mapped and identified using GPS and aerial photographs. During all harvest operations, specially marked and numbered collection bags were issued to harvesters, allowing repeated inspection and verification of adherence to harvesting guidelines by individual harvesters. Marked collection bags were then tracked from harvest sites to the biomass process site using electronic and paper-based auditing systems. Third-party auditors (Smartwood) were present during some harvest operations (Chatham Biotec, 2005).

2.3. Legal framework and law enforcement: Provide details of national and international legislation relating to the conservation of the species.

The conservation and management of wild species is multi-jurisdictional in Canada, falling under the authority of various provincial, territorial, and federal acts and legislation related to wildlife management. Canada's provinces and territories hold responsibility for management and inventory of natural resources within their respective jurisdictions.

Commercial-scale *T. canadensis* harvesting has influenced Provincial policies regarding collection on Crown (publicly owned) land to varying degrees in four Provinces; (Prince Edward Island, New Brunswick, Quebec and Ontario). Specific regulation of *T. canadensis* harvest varies by jurisdiction.

Examples:
In the Province of Prince Edward Island, adherence to CYA harvesting guidelines and Principles is a legal requirement under the Province's Wildlife Conservation Act. To harvest legally on Crown land, harvesters must obtain a harvesting license from Provincial Ministry of Agriculture and Forestry. To be granted a licence, applicants must successfully complete a government-approved harvester education program. Persons who wish to act as buyers of *T. canadensis* biomass from licensed harvesters must apply for and hold a buyer's license also issued by the provincial government. The license requires buyers to pass a government-approved T. canadensis buyer education program. Buyers must provide the names and addresses of all persons operating buying stations on their behalf and must also provide the location of warehouses, shops or other buildings in which biomass will be stored.

Licensed *T. canadensis* buyers are required to maintain detailed records regarding acquisition of biomass from licensed harvesters, including: the identity and registration of the harvester; the precise position and location in latitude and longitude of the harvest site; the weight of biomass acquired specified as green or dry weight, and; the price paid per unit weight (pound or kilogram) of biomass. The buyer must provide a duplicate copy of this record to the licensed harvester. In the case of harvest on privately owned land, the harvester must have written permission to harvest from the land owner. Transport of biomass requires identification of location, date of harvest and identification of harvester to be clearly displayed on the biomass container. Import and export of *T. canadensis* biomass from the province is restricted to holders of a valid buyer's license (Prince Edward Island, 2006).

In harvesting on private lands in the Province of Quebec, *T. canadensis* is treated in a fashion similar to other forest products. Legislation which covers trade with other provinces and other countries requires that biomass can be sold to processors only by a government marketing board. The marketing board acts as a broker, buying biomass from the harvester and selling it to the processor. All harvested biomass must be sold to the marketing boards who maintain internal auditing procedures (Canada Yew Association, 2005).

The Province of Ontario currently has a voluntary system in place for managing the commercial harvest of *T. canadensis*. Companies requesting the right to harvest on Crown land submit a business plan to the Provincial Ministry of Natural Resources. This plan must meet specific requirements in order for the company to receive a "Letter of Support" from the Ministry. There currently appears to be general compliance with the Ministry's voluntary management system for *T. canadensis* on public land and existing sustainable harvesting guidelines (Ontario Ministry of Natural Resources, 2007).

3. GENUS *TAXUS* UTILIZATION AND TRADE

3.1. **Type of use** (origin) **and destinations** (purposes) (e.g. commercial, medicinal, subsistence hunting, sport hunting, trophies, pet, food)

Biomass (leaves, twig, bark and roots) of all *Taxus* species contains a unique class of diterpenoid alkaloids that are the source of a chemotherapeutic drug Taxol, which is used to treat a range of human cancers. Since the 1990s, a phenomenal demand by pharmaceutical companies for paclitaxel and other taxane compounds extracted from *Taxus* spp. world-wide has subjected all yew populations to severe harvest pressure, to the point that some are currently threatened or endangered. Recent field surveys and other supporting data suggest most populations of *Taxus* spp. are in decline (CITES, 2004).

Beginning in the early 1990's, the bulk of paclitaxel produced globally has been marketed under the name Taxol, a registered trade name held by Bristol Myers Squib. (It is the process by which a paclitaxel-based drug is produced or its formulation which is held under patent, rather than the compound itself). After 2001 additional companies began marketing generic formulations of paclitaxel, thereby increasing the demand for biomass. Subsequently, patents for other processes, including generic and semi-synthesized compounds have also been registered (Nikolakakisa *et. al*. 2003).

Approximately 30,000 kg of *Taxus* biomass is required to produce 1 kg of refined paclitaxel. An estimated 400 kg per year of paclitaxel products are marketed annually in North America and Europe, with global amounts estimated at 800 -1000 kg (Smith and Cameron, 2001). World sales of Paclitaxel in 2003 were estimated at $4.2 billion US, and were expected to grow to $13 billion US by 2008 (CITES, 2004). Bioxel Pharma Inc., a Canadian Laboratory producing active pharmaceutical product projected annual sales of $90 million US in 2004.

Taxus biomass in trade is sometimes exported as dried needles and twigs, or often in a crude liquid or powdered extracts of varying concentrations. Form and appearance of the chemical derivative in varies depending on the state of refinement. Chemical derivatives can be differentiated from finished pharmaceutical product. Chemical extracts of *Taxus* spp. in trade vary in appearance from a tar-like substance (sometimes referred to as "brown liquor") shipped in drums to a light brown powder. Pure paclitaxel is a whitish or yellowish, crystalline material.

Indigenous people are known to have used yew species in utensils and medicines (Hartzell 1991). North American indigenous people used yew for implements, including bows, dip-net and drum frames, as well as for medicines (Alaback et al, 1994). In Europe and Asia the wood of the tree was prized for bows and is still valued for fine musical instruments, cabinets, and utensils (Vance and Rudolf, 1974; Hartzell, 1991). The bark of *T. wallichiana* (Himalayan yew) is used for preparing beverages and medicines (Purohit, *et al.* 2001).

Several Taxus spp., in particular *T. baccata, T. cuspidata* and hybrids have, for more than 100 years, been used extensively in horticulture in North America and Europe. Horticultural material is almost exclusively derived through artificial propagation (Krüssman, 1983).

As chemical derivatives rather than plant biomass are the *Taxus* commodity most often traded, the CITES Appendix II annotation specifically designates all parts and derivatives except seeds, pollen and finished pharmaceutical products.

It is possible to fully synthesise Taxol. However, its molecular structure is complex and its synthesis costly. As a result, harvest of wild or plantation-grown biomass remains more economically attractive to pharmaceutical companies than does full synthesis (Guo *et al*., 2006). Most range countries report efforts to propagate and develop, at varying scales of production, plantations as a source of biomass. Growth and establishment of *Taxus* spp. individuals is slow, suggesting wild harvest of Taxus biomass will continue to represent the main source of material in the short to mid-term (CITES, 2004).

3.2. Harvest:

3.2.1. *Harvesting regime* (extractive versus non extractive harvesting, demographic segment harvested, harvesting effort, harvesting method)

Historically, two approaches to harvesting have been followed for Taxus spp; harvest of bark and harvest of leaf and twig biomass.

Bark from the species *T. brevifolia* (Pacific yew) was the first identified source of paclitaxel. Early clinical studies of Taxol production by the pharmaceutical company Bristol Myers Squib created high demand for bark of the species. The harvest approach was by definition destructive; it required large amounts of bark biomass (i.e. bark from an estimated 52 000 to 78 000 yew trees annually during the early 1990's). Approximately 10,000 kg of Pacific yew bark was required to make 1 kg of Taxol, with the bark of at least six trees required for a single treatment dose. In January 1993, Bristol Myers Squib announced significant progress with alternative approaches and alternative Taxus species, and that the company no longer required large quantities of *T. brevifolia* bark (USDA Forest Service, 1993).

Taxanes were found to occur in the stem bark, roots and needles of other yew species (Witherup et al., 1990) including *T. wallichiana* (Himalayan yew) (WCMC, 2002). Discovery that leaves and twigs of most *Taxus* spp. contained appreciable levels of taxanes created an alternate harvesting approach that had potential to support repeatable and sustainable harvesting. The harvest method is essentially that of pruning or shearing (as with a hedge or a topiary display). For example, the Italian pharmaceutical company Indena (among the world's largest producers of taxane-derived pharmaceuticals) undertakes large-scale production of semi-synthetic paclitaxel using *T. baccata* trees cultivated in plantations in northern Italy (Megget, 2007).

3.2.2. *Harvest management/ control* (quotas, seasons, permits, etc.)

These are specific to individual jurisdictions, and are not considered here.

3.3. Legal and illegal trade levels:

Large paclitaxel production facilities exist worldwide, including facilities in India, China, North America and Europe. Taxanes are a global commodity and the distribution of *Taxus* spp. biomass and chemical derivatives for use in pharmaceutical production occurs on a worldwide basis. The import and export of biomass of one or another *Taxus* species is largely a function of supply and cost.

Demand for Taxol in North America and Europe in 2002 was estimated at 300-400 kg/year, requiring 12,000,000 kg of *Taxus* biomass.

Global demand for Taxol is growing and estimated at 800-1000 kg worldwide by 2012 (Cameron and Smith, 2002).

Although *T. wallichiana* has been listed in CITES Appendix II since 1995, there remains little information available regarding current rates of harvest and trade. It is reported this results from a combination of factors, including: varying interpretations and confusion regarding the taxonomy of *T. wallichiana* and other *Taxus* species; generally low levels of CITES implementation for medicinal plant species; exclusion of chemical derivatives (extracts) from CITES trade controls from 2000-2005; and difficulty in visually identifying the main products in trade (leaves, bark, extract), including with regard to discriminating between parts and derivatives from *T. wallichiana* and those from other *Taxus* species (CITES, 2008).

CITES documents indicate it is difficult to quantify the level and extent of illegal trade in *Taxus* spp., but that unlawful activities undoubtedly occur. In China, attempts have been made to export *Taxus* species by misdeclaration, including illegal export of native *Taxus* species alleged to be processed material originally from North America (CITES, 2004).

It is similarly difficult to quantify the level and extent of illegal harvest of *T. canadensis* elsewhere. In Canada, *T. canadensis* is not specifically regulated as a threatened or endangered species, under domestic law or by CITES. Specific cases of destructive over-harvesting are known to have occurred.

II. NON-DETRIMENT FINDING PROCEDURE (NDFS)

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

__yes _X_no

Discussion:

It is not the purpose of this general case study to describe a specific non-detrimental finding procedure. However, the sustainable harvesting guidelines developed for *T. canadensis* as discussed in Section 2 address factors that would require consideration in developing an NDF. These emphasize the level of harvest intensity that can reasonably be employed if full regeneration of the harvested population is intended.

With respect to non-detriment determination and the guidelines and principles presented for sustainable harvest of *T. canadensis*:

1. Harvest limits suggested in the guidelines are applied directly to individual plant stems, rather than indirectly to (e.g.) volume of biomass per unit of harvested land area. Specific growth responses will vary among *Taxus* spp., but linkage of sustainable harvest intensity to a physiologically-based rate of annual stem growth is a transferable method for informing non-detriment determination. In addition to biological advantages, use of plant-specific measurements in harvest guidelines can serve to reduce regulatory burdens associated with enforcing area- or volume-based harvest controls.
2. Non-detrimental harvesting and economics are directly linked. Preliminary harvest trials in Canada indicate that limiting *T. canadensis* harvest to 3 years of annual growth results in economic advantages for harvesters (Stewart Cameron, Canadian Forest Service, personal communication). This is because large-diameter branches (i.e. sections older than 3 years) contain appreciably less taxane by volume than do leaves and small twigs (likely the case for other *Taxus* spp. as well). Overly aggressive harvesting of biomass increases the weight and volume of material transported from a harvest site, without greatly contributing to the taxane content of the material harvested. Limiting harvest to 3 years of growth extension reduces handling and transport costs while increasing the quality by volume of the product. The quality of the product expressed as the amount of taxanes per tonne of biomass is also maximized.

   Additionally, overly aggressive biomass harvesting eliminates a site's potential for re-harvest for an extended period of time. As a result, harvesters are obliged to seek ever more distant sites with resulting increases in travel, transport and operating costs. By limiting harvest to three years of growth per stem, harvested sites can be revisited after four years (three years of growth replacement growth plus one year to ensure full recovery from harvest). Carefully planned, a four-year harvesting cycle would allow harvesters to operate commercially and sustainably on a fixed landbase.

3. Artificial Propagation of *Taxus* spp.:
   As an alternative response to increasing demand for biomass, domestication programs have begun in Canada and elsewhere, with the objective of using rooting cuttings from selected high-yield clones in field crop production (Smith and Cameron, 2002). *T. canadensis* stems are reported to be moderately amenable to roo-

ting, but slow to do so. Certain clones cannot yet be rooted effectively (Webster *et. al*., 2005). Given the demonstrated potential for cropping of *T. baccata, T. canadensis*, *T. wallichiana* and of *T. x media* cultivars in plantations, this area of research represents an important additional approach to sustainable harvest and management of all *Taxus* spp.

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GENUS-LEVEL APPROACH TO *TAXUS* SPECIES.

AUTHOR:
Ken Farr

The purpose of this general case study was not to describe a specific non-detrimental finding procedure applicable to all *Taxus* spp. Rather, this study outlines an approach to sustainable harvest of leaf and twig biomass of the North American species *Taxus canadensis,* with the intention of informing discussion around the making of non-detrimental findings for other *Taxus* species.

Within the study, sustainable harvesting guidelines and principles developed jointly by researchers and harvesting companies in Canada for *T. canadensis* are presented. The guidelines focus primarily on the level of harvest intensity that can reasonably be employed if full regeneration of the harvested population is expected. In the specific case of *T. canadensis*, physiological research and field testing have determined that the optimum sustainable harvest level is removal of up to, but not more than, three years of growth (i.e. the three most current seasonal growth extensions) from any stem. Thus, biomass harvest limits are applied directly to individual stems, rather than indirectly to (e.g.) volume of biomass per unit of harvested land area.

In addition to facilitating a sustainable biomass harvest, it is possible use of direct stem-specific limits in harvest guidelines can reduce regulatory burdens associated with enforcing area- or volume-based harvest controls. Stem-specific limits allow direct monitoring of individual harvesters' adherence to guidelines through simple visual inspection of the portion of biomass removed from plants.

Where *T. canadensis* harvesting guidelines have been incorporated in legislation, additional monitoring and control methods are employed. These include requirements for harvest site mapping and reporting, mandatory training and licensing of biomass harvesters and sellers, chain-of-custody and transport controls, and limit of legal biomass export and import to licensed buyers.

Current, ongoing research suggests that in addition to sustainability gains, the stem-specific harvest limits contained in the guidelines can produce measurable economic advantages for harvesters — an outcome likely to encourage compliance with regulations. Conversely, aggressive harvesting methods that exceed the optimum harvest level result in additional costs to harvesters. Positive economic outcomes are linked to quality and quantity of product (taxanes) in biomass harvested, and to reduced travel, transport and operating costs.

It should be noted that all discussion here relates to harvest of *Taxus* spp. for leaf and twig biomass. Sustainable harvest of *Taxus* spp. for bark appears problematic and, based on available information, cannot be recommended.

NDF WORKSHOP CASE STUDIES
WG-1, Case Study 6

Genus-level Approach to *Taxus* Species

Ken Farr,
CITES Scientific Authority, Natural Resources Canada,
Canadian Forest Service

Case Study Intent

- Purpose of is <u>not</u> to describe a specific non-detrimental finding procedure applicable to all *Taxus* spp.

- Case study presents an approach to sustainable harvest of the species *Taxus canadensis*

- Intent is to inform a discussion around making of non-detrimental findings for other *Taxus* species

Case Study: Placement?

- Initial question: Does this NDF case study belong in Trees Working Group? “Yes”, because …
- Involves a long-lived understorey woody species
- An example of a challenge facing forest managers: reconcile timber and non-timber resource demands
- sustainable approach requires knowing “For what do you wish to manage?”

Taxus: Classification

- Classification of species in the genus *Taxus* “notoriously difficult”
- “One species with numerous varieties” (Pilger, 1903)
- “Twenty-four species, 55 varieties” (Spjut, R.W. 1999).
- CITES (Farjon, 2001): 10 species, 3 infraspecific taxa within the genus
- 5 CITES Appendix II listed spp. (Asia)
- 5 non-listed (Europe and North America)

Classification

CITES Appendix II-Listed Species

	IUCN Status
• *Taxus chinensis*	(LR/lc)
• *Taxus cuspidata*	LR/lc
• *Taxus fuana*	Vulnerable (VU D2)
• *Taxus sumatrana*	LR/lc
• *Taxus wallichiana*	Data Deficient (DD)

Classification

CITES Non-Listed Species

IUCN Status

- *Taxus baccata* L. LR/lc
- *Taxus brevifolia* Lower Risk Near Threatened
- *Taxus canadensis* LR/lc
- *Taxus floridana* Critically Endangered CR B1+2c
- *Taxus globosa* LR/nt

Distribution

Global Distribution, Genus *Taxus* (Earle, 2008).

Global Population

- North American spp.: “isolated individuals in discontinuous populations”
- Asian spp. “scattered individuals under the canopy of other trees rather than as dominant species”
- Main threats to populations: habitat loss/degradation (human induced) & harvesting

Morphology

T. baccata

T. canadensis

T. baccata x T. cuspidata = T. x media

Biological Characteristics

- Non-resinous, evergreen gymnosperms (Pinophyta)
- Slow-growing, shade-tolerant understorey plants
- Many species reported as extremely slow-growing, long lived, taking 100 years or more to attain appreciable size
- Lateral branches well developed, similar to leading shoots (of interest in biomass collection)

Biological Characteristics

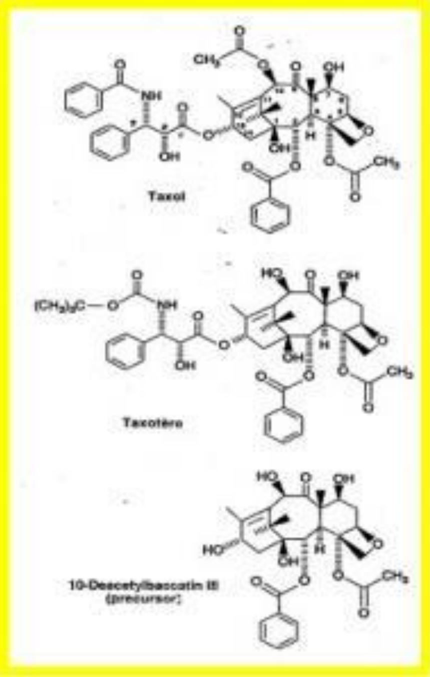
- *T. wallichiana* (Himalayan yew) reported to reach 20 (30) m with dbh to 1 (1.5) m
- *T. canadensis* (Canada yew) a sprawling multi-stemmed shrub rarely exceeding 2 m
- Numerous yew cultivars exist; exhibit distinct morphological variance in growth form, habit and needle form and colour

Biological Characteristics

T. x media ‘Hicksii’

UTILIZATION AND TRADE

- Biomass (leaves, twig, bark, roots) of all *Taxus* species contains a unique class of diterpenoid alkaloids (taxanes)
- Since the 1990s, phenomenal pharmaceutical demand for paclitaxel and other taxane compounds
- paclitaxel (trade name Taxol), used to treat a range of human cancers



UTILIZATION AND TRADE

- Approximately 30,000 kg of *Taxus* biomass required to produce 1kg of refined paclitaxel
- Estimated 400 kg per year of paclitaxel products marketed annually in North America and Europe, global market estimated at 800 -1000 kg (2001)
- World sales of Paclitaxel in 2003 estimated at $4.2 billion US, were expected to grow to $13 billion US by 2008

UTILIZATION AND TRADE

- Demand for Taxol in North America and Europe in 2002 estimated to require 12,000,000 kg of *Taxus* biomass
- Large paclitaxel production facilities exist worldwide, including facilities in India, China, North America and Europe
- Import and export of biomass of one or another *Taxus* spp. is largely a function of supply and cost

UTILIZATION AND TRADE

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- Large paclitaxel production facilities exist worldwide, including facilities in India, China, North America and Europe
- Import and export of biomass of one or another *Taxus* spp. is largely a function of supply and cost

COMMODITY IN TRADE

- *Taxus* biomass sometimes exported as dried needles and twigs
- More often as crude liquid or powdered extracts of varying concentrations
- Chemical extracts in trade vary from “brown liquor” shipped in drums to whitish powder
- Pure paclitaxel is a whitish or yellowish, crystalline material

HARVEST METHODS

Harvest of Bark

- Bark from *T. brevifolia* (Pacific yew) was the first identified source of paclitaxel
- 10,000 kg of Pacific yew bark required to make 1kg of Taxol
- Bark from 52 000 to 78 000 yew trees harvested annually during the early 1990's
- By definition destructive, approach discontinued in 1993 by producer (Bristol Myers Squib)

HARVEST METHODS

Harvest of Leaf and Twig Biomass

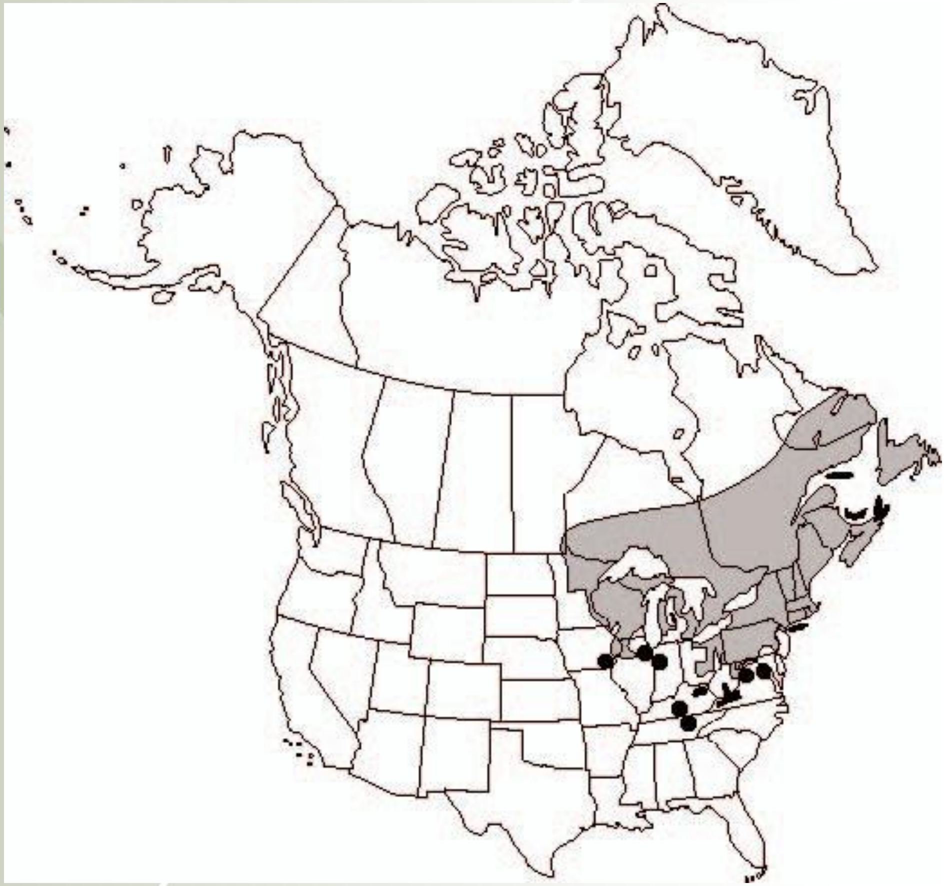
- Taxanes found to occur in the stem bark, roots and needles of other yew species e.g. *T. wallichiana* (Himalayan yew)

- Emerged as an alternate harvesting approach that had potential to support repeatable and sustainable harvesting

Example, *T. canadensis*

- Management approach here presented is specific to one non-CITES listed sp. (*T. canadensis*)
- Historically, species was not seen as commercially important, largely missed in forest resource inventories *
- * Will be captured in “next generation” forest inventories

Example, *T. canadensis*



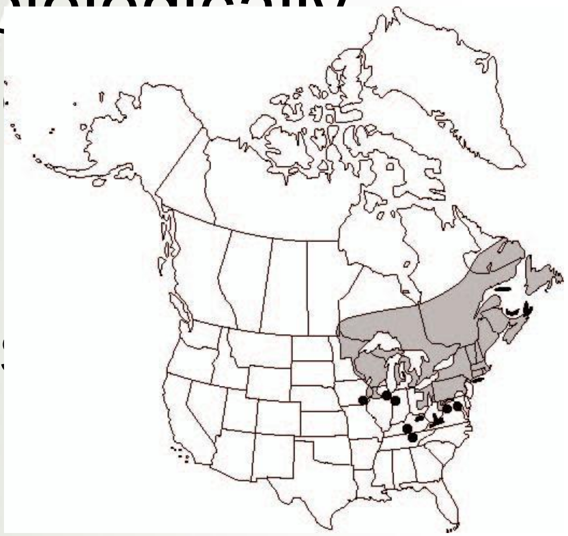
Distribution, *Taxus canadensis*

Management History

- Early 1990's, sudden interest in *T. canadensis* as an alternative source of income for rural communities

- Lead, initially, to excessive and b
unsustainable harvesting practic

- Experience suggested unlimited
harvesting in the accessible parts
of sp. range could result in
localized commercial extinction



Harvest Guidelines, Principles

- Response: formation of an *ad hoc* Working Group (Canadian Ground Hemlock Working Group)

- Comprised of Canadian Federal and Provincial forestry officials, private sector growers, harvesters and paclitaxel producers

- Worked together to establish voluntary harvesting guidelines, principles, corresponding criteria and indicators

Harvest Guidelines, Principles

Guidelines and principles were intended to address:

- adherence to applicable provincial and federal legislation and international treaties
- conservation of biodiversity, soil and water on harvest sites
- monitoring and tracking to ensure harvesting met sustainability

Harvest Guidelines, Principles

- Guidelines focused on the level of harvest intensity that can reasonably be employed if full regeneration of the harvested population is expected

- Initial guidelines suggested removal of 4 or 5 years of growth was ‘biologically’ acceptable

- View was based on provision plants would not be re-harvested for period of time equal to, or longer than, the number of years of growth extensions removed

Harvest Guidelines, Principles

- Guidelines focused on the level of harvest intensity that can reasonably be employed if full regeneration of the harvested population is expected

- Initial guidelines suggested removal of 4 or 5 years of growth was 'biologically' acceptable

- View was based on provision plants would not be re-harvested for period of time equal to, or longer than, the number of years of growth extensions removed

Harvest Guidelines, Principles

- Subsequent research and harvest trials suggested plants require a period of time significantly longer than 5-6 years to recover

- Physiological research, field testing determined optimum sustainable harvest level is removal of not more than 3 years of growth (i.e. 3 most current seasonal growth extensions) from any stem

- Revised guidelines reflected discussions among harvesters and harvest contractors

Harvest Guidelines, Principles

Significant point:

- Biomass harvest limits are applied directly to individual stems, rather than indirectly to (e.g.) volume of biomass per unit of harvested land area

- Guidelines are applied on Crown (publicly owned) lands in two Canadian provinces, part of legal framework in one province

Harvest Guidelines, Principles

Guidelines Also Consider:

- Timing of harvest
- Selection of plants for harvest (minimum plant size)
- Stem retention (one in five)
- Harvesting methods (tools, procedures)
- Optimum time between harvests (4 years)

Harvest Guidelines, Principles

Principles establish best practices and ‘code of conduct’ i.e. :

- Adhere to legal frameworks
- Maintain viability of natural populations
- Conserve the quality and quantity of biomass
- Ensuring conservation of biodiversity, soil, water and other ecosystem attributes

Legal Framework

- In Canada, conservation of wild species is multi-jurisdictional, under authority of various provincial, territorial, and federal acts related to wildlife management

- Specific regulation of *T. canadensis* harvest varies by jurisdiction

NDF Considerations

- Linkage of harvest intensity to a physiologically-based rate of annual stem growth is a transferable method for informing non-detriment determination

- Stem-specific control approach is an “allowable cut” estimation that, if verifiable, ensures non-detrimental harvest

NDF Considerations

Additional monitoring and control methods employed:

- requirements for harvest site mapping and reporting
- mandatory training and licensing of biomass harvesters and sellers
- chain-of-custody and transport controls
- limit of legal biomass export and import to licensed buyers

NDF Considerations

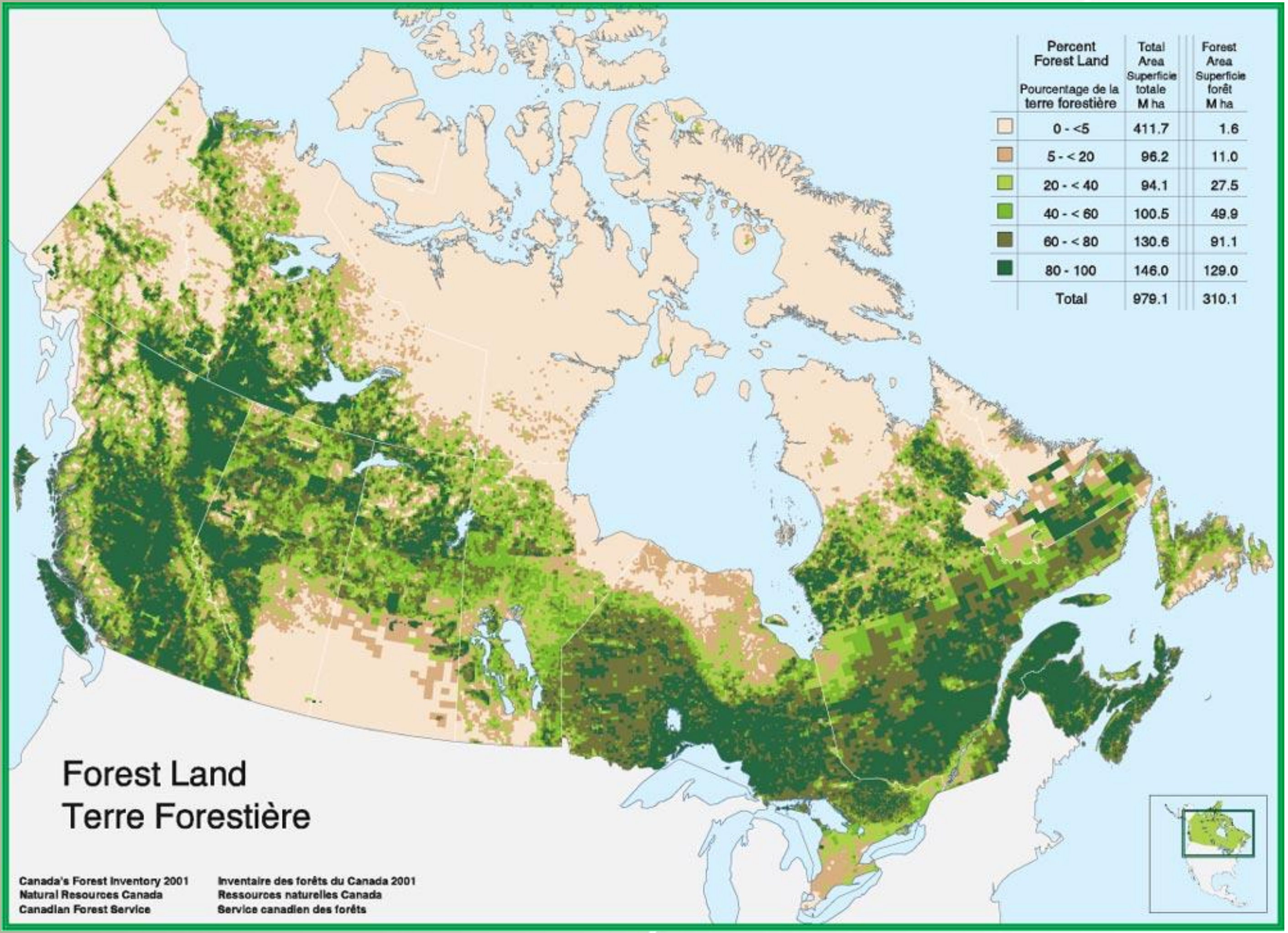
- Linkage of harvest intensity to a physiologically-based rate of annual stem growth should be a transferable method for informing non-detriment determination

- Use of stem-specific measurements in harvest guidelines can serve to reduce regulatory burdens (i.e.) regulation by area, volume

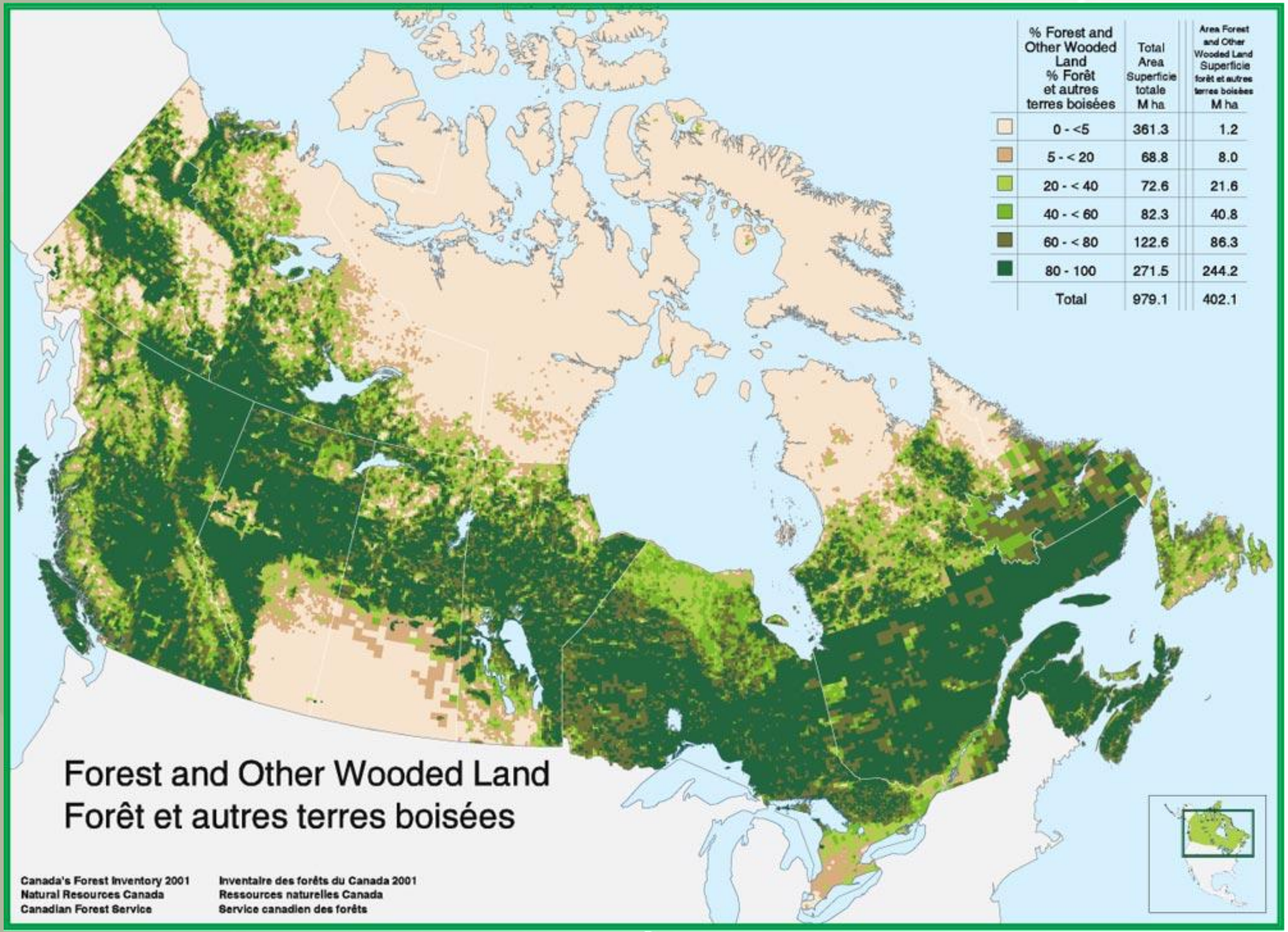
NDF Considerations

- Process here described a response to sudden, unexpected, uncontrolled and unsustainable demand pressure on an understorey species outside mainstream forest management
- In such situations, botanical and ecological data, forest classification data, modeling, may be required as short-term replacement for detailed forest resource inventories

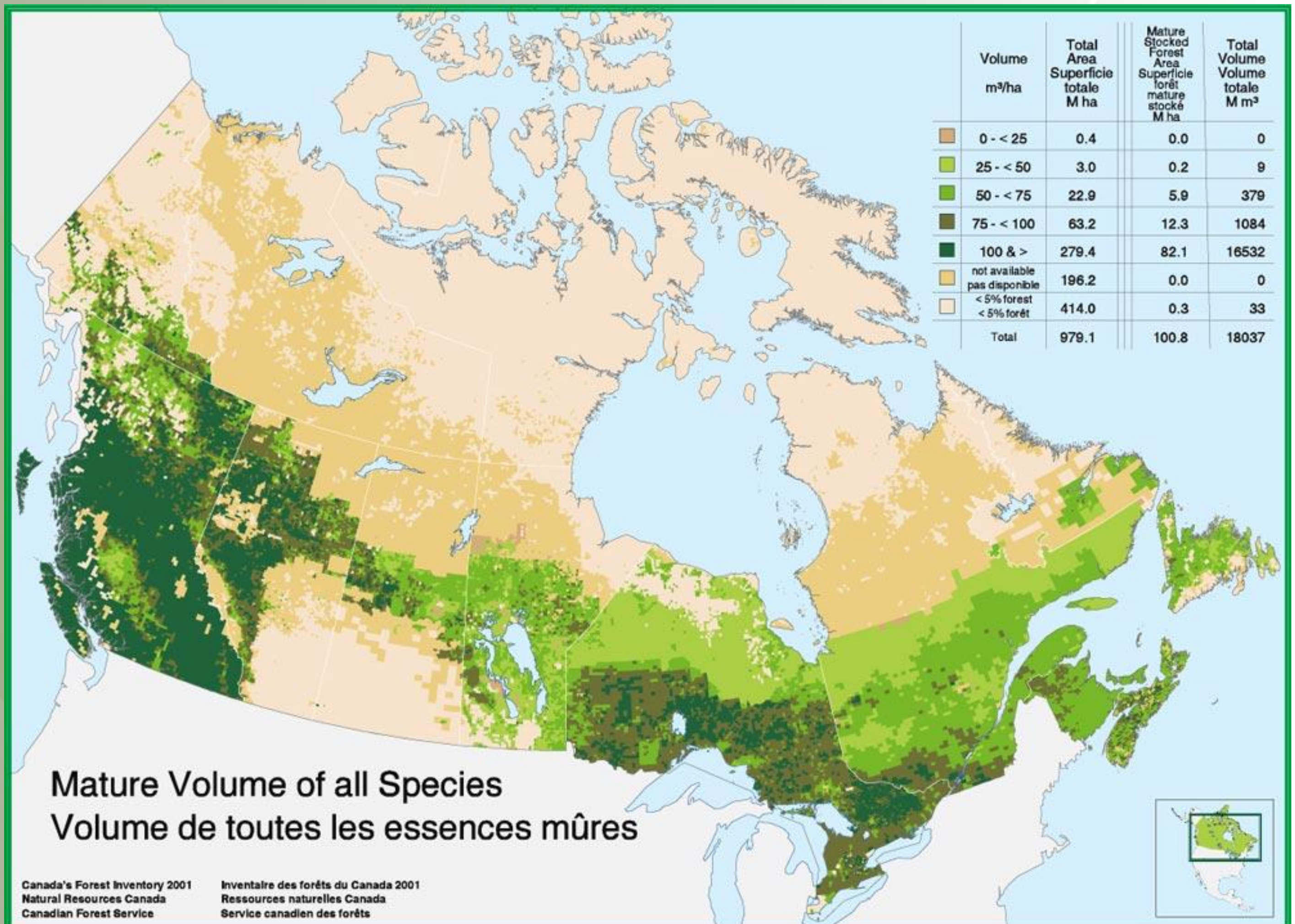
NDF Considerations



NDF Considerations

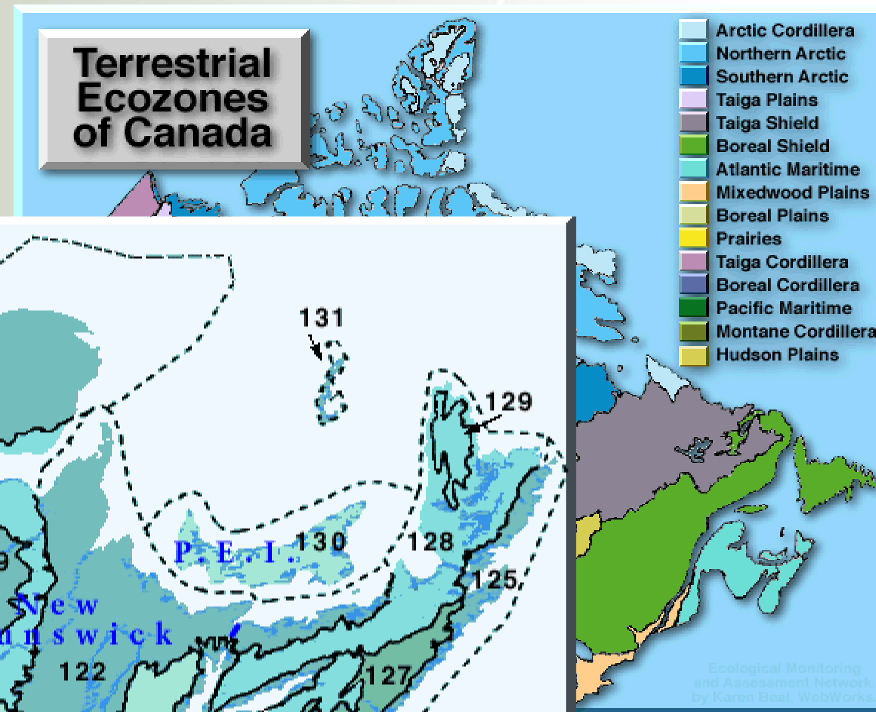


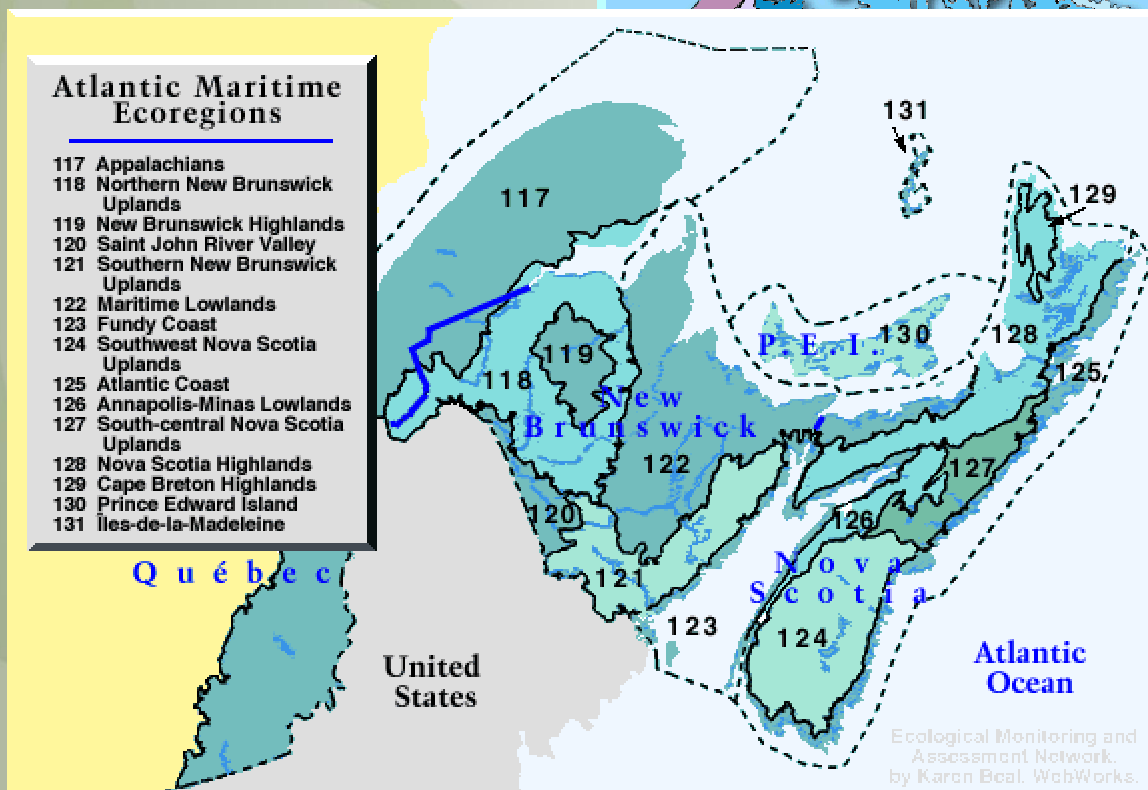
NDF Considerations



Considerations for NDFs

Considerations for NDFs





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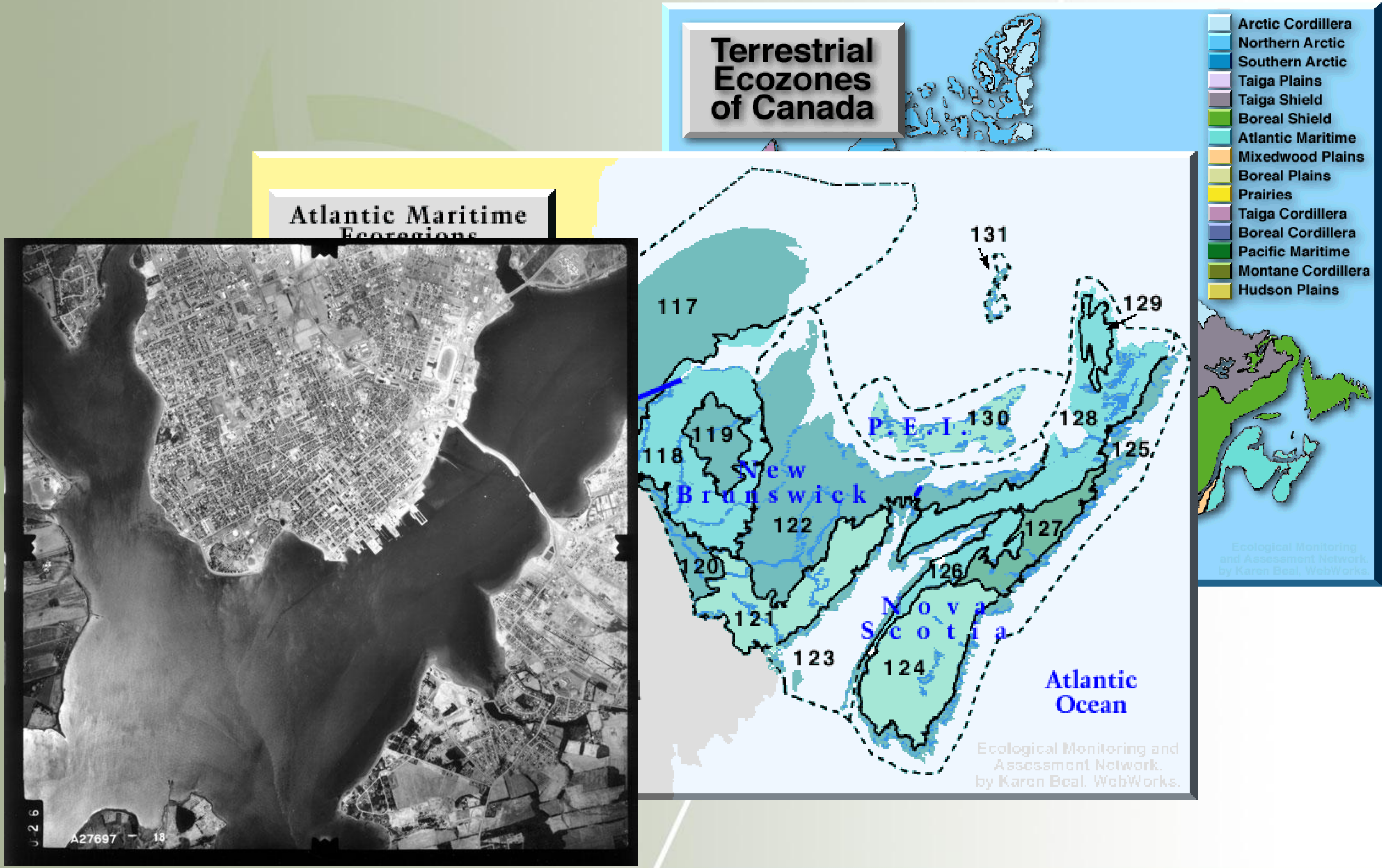
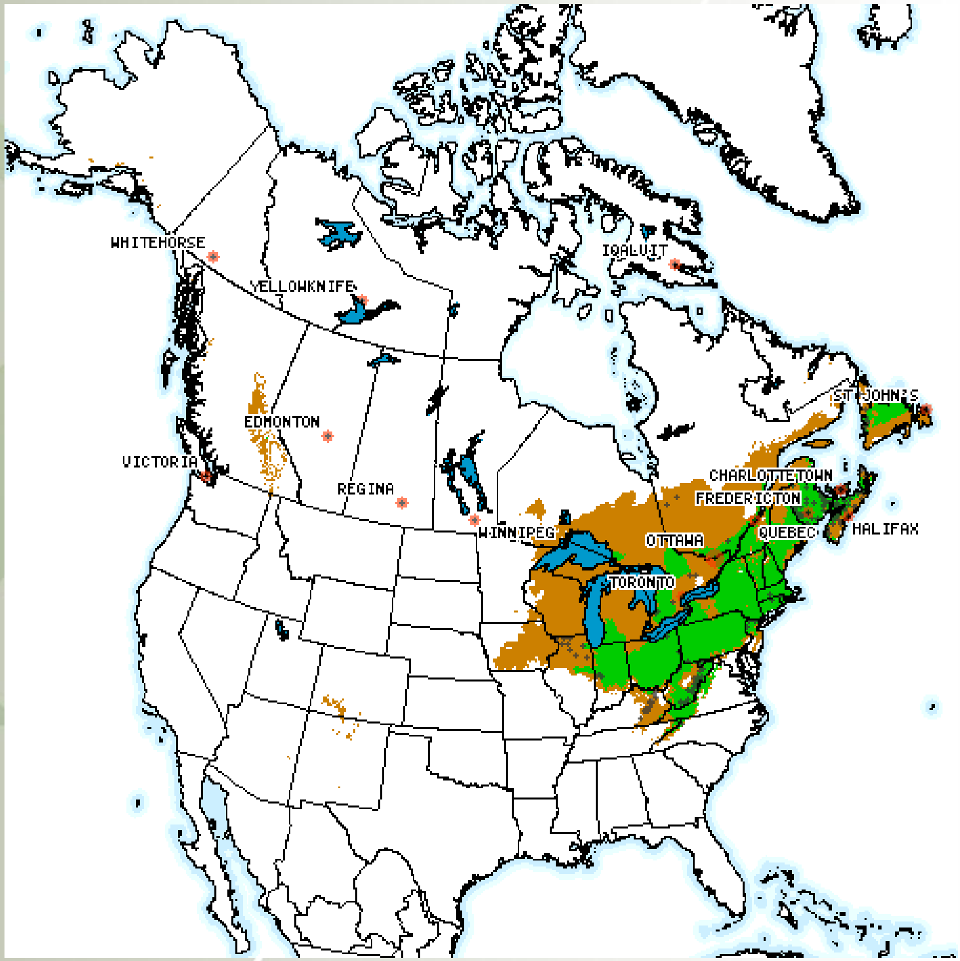
CFS CANADIAN FOREST SERVICE
scf-cfs.rncan-nrcan.gc.ca

Considerations for NDFs



Considerations for NDFs

- *T. canadensis* bio-map (climate and digital elevation modeling using ANUCLIM)



Economic Considerations

- Stem-specific harvest limits contained in the guidelines can produce measurable economic advantages for harvesters

- Positive economic outcomes are linked to quality and quantity of product (taxanes) in biomass harvested, and to reduced travel, transport and operating costs

Considerations for NDFs

- Process here described arose from a “wild west” situation … sudden, uncontrolled and unsustainable pressure on species
- In such cases, what is minimum information required for making an NDF?
- Full adherence to guidelines that evolved for *T. canadensis* (a sustainable stem-specific harvest) would equate (functionally) to a NDF

Considerations for NDFs

- Case study is about management (therefore not an NDF) but was based on an NDF ‘finding’ − a harvest limit based on a species specific morphology, physiology

- Inclusive approach (regulators, harvesters, buyers, commodity producers) was a component of success

Considerations for NDFs

- Global NTFP market (pharmaceuticals) evolves, relocates more rapidly than fibre market − ability to consider, produce NDF's quickly required
- NTFP and traditional forest management approaches increasingly linked … (a challenge for managers and Scientific Authorities)
- Final point for consideration … sustainable harvest does not equate to sustainable forest management

NDF WORKSHOP CASE STUDIES
WG-1, Case Study 6

Genus-level Approach to Taxus Species

Ken Farr,
CITES Scientific Authority, Natural Resources Canada,
Canadian Forest Service

NON-DETRIMENT FINDINGS REPORT ON *GUAIACUM SANCTUM* IN MEXICO

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I. Background information on the taxa

1. BIOLOGICAL DATA

1.1. Scientific and common names

Guaiacum sanctum, Linnaeus (1753). Most authors identify four or six species in the genus Guaiacum. Four different synonyms have been recognized for G. sanctum:

1. *Guaiacum multijugum* Stokes (1812).
2. *Guaiacum guatemalense* Planch. ex Vail & Rydberg likely to be an hybrid between *G. sanctum* and *G. coulteri* (Porter 1972).
3. *Guaiacum sloanei* Shuttl. ex A. Gray (Gray 1897, Vail & Rydberg 1910).
4. *Guaiacum verticale* Orteg. (Gray 1897, Vail & Rydberg 1910).

Guaiacum sanctum is commonly called lignum vitae in English, and guayacan or palo santo in Spanish. Guaiacum coulteri, a very similar species to G. sanctum, is also called guayacan or lignum vitae.

1.2. Distribution

Guaiacum sanctum is found in Mexico, Nicaragua, Puerto Rico, the Dominican Republic, the United States (Florida), Costa Rica, Guatemala, Bahamas, Haiti, Cuba, Honduras, El Salvador, Trinidad and

Tobago, and the Turks & Caicos Islands. In some of these countries, *G. sanctum* has become endangered or is virtually extinct. The Mexican populations cover a greater portion of the species' natural range than those in any other country. There is no data available for the global population. However, a worldwide analysis of the tropical dry forest estimated a remaining range of 131,087 km^2 for North and Central America including Mexico. In general this coincides with presence information of G. sanctum, and we could consider this a very rough estimate of the world distribution area of *G. sanctum* (Miles *et al*. 2006).

The distribution of *Guaiacum sanctum* in Mexico was estimated based on an ecological niche modelling approach using the Genetic Algorithm for Rule-set Prediction (GARP) (Stockwell & Noble 1992, Peterson *et al*. 1999, Stockwell & Peters 1999, Anderson et al. 2003, Anderson & Martinez-Meyer 2004). Based on presence data and environmental information, GARP models species' responses to environmental conditions and projects the model in geographic space. Data on species' presence and absence obtained from field observations, interviews, literature and herbarium reviews may be used to test and refine the historic distribution models, and these can be combined with land-use data to describe the current distribution of a species. In this case we used data from 161 sites where *G. sanctum* is known to occur and 15 environmental variables.

The model generated by GARP was filtered in Arcview 3.3 (ESRI 2002) to generate an approximation to the historic distribution of the species (Anderson & Martinez-Meyer 2004). We included only those areas where there is a strong likelihood that the species is present based on herbarium information, literature sources and field surveys. The first filter removed biogeographic provinces where the species had never been recorded, using the Mexican biogeographic provinces map (CONABIO 1997). A second cut was applied by using a potential vegetation map (Rzedowski 1990) to remove vegetation types where the species has not been recorded. Thirdly, only those states where *G. sanctum* or *G. coulteri* have been collected or recorded previously were retained within the final distribution maps for the two species.

The final GARP model predicted the presence of *G. sanctum* in five states of southeast Mexico (Oaxaca, Chiapas, Campeche, Quintana Roo and Yucatan; Figure 1). The species is generally confined to tropical scrub and deciduous, semi-deciduous and evergreen forests in three main regions: (i) the coast and Isthmus of Tehuantepec in Oaxaca, (ii) the Central Depression in Chiapas, and (iii) a considerable part of the states of Campeche, Quintana Roo and Yucatan. Our model estimated a total distribution of *G. sanctum* in 2000 of approximately 95,400 km^2. About 88% of this distribution is within the Yucatan Peninsula in a roughly continuous distribution. *Guaiacum sanctum* overlaps with the distribution of G. coulteri in coastal regions of Oaxaca, Sierra Madre del Sur and the Isthmus of Tehuantepec.

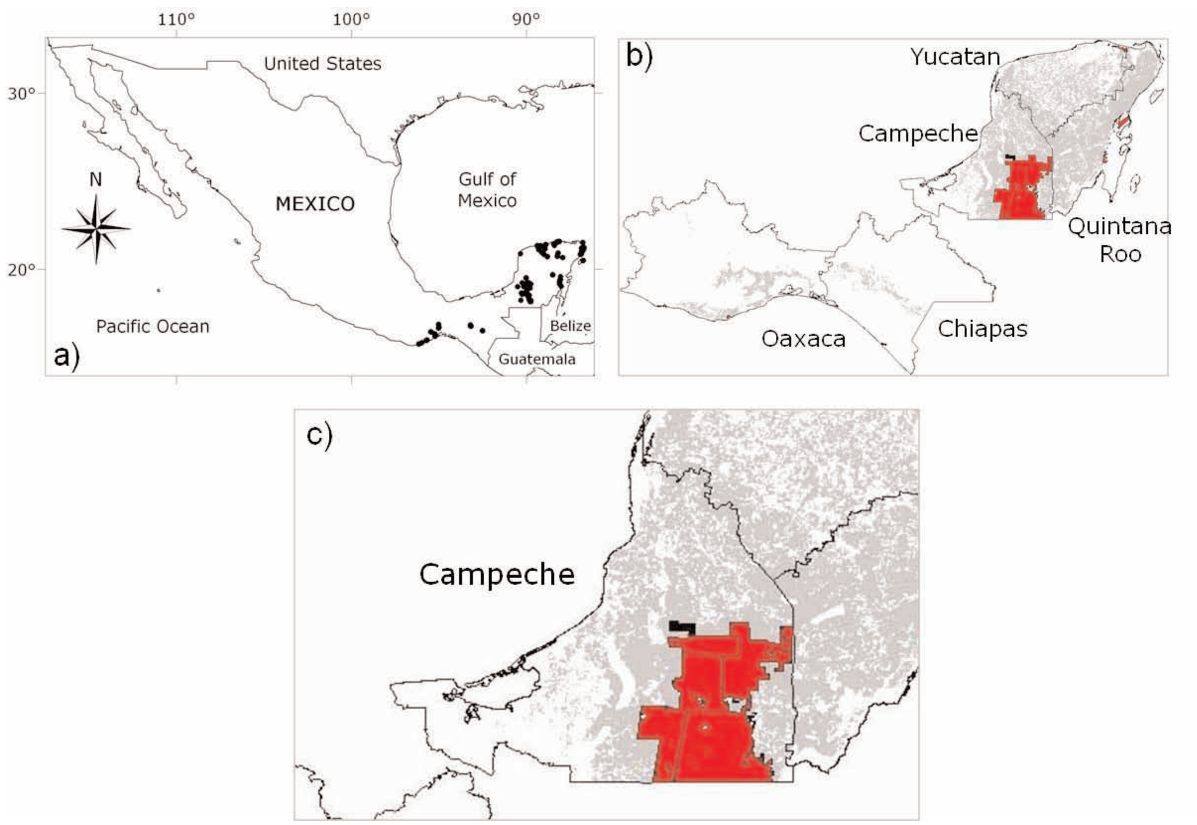

Figure 1. Distribution of *G. sanctum*. a) Confirmed presence information is showed with filled circles b) Potential distribution of G. sanctum in 2000 obtained based on ecological niche modelling (light gray), natural areas where the species is protected are show in red c) Campeche State showing in black, the area where forest management is still underway (Ejido Pich Forest Reserve).

Land use change has generated a rapid increase in fragmentation of forests, measured as the change in number of small fragments and the area they occupy. In the period 1990-2000 the number and area of tracts of continuous forest (>100 km^2) declined at rates of 3.99% year-1 through fragmentation and creation of new patches of forest, agriculture-pasture and human settlements of small size (0.1, 1 and 10 km^2). The total area occupied by fragments of forest declined by 2232.4 km2 yr^{-1}. Especially, in Chiapas and Yucatan states the populations are very fragmented due to agriculture and pasture conversion. The greatest area of presence of *G. sanctum* is found in central-south

Campeche, where the Calakmul Biosphere Reserve and the Balam-Kin and Balam-Ku state reserves protect about 12,000 km^2. These three reserves are connected with many communal reserves (*tierras ejidales*) possessing extensive forest reserves. Together they represent the most important areas for *G. sanctum* in terms of distribution and abundance.

1.3 Biological characteristics

1.3.1 *General biological and life history characteristics of the species*

Guaiacum sanctum L. (Zygophyllaceae) is an evergreen tree that grows up to 25-30 m in height and 60 cm diameter at breast height (dbh). Its leaves are paripinnate and opposite with 4-12 oblong to obovate leaflets. The crown is much dispersed. The very attractive flowers are solitary or in terminal panicles with blue-violet petals 0.7-1.2 cm long and yellow stamens. Fruits are capsules 1.5-2.0 cm long, winged, and turning yellow-orange when ripe. Seed are enclosed by an intensely red aril (Jimenez 1993, Chavarria *et al*. 2001, Grow & Schwartzman 2001).

MORTALITY

The highest mortality rates are in small individuals and decline with increasing tree size. Seedlings and juveniles (<150 cm height) may present a mortality rate between 5-20% year-1 while adults (>1 cm dbh) present very low mortality. Within a population of 3,000 individuals >1 cm dbh in Central Campeche, only two stems >5 cm dbh died during the period 2003-2008.

SIZE, GROWTH AND AGE

Guaiacum sanctum can be classified as a shade tolerant and slow-growing species over its life cycle. For example, in two different sites during three years of measurement in central Campeche, we found height growth for seedlings (<50 cm height) of 2-4 cm year-1 and for juveniles (50-150 cm height and <1 cm dbh) a height growth of 3-8 cm $year^{-1}$. For adults 1-40 cm dbh we measured growth rates of 1.5-2.3 mm $year^{-1}$. Based on these measurements, we estimate that the age of trees 35-40 cm dbh is between 280-390 years.

Additionally, radiocarbon estimations indicate ages between 377-460 ± 11-55 years for trees 60-64 cm dbh with diameter increments of 1.6-2.0 mm $year^{-1}$. These growth rates obtained from radiocarbon dating indicate very similar rates to those estimated from direct measuring methods (Brienen unpub. data). Similar growth rates have been found in Palo Verde, Costa Rica (Eric Ribbens pers. comm.). Therefore, we can fairly affirm that *Guaiacum sanctum* is a slow-growing species.

Based on interviews with local people, large trees (up to 70 cm dbh) were common in the past in central Campeche, but now most large trees have been harvested and the largest that we have found in the area of Calakmul, Campeche are no more than 55 cm dbh. However, even larger trees (90 cm dbh) have been observed in the Central Depression of Chiapas near Tuxtla (Gutierrez pers. obs.).

Reproduction and regeneration

Guaiacum sanctum populations flower twice a year, first in February-March and then in June-July. Fruit production occurs between May-June and August-September. Fruits are capsules containing 1-3 seeds. Probability of reproduction of *G. sanctum* increases with dbh. The smallest reproductive trees are 1 cm dbh, which corresponds to an age of 30-70 years according to the age-size estimates presented above.

Fruit production increases exponentially with tree size, with the smallest trees (1-4.9 cm dbh) producing about 10 fruits and the largest trees (>35 cm dbh) producing >10,000 fruits. However, there are low density populations of adult trees areas in Calakmul Biosphere Reserve with lower fruit production, which might indicate a lack of pollinators or low self-compatibility (Bawa & Crisp 1980, House 1992). The pollinators of G. sanctum are unknown, but floral morphology (the purple color of the petals and yellow anthers) suggests pollination by bees. Every fruit has two to four lobes that potentially produce one seed each, but fruits from low adult density areas usually produce only one seed. Fruits in high adult density areas have a mean of 2.5 seeds. In contrast, we have detected isolated reproductive trees in areas of the Central Depression of Chiapas that have high fruit production and up to 70-80% seed viability indicated by seed germination and x-ray seed tests. However, the density of seedlings in this area is very low, which likely indicates predator effects on seeds or seedlings (Gutierrez & Lopez unpub. data).

The regeneration of *G. sanctum* along its distribution range is highly variable. For example, in the centre of the range regeneration in undisturbed forest was very high, with densities of 1,500-15,000 seedlings ha^{-1}, whereas near the limits of its distribution (Oaxaca, Yucatan and Quintana Roo) densities of only 23-142 seedlings ha^{-1} were found. The underlying causes of these differences are not known, but it is clear that the more marginal populations require monitoring and protection from land use in order to ensure their long-term persistence.

Guaiacum sanctum is able to regenerate after small disturbances, such as selective logging. For example, we recorded continuous recruitment of seedlings for two years after harvesting. However, regeneration was 40-50% less in logged areas than in undisturbed forest. Additionally, we recorded higher regeneration of *G. sanctum* than other tree species and we found that it dominates the community regeneration process. Following the demography and population dynamic of two 0.5-ha plots in recent logging, old logging and protected areas, the population growth rate of the species was | >1.0 for the three populations. This indicates that even after timber harvesting, the populations are still growing. The plots in recently and old–logged forest included logging gaps, skid trails, logging roads and log landings. A high proportion (~80%) of individuals cut or damaged during harvesting were able to re-sprout, but this response depended on the diameter and height at which damage occurred. We have observed that individuals cut higher up the stem were more able to re-sprout than individuals cut at the base. Individuals >10 cm dbh were unable to re-sprout. In the case of *G. sanctum*, sprouting may help to minimize the negative impacts of logging.

1.3.2 *Habitat types*

In Mexico, *Guaiacum sanctum* grows in scrub, semi-deciduous and evergreen tropical forest on karstic soils. It grows on karstic hills from 5 to 600 masl and in localities with no more than 1500 mm of annual rainfall. In semi-deciduous and evergreen tropical forest in the south of Campeche and some areas in Chiapas, it can grow up to 25-30 m height, but in scrub tropical forests of north Yucatan Peninsula it only grows to 3-4 m and never reaches more than 20 cm dbh. This is probably an effect of nutrient-poor karstic soils and very low annual rainfall (<550 mm).

1.3.3 *Role of the species in its ecosystem*

In some of the deciduous, semi-deciduous or evergreen tropical forests of south Mexico, G. sanctum is a very important species in number of individuals and in biomass. Especially in Campeche, our studies estimate that an adult tree (>40 cm dbh) is 350-400 years old and we consider that these individuals represent an important store of carbon. Thus, considering the species' abundance, wide distribution and high biomass in some forest of Campeche, we can expect that its multiple roles in ecologic function like fixing and storing carbon, nutrient and water fluxes, soil conservation, and source of food for animals, are very important. For example, many birds and mammals eat the fruits and seeds of G. sanctum, or trees are used for perches, nesting or protection. Based on *G. sanctum*'s flower type and massive flowering, it is very likely that the species is also an important resource for pollinators.

1.4 Population:

1.4.1 Global population size

The Mexican populations seem to be the core populations where stem densities are particularly high. The number of individuals in the surveyed localities varied from 130 to 1500 ha^{-1} potentially reproductive individuals (>1 cm dbh), and our estimate of total distribution indicates that Mexican populations cover about 95,400 km^2. If we are very conservative and consider the lower density of individuals (130 individuals ha^{-1}) for the total distribution (95,400 km^2), we obtain a population size greater than the limits required for the IUCN Endangered category (>10,000 individuals).

The abundance of the species is variable throughout its distribution area, with the highest densities per hectare in the Yucatan Peninsula. In Central Campeche, densities of up to 1200 ha^{-1} potentially reproductive individuals (>1 cm dbh) have been registered (Lopez 2008). In contrast, towards the edges of its distribution (Oaxaca, Yucatan and Quintana Roo), densities of only 150-470 individuals ha^{-1} have been found. The lowest densities have been registered in the state of Chiapas with at most <10 ha^{-1} reproductive individuals. In other areas of Chiapas, where herbarium information indicates historical presence of the species, forests have been reduced, fragmented or eliminated. Locally, *Guaiacum sanctum* can be relatively patchily distributed, and it is especially confined to karstic soils with moderate to strong slopes. In some areas the boundary between porous karstic soils and adjacent mixed seasonally flooded forest (*bajo mixto*) is associated with a transition from high densities of *G. sanctum* stems to very low density or total absence within a distance of just 5-10 m.

1.4.2 *Current global population trends*

___increasing __X__decreasing ____ stable ____unknown

1.5 Conservation status

1.5.1 *Global conservation status* (according to IUCN Red List)

___Critically endangered ___Near Threatened
_X_Endangered ___Least concern
___Vulnerable ___Data deficient

The global conservation status of *Guaiacum sanctum* is Endangered (ENC2a) and many countries of its natural distribution consider it a threatened species (CITES 2000, Chavarria *et al* 2001, Vivero et al. 2006,).

1.5.2 *National conservation status for the case study country*

For the case of Mexico, we consider that the species should be considered as Near Threatened, because it has had habitat loss of 28.2% in the last three generations, and the extent of its geographic range and population size in Mexico (95,421.6 km^2 and >10,000 individuals, respectively) exceed the limits required for the "Endangered" category. Therefore the species is not facing a high risk of extinction, but it is likely to reach the Threatened category in the near future (IUCN 2007). We acknowledge that the conservation status of the species may be very different in other countries. In Guatemala and Costa Rica, *G. sanctum* has been assessed as Vulnerable (VU A2ad) and Endangered, whereas in El Salvador and Florida *G. sanctum* is considered endangered or nearly extinct, respectively. By contrast, the Cuban populations apparently are abundant (Jimenez *et al*. 1993, CITES 2000, Vivero *et al*. 2006, Dertien & Duval 2008). There are also important regional differences between the Mexican populations: habitat loss has been much greater in Yucatan, Chiapas and Oaxaca than in the core populations in Campeche and Quintana Roo.

G. sanctum has been considered a threatened species in Mexico since 1994 (NOM-059-SEMARNAT-2001), specifically in the "Species under special protection" category. However, our results suggest that new categorization of the conservation status is required. Under the criteria for the Mexican method of Risk Evaluation (SEMARNAT 2002), a score of 11 was obtained for *G. sanctum*, which indicates that the species should be considered as Endangered and up-listed from the current category of risk (Special Protection) to endangered. The current risk category differs with the IUCN category of endangered.

1.5.3 *Main threats within the case study country*

___No Threats
_X_Habitat Loss/Degradation (human induced)
___Invasive alien species (directly affecting the species)
_X_Harvesting [hunting/gathering]
___Accidental mortality (e.g. Bycatch)
___Persecution (e.g. Pest control)
___Pollution (affecting habitat and/or species)
___Other_______________
___Unknown

The main threats for *Guaiacum sanctum* in Mexico are HABITAT LOSS/DEGRADATION OF HABITAT provoked by human activities, especially the conversion from forest to agriculture-pasture lands and human settlements.

OVERHARVESTING of *Guaiacum sanctum* has reduced its abundance in some areas, but currently does not represent a threatening factor. Local use of the species is present in some communities, but at very low levels and we do not consider this a threat for the long-term persistence of the species. In general, illegal logging for commercial purposes is rare, but its effects cannot be discounted. For example, in September 2008 a small amount of *G. sanctum* timber was confiscated in a small community of Yucatan, near Merida (Dzitia), because of lack of authorization for harvesting.

With regards to POLLUTION, no effects have been reported for *Guaiacum sanctum*. However, there are some forested areas with presence of Guaiacum sanctum near cities (specifically Tuxtla Gutierrez in Chiapas) where urban growth seems to threaten the long-term persistence of the species. We have witnessed district development in areas with presence of *Guaiacum sanctum*. Other areas near Tuxtla Gtz, in a state reserve, present very poor regeneration even when trees produce abundant seeds. This probably indicates that seeds or seedlings suffer high predation or mortality.

2. SPECIES MANAGEMENT WITHIN THE COUNTRY FOR WHICH CASE STUDY IS BEING PRESENTED

2.1 Management measures

2.1.1 *Management history*

Different sources indicate that G. sanctum has been traded during the past four to five centuries. *G. sanctum* has historically been heavily exploited for its medicinal properties, especially for the treatment of syphilis and arthritis, which ensured an important market and resulted in reductions in its abundance in many locations (CITES 2000). It was also used as a laxative, anti-inflammatory, diuretic, and diaphoretic. Preliminary studies indicate that it also might have anticancer properties (Chavez 2001). Minimal medicinal use continues through use in local remedies. However, an international but probably irregular trade of *G. sanctum* for medicinal purposes persists, and a variety of products can be obtained online (*www.herbalremedies.com/, www.globalherbalsupplies.com/, www.abchomeopathy.com/*), but the origin of these products is unknown. Some are advertised as *G. officinale* of Mexican origin. However, this species is not present in Mexico and it is probable that these products are derivatives of *G. sanctum* or *G. coulteri* and apparently under unregulated trade. *Guaiacum sanctum* is also sold and planted as an ornamental tree and seeds can also be bought over the internet.

Currently the more important trade is for timber products. The high density and resin content of the wood confer auto-lubricating properties that make it suitable for the ship-building industry (Jiménez 1993, CITES 2000, Chavarría *et al*. 2001). Exploitation of *G. sanctum* for the timber industry in Mexico is mainly from the state of Campeche, but this activity it has been reduced. The most important period of industrial extraction occurred during 1960-1990 with trade to European, Asian and North American countries representing about 3000 tons $year^{-1}$. However, more recently the trade has declined significantly because G. sanctum timber has been replaced by plastic substitutes.

During 1987-1998 the amount traded was only 117 tons $year^{-1}$ on average, with a maximum of 270 tons and a minimum of 10 tons. For some time timber from Cost Rica was also traded internationally, but since 1978 Mexico has been the only exporter of lignum vitae timber under CITES regulations. Japan, France and the US have re-exported *G. sanctum*, but apparently most of this was of Mexican origin. This is in part due to a reduction in the demand for the timber, but also because stocks have been depleted and the species is classified as nearly extinct or endangered in other countries within its natural range (CITES 2000).

The International Union for the Conservation of Nature has classified *Guaiacum sanctum* as an endangered species (ENC2a) due to its threatened conservation status within most of the natural range. Anecdotal evidence suggests that this classification is appropriate for populations of *G. sanctum* on the Caribbean Islands and for some countries in Central America (CITES 2000). For example, in El Salvador, *G. sanctum* is considered to be extinct in the wild and in Guatemala it is considered as a Vulnerable species (VU A2ad; Vivero *et al*. 2006). The best available evidence suggests that G. sanctum is threatened in eleven countries, although quantitative assessments have rarely been conducted (CITES 2000, Vivero *et al*. 2006).

Guaiacum sanctum has been included in CITES Appendix II since 1975 to control the international timber trade. However, from 1985-2003 all parts and derivatives were subject to control, with the exception of seeds and pollen, seedlings or tissue cultures obtained in vitro, cut flowers, or artificially propagated plants. Since 2003 all species in the genus have been included in Appendix II, meaning that CITES controls international trade for all parts and derivatives of plants of the genus (Oldfield 2005).

Guaiacum sanctum has been considered a threatened species in Mexico since 1994 (NOM-ECOL-059), especially in the "Species under special protection" category. For any proposed logging activity, special permits and a management program are required. The last logging management program in Mexico was carried out during 1990-2005 in the Ejido Pich and Ejido Dzibalchen Forest Reserve, both in the southern state of Campeche with about 8,000 ha under management. A new program was recently granted to Ejido Pich with about 3000 ha to be managed during 2009-2024.

2.1.2 *Purpose of the management plan in place*

At the moment there is no management plan being carried out in Mexico, but a recently approved one will start by approximately March 2009. This management plan is for timber exploitation in the southern state of Campeche, specifically in the community Ejido Pich. This management program was planned by a timber enterprise in commercial agreement with the community (Ejido Pich). The purpose of this program is the exploitation of timber under non-detrimental methods for the long-term survival of this species in Mexico.

2.1.3 *General elements of the management plan*

The elements of the management plan include: i) Sustainable exploitation of *Guaiacum sanctum*. This includes selective logging of commercial trees >37.5 cm dbh, with the least possible impact at the moment of felling, skidding and transport of logs. ii) Reduced environmental impact to trees remaining in the forest, soil, flora and fauna. iii) Restoration or induced regeneration in case of negative impacts of harvesting. iv) Monitoring of demography and population dynamics.

2.1.4 *Restoration or alleviation measures*

In general, any management plan for timber extraction includes four different components: restoration, reforestation, prevention of damages, and control of damages.

The management plan intends to carry out restoration techniques if negative impacts are provoked by harvesting. The managers indicate that seeds of the species will be collected and dispersed. Additionally, they will also produce seedlings and saplings in shade houses and then plant them in gaps generated by harvesting. However, studies of the demography, population dynamics, regeneration in logging gaps, and germination indicate that silvicultural treatments are likely to be unnecessary. Additionally, the slow growth of the species indicates that seedling and sapling production is likely to be difficult and therefore not recommended.

2.2 Monitoring system

There is still no well-defined monitoring plan. The logging company which will carry out the management plan proposed to establish a series of permanent plots at pre-harvested, harvested and protected sites to follow demographic patterns and population dynamics of the species. For this monitoring, the demographic schedules are planned to be followed for ten years with annual censuses during the first two to three years and then a biennial census. This demographic data will provide the basis for population dynamics to be estimated using matrix modelling. This monitoring will allow approximate determination of the effects of harvesting on population dynamics, and represents a good scenario for setting up an experiment examining the impacts of different percentages of harvest damage to small individuals and commercial adults. As the management plan also includes other species, some other effects can also be evaluated.

However, there is still no funding available to establish this monitoring programme and the managers together with the community and probably some academic institutions will apply for financial support from the Mexican Forestry Commission or other institutions.

2.2.1 *Methods used to monitor harvest*

Though the monitoring program has yet to be properly established because the management program will begin in March 2009, it is likely to be developed with participation by scientists, forest managers, and the Ejido Pich community. Monitoring will include the establishment of permanent plots in i) pre-harvest, ii) post-harvest, and iii) undisturbed populations where all individuals will be tagged and measured. Two hectares (in four 0.5-ha plots) in each population type will be established. In harvested populations two to three annual censuses will be completed and then biennial censuses will be completed for 8-10 years. Survival, growth in height and diameter, probability of reproduction, and fecundity rates will be followed. Population dynamics studies will be carried out using matrix modelling, simulating different harvesting systems to propose better management of the species.

Rapid assessment will also be completed throughout the logged area to determine the rate of harvested trees, the remaining stock, and the potential for regeneration at the landscape level.

2.2.2 *Confidence in the use of monitoring*

Permanent plots and matrix modelling have been widely used to understand the dynamics of stage-structured populations in evolutionary studies, in research on the control of weedy and invasive plants, and in the conservation or management of populations of a wide range of species (Silvertown *et al.* 1993, Caswell 2000, de Kroon *et al.* 2000, Heppell *et al*. 2000, Franco & Silvertown 2004, Davis *et al*. 2004). Matrix modelling simulations of management interventions in populations of tropical woody plants have also been used to give recommendations on the restoration or exploitation of plants (Olmsted & Alvarez-Buylla 1995, Ratsirarson *et al*. 1996, Svenning & Macía 2002, Zuidema & Boot 2002). Furthermore, matrix models can be used to conduct elasticity analysis, which allows comparison of the relative contribution of different stage-specific vital rates (survival, growth and fecundity) to the population growth rate (de Kroon *et al*. 1986, Heppell *et al*. 2000, Caswell 2000). Elasticity analysis is useful for identifying potential management targets because it can detect life stages and vital rates with the greatest impact on the population growth rate, which helps the decision-making process (de Kroon *et al*. 2000, Heppell *et al*. 2000, Caswell 2000). To our knowledge, there have been no studies evaluating the effects of field-scale commercial harvesting on the population response of slow-growing tropical timber species. This issue is very important for the establishment of both general and site-specific management recommendations.

2.3 Legal framework and law enforcement

Guaiacum sanctum has been listed in CITES Appendix II since 1975. In 2000, the species was proposed to be listed in CITES Appendix I, but insufficient data were available to justify this status change. In 2003 all species in the genus were included in Appendix II to control international trade for all parts and derivatives of plants of the genus (CITES 2002, Oldfield 2004).

G. sanctum has also been considered a threatened species in Mexico since 1994 (NOM-ECOL-059), specifically in the "Species under special protection" category. However, our results suggest that new categorization of the conservation status is required for this species. Under criteria for the Mexican method of Risk Evaluation (SEMARNAT 2002), a score of 11 was obtained for *G. sanctum*, which indicates that the species should be considered as Endangered and therefore should be uplisted from the current category of risk (Special Protection), which differs from IUCN's category of endangered.

We consider that Mexican populations of *G. sanctum* should remain listed on CITES Appendix II to help reduce pressure on *G. sanctum* populations from timber exploitation and international trade. This measure would indirectly ameliorate demand for *G. coulteri*, which is occasionally substituted for *G. sanctum* (CITES 2000). By contrast, an up-listing to Appendix I as previously proposed would impose difficulties for international trade, reduce interest in forest management, and provoke increased risk of land conversion (CITES 2000). This work would have to follow regulations imposed by the Mexican environmental authorities (SEMARNAT 2002), and timber exports would remain subject to CITES regulations (CITES 2000).

3. UTILIZATION AND TRADE FOR RANGE STATE FOR WHICH CASE STUDY IS BEING PRESENTED.

3.1 Type of use

Wild populations of *Guaiacum sanctum* have historically been heavily exploited for its medicinal properties, resulting in reduced abundance in many locations. Nowadays the international market for medicinal use has nearly vanished. However, some products derived from the bark, leaves and roots continue to be traded over the internet, but the origin of these products is uncertain. Many of these products are advertised as derivatives of *G. officinale* and of Mexican origin. However, this species is not present in Mexico and we might assume that these products are derived from *G. sanctum* or *G. coulteri*.

In some small villages in the Yucatan Peninsula *G. sanctum* is still used for medicinal purposes, but apparently only for domestic use. Medicinal properties include the use against syphilis and, in general, sexually transmitted diseases as well as arthritis, gout and asthma. It is also used as a laxative, diaphoretic, diuretic, and for pain relief. None of these properties has ever been studied and confirmed scientifically.

G. sanctum was also used for railroad ties, but now this use has completely disappeared. One use which still occurs is for handicrafts at some villages in the state of Yucatan. No estimation of the extent of this use is available. A small shipment of G. sanctum was recently confiscated in a small village in Yucatan (Dzitia), which apparently was supplied illegally from the north of Campeche (A. Pani pers. comm.).

Sawdust, a waste by-product from sawmills, is used in some mosquito repellents (slow-burning coils) due to the wood's slow combustion rate. Chips and other wood waste are exported to Germany to be used together with other 42 different aromatic herbs for the preparation of the "Underberg", a traditional digestive.

Currently the most important trade is in timber products. *G. sanctum* timber's high specific gravity and its high resin content confer resistance to the attack of natural enemies and give the wood autolubricating properties that make it suitable for the ship-building industry (Jiménez 1998, CITES 2000, Chavarría *et al*. 2001). Internationally traded timber is totally of wild origin. During the last management program about 8000 hectares in the southern State of Campeche were exploited during the 1990-2005 period. Most of the timber exploited during this management program was exported to European and Asiatic countries, especially Germany, Japan and the Philippines (Salmon pers. comm.).

Timber of *Guaiacum sanctum* has been included in CITES Appendix II since 1975. In 1985 all parts and derivatives were also included in the Appendix II listing. In 2000 it was proposed to up-list G. sanctum to Appendix I, but insufficient data were available to justify this status change. In 2003 during CoP12 (Santiago de Chile), all species in the genus were included in Appendix II. *G. sanctum* is also listed as a "Species under special protection" in the Mexican list of threatened species since 1994 (NOM-ECOL-059) and therefore for any proposed logging and trade, special permits and a management program are required.

3.2 Harvest:

3.2.1 *Harvesting regime*

The most important use of *G. sanctum* is for timber, and exploitation is under selective logging techniques. This means that only adults >35 cm dbh (>37.5 cm in the recently authorized management plan) are harvested. In central Campeche where all the management programs have been carried out in the last 18 years, *G. sanctum* abundance is high (up to 1200 individuals >1 cm dbh ha^{-1}). However, the density of commercial trees is only 8-12 ha^{-1}, and after discounting those distorted, split at the bottom, or difficult to access, only about 40-50% is commercially available. The estimation of the potential stock available for exploitation (m^3 ha^{-1} year-1) is based on the inventory of the population in 2% of the area proposed to be managed.

Generally, only the main log of a given tree (4-5 m) is extracted, leaving the rest of the stem and branches in the forest as these are not useful to the timber industry. These branches are sometimes used in the small-scale industry of handicraft production in the neighbouring state of Yucatan. Special permits are required to transport these small-scale quantities.

To extract logs a skid trail is created by cutting the trees standing in the way, including some *G. sanctum* individuals of sub-harvestable size. Trees of *G. sanctum* >10 cm basal diameter are unable to re-sprout. Harvesting is carried out during the dry season from approximately February to May.

Demographic studies and elasticity analysis indicate that *Guaiacum sanctum* populations in central Campeche are sensitive to harvesting damages to non-commercial adult trees (1-25 cm dbh). Computer simulations suggest that logging of commercial trees has a low impact on the population growth rate (Ï). In contrast, small increases (>8%) in the mortality rate of non-commercial trees produce strong negative effects on the population growth rate.

3.2.2 *Harvest management / control* (quotas, seasons, permits, etc.)
To exploit any forest product in Mexico, a management program and special permits are required. As a new legal requirement, a population study must be undertaken to demonstrate the ability of the population to recover from exploitation and to assure that harvesting will not place a commercial species at risk.

In general, the management program includes a description of the inventory, estimation of the potential harvestable stock, description of logging methods, and explanation of how negative outcomes will be avoided.

In the recently approved management plan for *G. sanctum*, only adults >37.5 cm dbh were authorized to be harvested. The availability of these trees is approximately of 7-12 ha^{-1}. Depending on the quality of the logs (i.e., their length, straightness, and accessibility), about 40-50% of commercial trees are felled. Trees left in the forest represent an important source of seeds as they contribute a large percentage of the total number of seeds produced annually.

There is apparently good regulatory control over the management program. Some of the permits or authorizations required for this management program include: i) Authorization of the Environmental Department (Dirección General de Vida Silvestre-SEMARNAT-CITES Management Authority). ii) In the field, trees identified by loggers for harvest can be felled only after being visually authorized and marked by a forestry supervisor from the company which will carry out the management program. iii) Authorization of the legal representative of the Mexican Environmental Department (PROFEPA-SEMARNAT), which completes a field inspection to check the geographic coordinates of the area under management, diameter of trees felled, etc. iii) Permission to transport the timber from the field to the sawmill must be granted by the Mexican Environmental Department (SEMARNAT). This permission is for every truck carrying out *G. sanctum* timber. The truck may only contain commercial-sized logs and police departments may stop and ask for this permission. If the driver fails to show valid permission, police may confiscate timber and truck. iv) Authorization to transport timber products from the sawmill to the port for export. v) An NDF from the Scientific Authority (CONABIO). vi) CITES certificate for exporting. If any irregularity is found, the company is fined or legal actions may be taken and the authorization program can be revoked.

All of these permits are necessary to control the harvesting process and to promote conservation of the species. However, sometimes all of these permits or authorizations seem tedious due to bureaucracy and may take a long time, delaying the whole process. Thus, this may provoke a lack of interest of managers and the communities in forest management and paradoxically bring negative consequences, as communities may become interested in other forms of land use associated with simpler legal processes.

NOTE: For this species, the last two management programs (and earlier ones) were reviewed by the Scientific Authority before the harvesting authorization was given by the Dirección General de Vida Silvestre-SEMARNAT.

3.3 Legal and illegal trade levels

Although there are no estimates of the extent of illegal logging for international trade, it is likely to be very low or non-existent given the reduction of *G. sanctum*'s use. The legal international trade has decreased in recent years and further reduction is expected in the coming years. For example, during 1987-1998 the most important company (Transforesta) exported about 117 tons year^{-1} on average, with a maximum of 270 tons and a minimum of 10 tons. Table 1 show the Mexican exports from 1999 to 2006 registered in the trade database (UNEP-WCMC-CITES 2008), this exportation were mainly to France, Great Britain and the US.

Table 1. Mexican exports of Guaiacum sanctum, as recorded in the UNEP-WCMC CITES Trade Database.

Product	Unit	1999	2000	2001	2002	2003	2004	2005	2006
Carvings	kg	1	0	20	0	0	0	0	0
Logs	m3	0	1	0	0	0	<.01	0	7.1
Powder	m3	0	0	0	0	0	0	0	7
Sawn wood	m3	1	6	7	41.1	162	56	18	141.2
Sawn wood	kg	0	0	0	1090	746	1	25	0
Timber	m3	171	314	148	232	0	149	99	29.2
Timber	kg	0	0	2	0	4	750	3767	225
Timber pieces	m3	0	0	0	0	0	0	0	14

According to our interviews and field work, illegal logging is very low or non-existent and mainly for local use. However, minor commercial use cannot be discounted. For example, *G. sanctum* is used for handicrafts and recently a small shipment in Yucatan was confiscated. Even if illegal logging exists, the volumes involved are very low and likely to have minimal impact on populations. Locally, medicinal use persists in some villages in Yucatan Peninsula, but this seems to be more for domestic use and there is no trade. Over the internet is possible to find derivatives of *Guaiacum* advertised with medicinal properties, but the origin and authenticity of these products are not clear.

II. Non-detriment finding procedure (NDFs)

1. IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS?

___yes __X__no

2. CRITERIA, PARAMETERS AND/OR INDICATORS USED

The NDF for Guaiacum sanctum is based on the following criteria:

1) Biological criteria
   a. Distribution and abundance
   b. Population
      i) Number of commercial trees per hectare
      ii) Population structure
      iii) Estimation of seed production
      iv) Growth in diameter at breast height (dbh) and height
      v) Probability of reproduction and seed production
      vi) Population growth rate (Ï) obtained from permanent plots
      vii) Effects of simulated harvesting based on population modelling
      viii) Hollow trees (10%)

2) Harvesting and management criteria
   a. Harvesting area
   b. Management methods
      i) minimum cutting diameter
      ii) cutting methods
      iii) cutting periods
      iv) opening paths for extracting trees

3. MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED

3.1 Sources of data

The Scientific Authority of Mexico uses two main sources of data for making NDF for Guaiacum sanctum.

i) CIEco UNAM study

A four-year study on "Abundance, distribution and conservation status of *Guaiacum sanctum* L. in Mexico” where the conservation status of the species in Mexico and the effects of timber harvesting on the population was assessed (see Annex). The study was developed by a group of scientists from the Centro de Investigaciones en Ecosistemas at the National Autonomus University of Mexico (CIEco UNAM), led by Dr. Miguel Martínez Ramos with support from CONABIO (Scientific Authority). CONABIO was responsible for coordination and administration of the project as well as for co-financing part of it, and therefore maintained communication with researchers, made periodic evaluations of project reports, and assisted with available resources (e.g., information systems, species localities database).

The study assessed the current distribution and abundance of the species. Demographic patterns (survival, growth and fecundity rates) and population dynamics (population growth rate and elasticity analysis) in managed and unmanaged areas were followed according to criteria established by Caswell (2000) (see Annex).

The study included modeling of harvesting scenarios and gave concrete recommendations:

A matrix model was generated for the species assuming populations are stable (growth, mortality and fecundity constant through time). After a defined number of iterations of the model, the future size structure was projected using different extraction percentages and recruitment values. The model suggested that a cut (harvest) rate of 50% of trees with ?35 cm dbh once every 10 years can maintain the population in equilibrium if recruitment is guaranteed.

A computer-based simulation was carried out to explore the possible results of different (hypothetical) selective logging scenarios of *Guaiacum* populations. Based on elasticity analysis it was determined that the most important life stages for the population growth rate (Ï) are adults 1-25 cm dbh; these individuals are even more important than adults >35 cm dbh. This simulation did not consider aspects such dry years, severe storms, pests and diseases, and especially germination of seeds and survival of sub-adults and adult trees.

Based on these simulations, it can be concluded that the extraction of commercial trees may not have a significant impact on the population growth rate. For example, for any extraction percentage of commercial trees (20%-100%), if small trees are left standing, the model suggests that Ï will be reduced only between 0.7% and 1.1% of its original value in the absence of commercial logging. On the other hand, if no commercial trees were extracted but a sustained annual extraction of small trees (above 9%) was carried out, Ï would fall below 1 (equilibrium) and the population could decline towards extinction over the long term. This means that commercial logging for *Guaiacum sanctum* must take into consideration a maximum extraction rate (i.e., due to damages) of not more than 4% of small trees (1-25 cm dbh). On average, for a sustainable harvest of 40% of commercial trees, the maximum extraction percentage of small trees would be around 7.3% annually. Extraction programs should therefore be planned carefully to prevent damages to small (sub-commercial) size classes.

As a general conclusion, simulations based on populations from EPFR showed that resting periods between harvests of 15 or more years is fundamental for sustainable management of Guaiacum sanctum. Nevertheless, this result should be analyzed and defined on a case-by-case basis, and in relation to the proposed extraction percentage and to population survey results from sites that are to be harvested. In table 2 is summarized the key management recommendations for G. sanctum, obtained from the demographic can population dynamic study.

In this study it was also determined how harvesting affect the short-term dynamics and regeneration of *G. sanctum* at the local gap level in order to provide management recommendations and long-term conservation guidelines for exploited populations. To achieve this aim the demographic attributes (mortality, growth and recruitment) of *G. sanctum* populations under managed and unmanaged areas were studied. This study found that logging reduced stem density and residual tree basal area at a local scale, but our study suggests that harvesting of *G. sanctum* had only minor short-term effects on the dynamics and regeneration of the tree community. Guaiacum sanctum seedling abundance and rates of growth, mortality and recruitment were sensitive to the effects of harvesting, but the demographic attributes of adults were unaffected by logging. Re-sprouting was an important attribute of the resilience of *G. sanctum* and other species to disturbances such as timber harvesting in this forest. We conclude that logging of *G. sanctum* had a lower impact at the population and community levels than in other documented harvesting operations. The low impact arises because only one species is logged, and the density of trees of commercial size is low enough that widespread damage to the tree community is avoided. It is important to mention that this study was a t the level gap and therefore did not include any damaged outside of the gap (for example other trees cut in the skid trail).

Table 2. Key optimum attributes for *Guaiacum sanctum* management, based on a demographic and population dynamic study in the Ejido Pich Forest Reserve, Campeche, Mexico.

Attribute	**Optimum rate**
Commercial Adult trees extraction (%)	<50
Mortality of non commercial trees (%)	<8
Frequency of harvesting (years)	>15
Population growth rate (Ï)	>1

ii) Management programs prepared by the proponents
For any proposed logging operation a management program should be completed and presented. A management plan must contain: specific objectives, short, medium and long-term goals, physical and biological description of the area and sampling methods, a chronogram of activities, management measures for specimens, populations and the habitat, contingency measures, a vigilance program, and a targeting system to identify specimens.

For the most recent management plan evaluated and authorized in 2008, a "Population study" was also required. This mainly consisted of a statistical study describing the population structure and some general tendencies of the population based on life tables. The population study was based on data from 2%-area sampling within the proposed management area (approximately 60-ha inventory). Exploratory inventories were done within the forest management areas and 100% censuses were done in the forest management plots.

3.2 Analysis of the information and definition of the NDF

In Mexico, all harvesting requests for national and international trade are accompanied with a management program. Management programs for this species are reviewed by the Scientific Authority before the harvesting authorization is given.

The process is as follows:

- First, the SA verifies that the harvesting area proposed by the management plan is where management can be done. The CIEco UNAM study elaborated a GARP analysis to identify areas requiring protection, restoration, and where management might be possible. Since the species has a non-homogeneous distribution, censuses prior to harvesting are required to identify low-density areas where harvesting might not be sustainable.
- The SA revises the information given in the population study of the management program. All biological parameters (population struc-

ture, growth in diameter at breast height, probability of seed production, and population growth rate) are compared with results from the study done by researchers of CIEco UNAM.
- The amount and characteristics of the specimens to be extracted are compared with recommendations derived from the harvesting modeling included in the CIEco UNAM study.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

The study on population dynamics done by researchers from CIECO UNAM, and their close working relationship with the SA, has helped to generate better knowledge of the species, its behavior, and the effects of extraction on the population.

This study represents the most detailed and only available population dynamics information for the species in Mexico or elsewhere.

To evaluate the conservation status of the species, the study completed an intensive herbarium review, completed rapid field assessments, and, to evaluate the effects of timber harvest, established three 1-ha permanent plots in recently logged, old logged, and protected forest populations. The demography and population dynamics have been followed during three years. Researchers also collected regeneration data in logging gaps created by harvesting and compared the effects with undisturbed forest.

Having data derived from population research like this has helped to identify the essential elements to be considered in an NDF, such as population parameters (periodic measures and sustainable indicators) and the development of sustainable methods for the species' management and logging.

The study also collected presence-absence information in 220 different localities. However, only 11 rapid field censuses were completed throughout *G. sanctum*'s potential distribution and this may limit the conclusions. The demography study was completed in only three 1-ha plots, which represent a local scale study, but field observations through the central Campeche region suggest that the permanent plots may roughly represent the situation in this region. However, these results should be considered with caution for the purpose of generalization.

Based on results from this project, CONABIO called for the creation of an evaluation group including relevant government agencies, scientists, and industry to follow up on the implementation of management recommendations derived from the study. A National Workshop on Conservation, Management and Sustainable Use of Lignum Vitae (*Guaiacum sanctum*) was held in Mexico City on October 11-12, 2006. The workshop was organized by the Scientific Authority (CONABIO) with the support of the Management and the Enforcement Authorities, with the main objective of establishing guidelines and coordination mechanisms to promote the conservation and sustainable use of *G. sanctum* in Mexico. To accomplish this, participants (stakeholders from academic, productive and government sectors) focused on: obtaining a first diagnosis of the species at a national level in order to define priority areas for conservation, restoration, and sustainable use; defining general guidelines for the management and sustainable use of the species, trying to strengthen the legal regulations in place; and defining mechanisms for institutional coordination through which there can be a follow-up on the national conservation, use and monitoring programs of wild populations of lignum vitae and its habitat.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF

The demographic studies represent powerful tools to explore the effects of perturbations such as timber harvesting and future population trends. However, to determine these effects it is necessary to complete detailed censuses in the medium or long term. This may take a long time to generate, which is not always possible when concrete recommendations are required in the short term.

The taxonomy of the genus is still unclear and identification problems might appear where *G. sanctum* and *G. coulteri* are both present due to the high degree of similarity between them. If reproductive structures are not present is very difficult to tell them apart. As well, some taxonomists indicate that these species may be hybridize, further complicating their identification. In the Yucatan Peninsula, only *G. sanctum* has been collected. Genetic studies will provide information on the taxonomy of the genus and may help to differentiate populations. However, timber of both species may be practically indistinguishable and illegal logging of *G. coulteri* cannot be ignored as it may be traded as *G. sanctum*.

6. RECOMMENDATIONS

The ecologic information available for *G. sanctum* in Mexico provides insights on the conservation of the species in Mexico and might be used for improving its management and in future non-detriment finding procedures. Simulations suggested that logging of commercial trees (> 35 cm dbh) had a low impact on the population growth rate for a harvesting intensity of <50% of all stems. In contrast, small increases (< 8%) in the mortality rate of non commercial trees (1-25 cm dbh) generated strong negative effects on Ï. Simulations also suggest that an optimum sustainable harvesting regime depends on a combination of very low damage to non commercial trees (2-8 %), low-medium harvest levels (<50%), and rotation periods of 15 years.

The demographic and population dynamic techniques are very time consuming and may take a long time to evaluate the effects of timber harvesting. However, the evaluation of the population structure can be very informative and static studies can be completed. Based on those, the commercial stock and regeneration of the species can be evaluated.

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Non-dentriment finding on *Guaiacum sanctum* in Mexico

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Guaiacum sanctum L. (Zygophyllaceae)

-About 20 m tall and 60 cm DBH
-Shade tolerant species
-Long life cycle
-Low mortality, high reproductive values
-Tropical dry forest from Florida to Central America with heterogeneous distribution
-IUCN (ENC2a), NOM-ECOL (Pr); CITES App II.
-Main threats: habitat lost and harvesting

-Medicinal. Timber species used in the ship building industry

NDF's procedure

- Based on two sources of information
- NDF completed by CONABIO (SA)

Parameters used

1.-Biological criteria

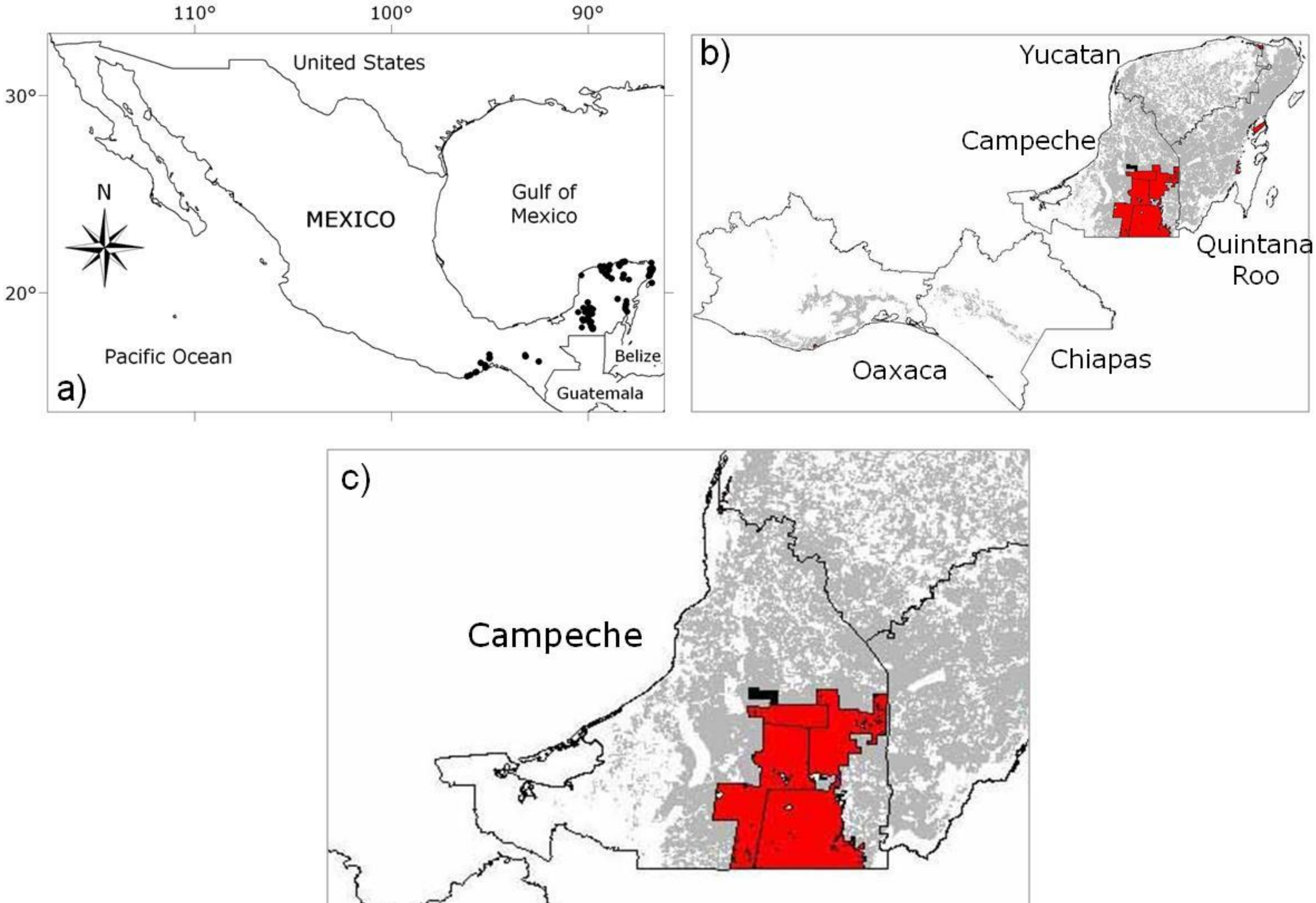
•Distribution and abundance

•Population

i) Population structure
ii) Number of commercial trees per ha
iii) Seed production and recruitment
iv) Growth (dbh and height)
v) Population growth rate (λ)

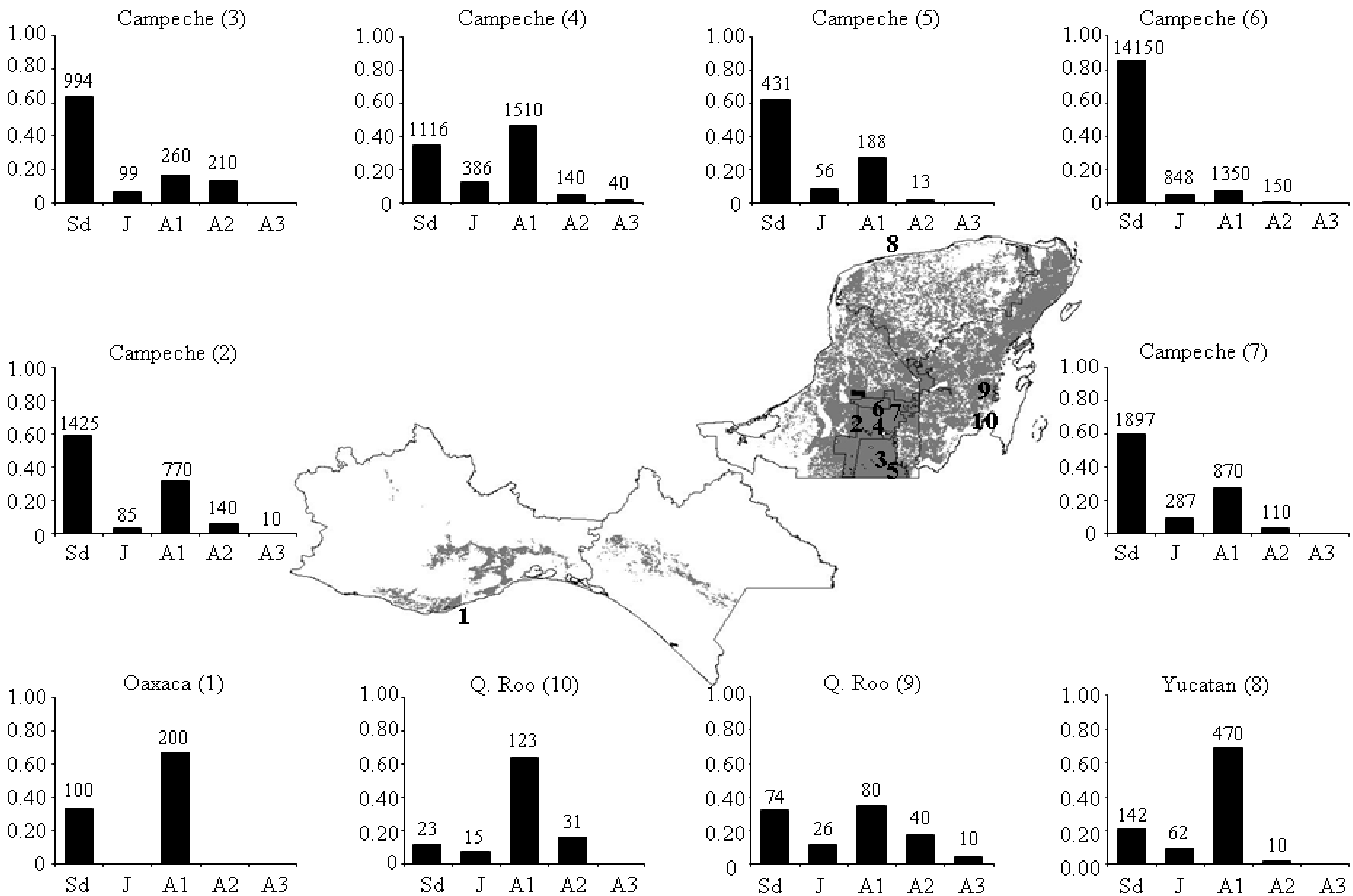
Distribution

- Potential distribution (modelled with GARP)



Abundance

Rapid field assessments



NDF's procedure

Parameters used

2.- Management criteria

i) Model of harvesting
ii) Minimum diameter cutting
iii) Cutting methods
iv) Frequency of harvesting
v) Skid trails (extract logs)

Harvesting matrix model

i) Harvesting commercial adult trees
ii) Damage to non-commercial adult trees
iii) Frequency of harvesting

Effects on:
a) Population growth rate (λ)
b) Number of commercial adult trees for harvesting

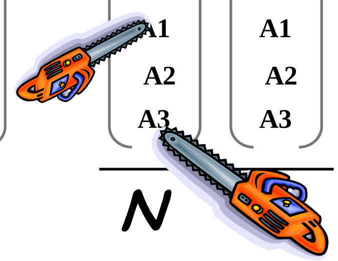
Stage at time t

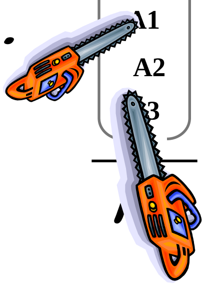
Stage at time $t+1$

$$\begin{array}{c} \\ \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{array} \begin{array}{c} \begin{array}{ccccc} \mathbf{Sd} & \mathbf{J} & \mathbf{A1} & \mathbf{A2} & \mathbf{A3} \end{array} \\ \left(\begin{array}{ccccc} 0 & 0 & F_{13} & F_{14} & F_{15} \\ G_{21} & S_{22} & S_{23} & S_{24} & 0 \\ 0 & G_{32} & S_{33} & S_{34} & S_{35} \\ 0 & G_{42} & G_{43} & S_{44} & S_{45} \\ 0 & 0 & G_{53} & G_{54} & S_{55} \end{array} \right) \end{array} \times \begin{pmatrix} \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{pmatrix} = \frac{\begin{pmatrix} \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{pmatrix} \begin{pmatrix} \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{pmatrix}}{N} \;\cdots\; \frac{\begin{pmatrix} \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{pmatrix}}{N} \frac{\begin{pmatrix} \mathbf{Sd} \\ \mathbf{J} \\ \mathbf{A1} \\ \mathbf{A2} \\ \mathbf{A3} \end{pmatrix}}{N}$$

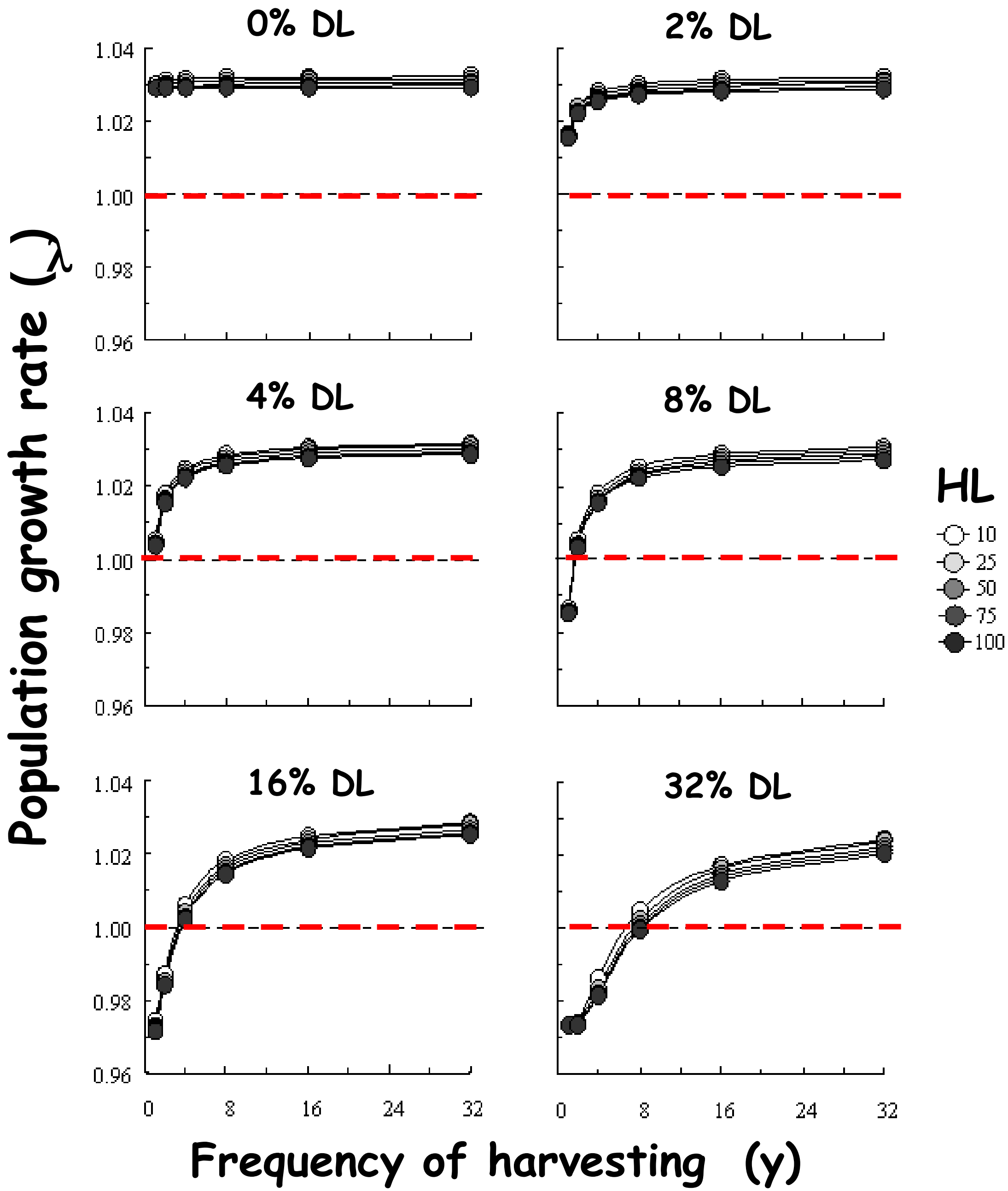
$-\lambda$

$-CT$





Effects on (λ)



Damage to non-commercial tress (1-25 cm dbh) might be more important than harvesting of commercial trees (>35 cm dbh)

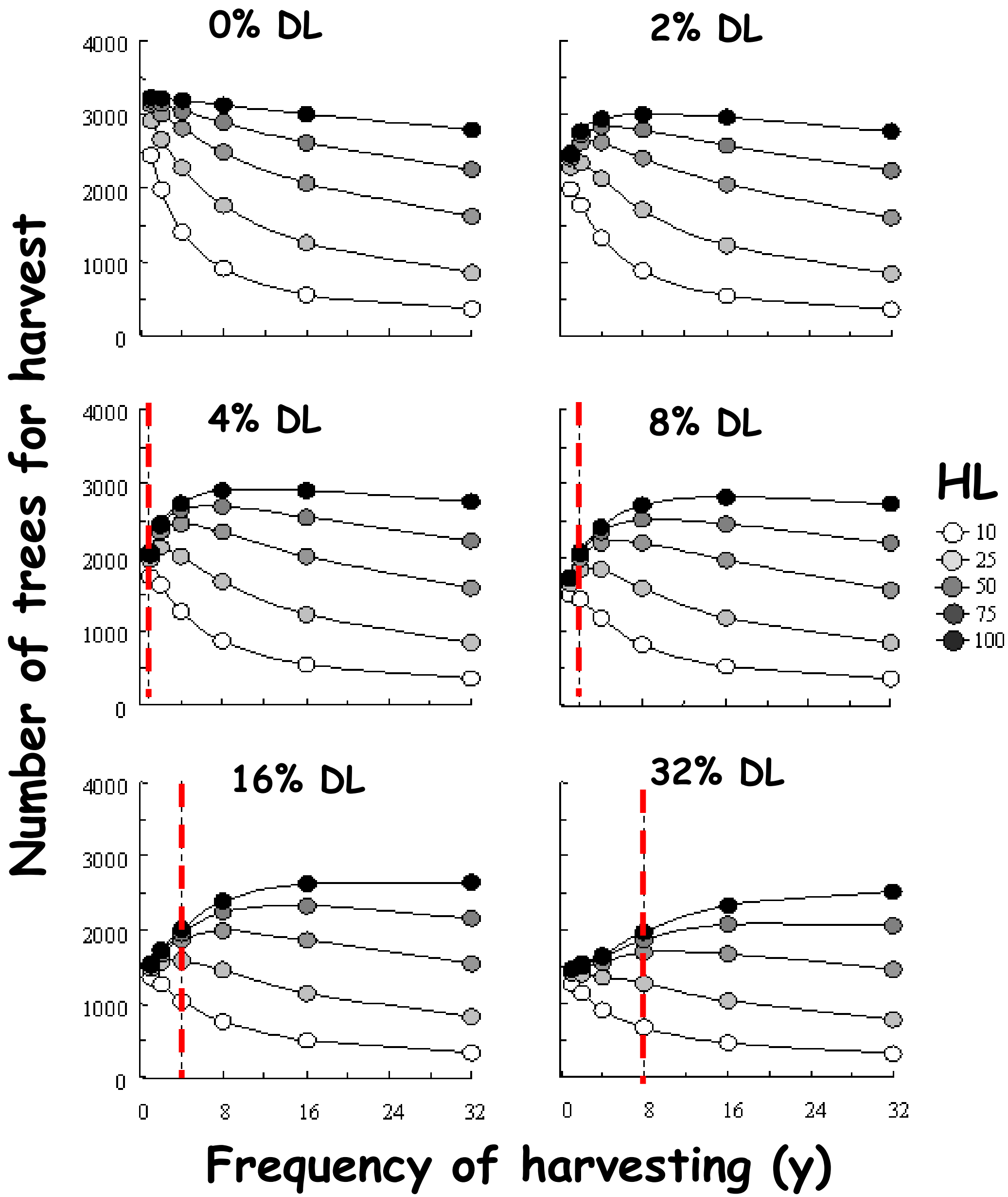
Best scenario

a) DL $\leq$ 8 %

b) Harvesting of commercial trees up to 100% (<50%)

c) At least frequencies > 16 y

Effects on the number of trees



Best Scenario

Damage $\leq$ 8%

Harvesting 50-75%

Frequency $\geq$16 ys

Conclusions

Sustainable use for *G. sanctum* is achievable

-Recruitment of new individuals to population

-Population growth rate > 1

-Minimum diameter cutting 35 cm DBH

-Harvesting intensity $\leq$50 %

-Damage level (non commercial trees) <8%

-Frequency of harvesting $\geq$ 10 ys

-Previous and post-harvesting monitoring of managed populations

-Silvicultural treatments not required

Data quantity and quality

-The best available information in Mexico

-Four years data with a big range of information (geographic, ecologic, genetic)

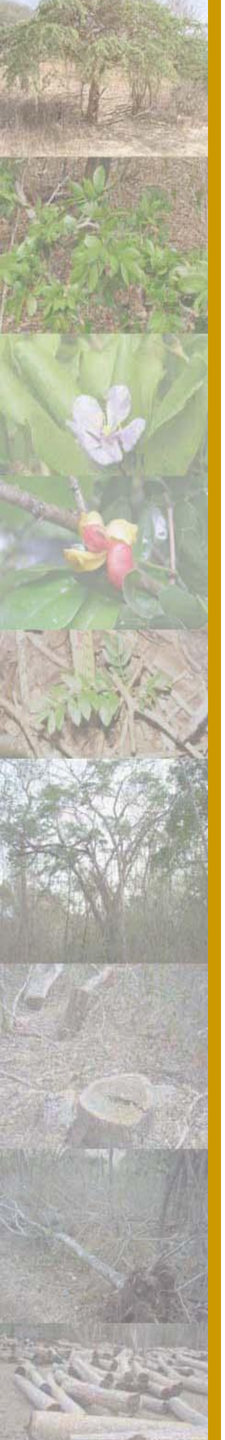
-Information at national level, insights at regional level, very good info at population level

Problems, challenges or difficulties

- Demographics studies are time consuming but population structures might provide good information

- Taxonomy of the genus still unclear

- Impossible to distinguish timber from *G. sanctum* and *G. coulteri*



Acknowledgements

CONABIO

CITES

CIEco UNAM

Empresa Transforesta

Case Study CS8: Evaluation of the Harvest of *Prunus africana* Bark on Bioko (Equatorial Guinea): Guidelines for a management plan.

International Expert Workshop on CITES Non-Detriment Findings

Cancún, Mexico, November 17-22, 2008

Rafael Mª Navarro Cerrillo, Margarita Clemente Muñoz, Alfonso García-Ferrer. University of Córdoba (Spain)

Outline

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Pygeum forests

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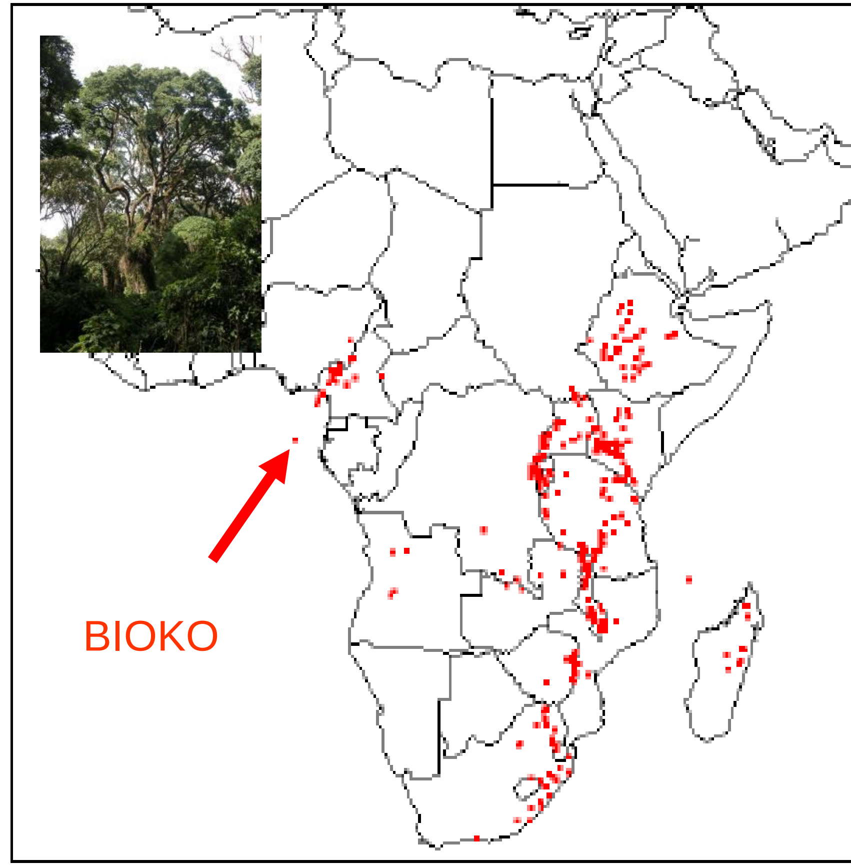
Global distribution of *Prunus africana*

- **Pan-african distribution**: Kenya, Tanzania, Malawi, Uganda, República del Congo, Camerún, Sudáfrica, Zimbabwe, Islas de Madagascar, Gran Comora, Santo Tomé e Isla de Bioko.

- Natural populations grow in afromontane forests with high risk of deforestation.



***Prunus africana* (Hook. f.) Walkman**

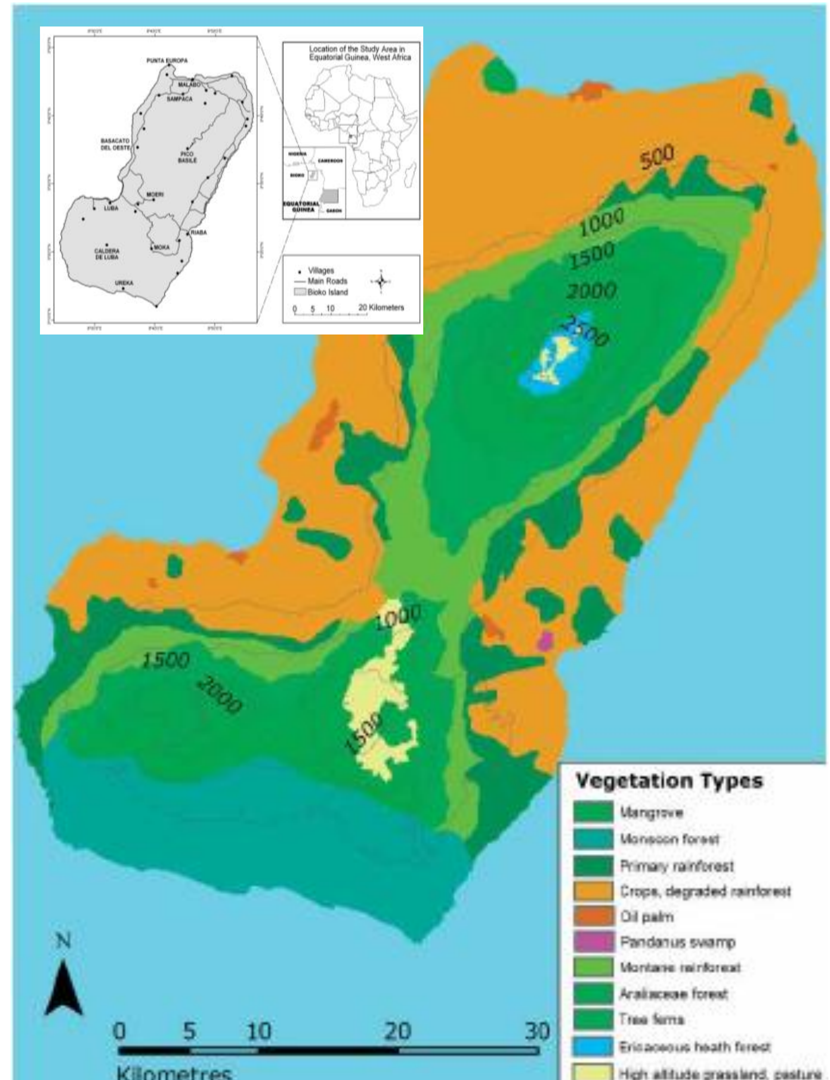
Context

Distribution of *Prunus africana* on Bioko

The Republic of Equatorial Guinea comprises three territories: Rio Muni (26,017 km^2), and the islands of Bioko (2,017 km^2) and Annobon (17 km^2).

Natural populations grow in afromontane forests in the mountains of Bioko Island

Altitude range	Ocaña, 1960	White, 1983	Summary review of potential vegetation types
0-20 m	Coastal drapery of greenery; coconut palms; mangroves	Guineo-Congolian rainforest; mangroves	Coastal Guineo-Congolian rainforest; mangroves
20-(600) 800 m	Equatorial forest; crops; monsoon forest	Guineo-Congolian rainforest	Guineo-Congolian rainforest; crops; monsoon forest
(600) 800 (1000) / 1400-1500 m	Montane rainforest; monsoon forest	Afromontane forest	Lowland afromontane forest: monsoon forest
1400 / 1500-2500 m	Araliaceous forest		Highland afromontane forest (Araliaceae)
2500-2700 m	Ericaceous area	Afromontane shrub area	Afromontane heath forest (Ericaceae)
2700-3000 m	Highland herbaceous prairies	Afromontane herbaceous area	Afromontane herbaceous area



Context

Bark explotation of *Prunus africana* in Bioko

- Use of *Prunus africana* is governed by Equatorial Guinea's Forestry Law of 1995 (EQG/96/002), under an appendix of 1997 that regulates sustainable use of non-timber forest products and harvest of *Prunus africana*.

- In 1999, the Forestry Department of Equatorial Guinea set an annual export quota for *Prunus* bark of 500 tonnes, upon consultation with the CITES Authorities in Malabo (Sunderland and Tako, 1999).

- Commercial harvesting is conducting to overexploited throughout its range and decline of *Prunus africana* forest ecosystems.

Bark of *Prunus africana*

Context

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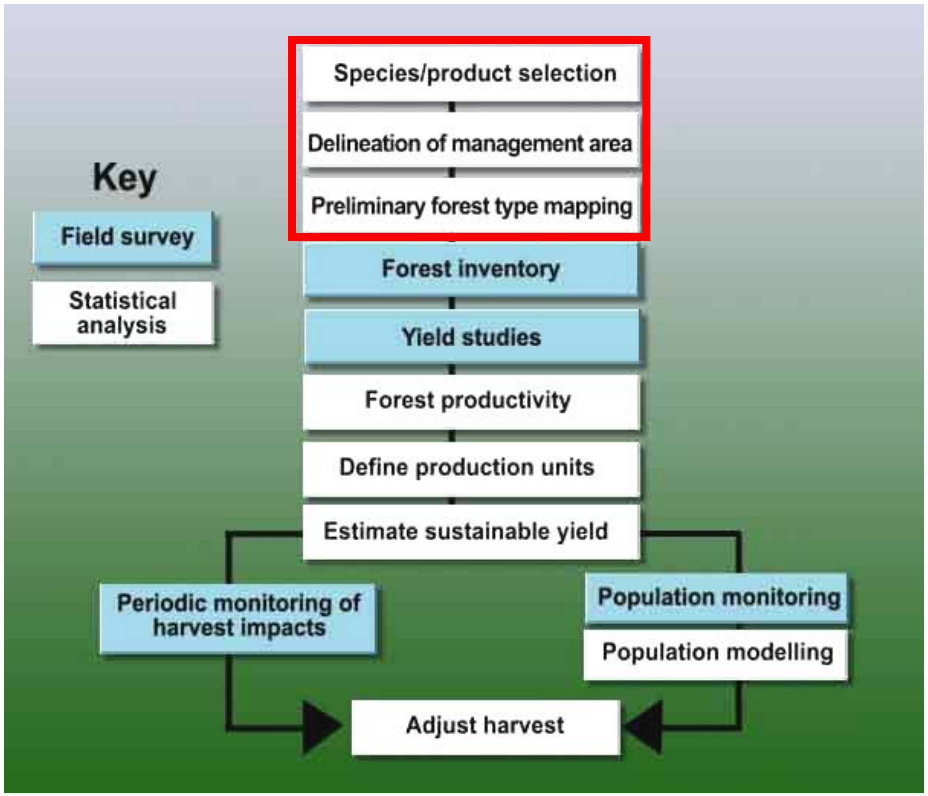
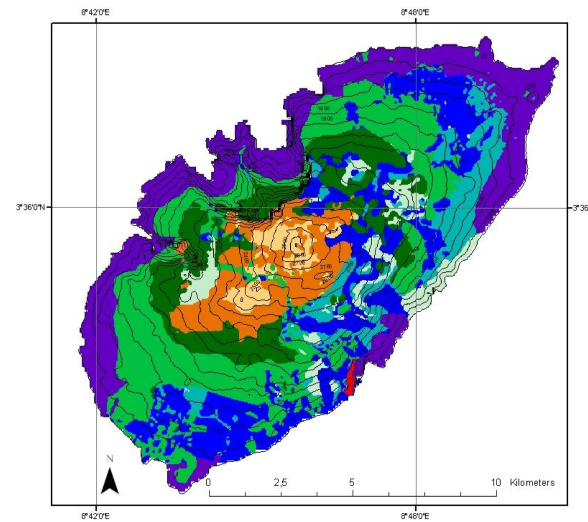


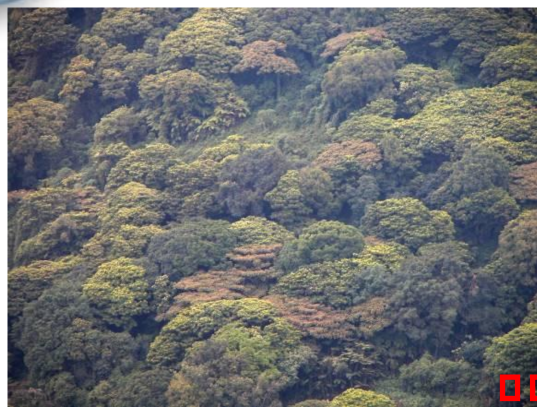


Wong, J L G, Thornber, K and N Baker. 2001. Resource assessment of non-wood forest products: experience and biometric principles. FAO, Rome

Afromountain forests (potential area of *Prunus africana*)

Supervised classification of Bioko Island

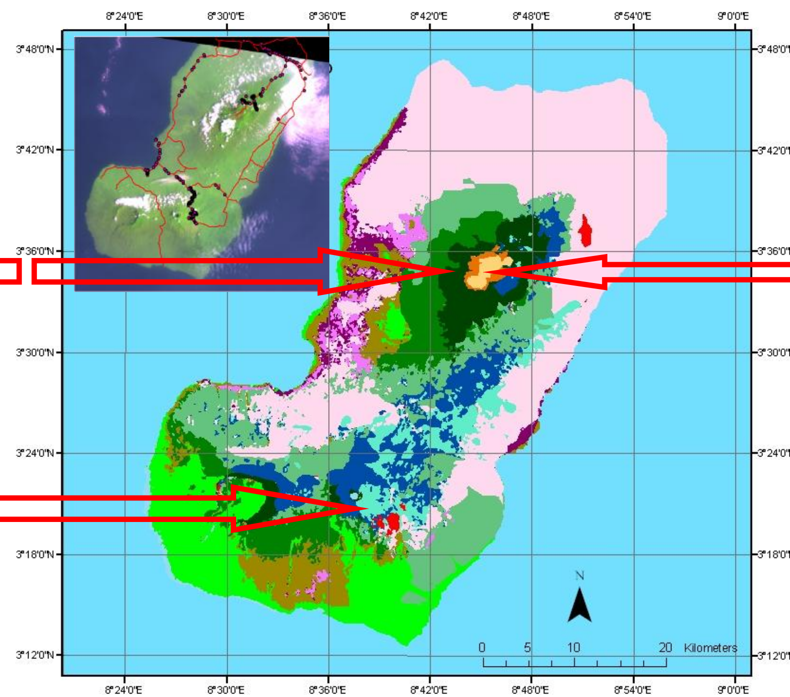
Vegetation types



Afromontane forests (*Araliaceae*)

Grassland (Degraded Afromontane forests)

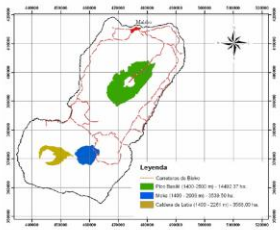
Afromontane shrub lands (*Ericaceae*)

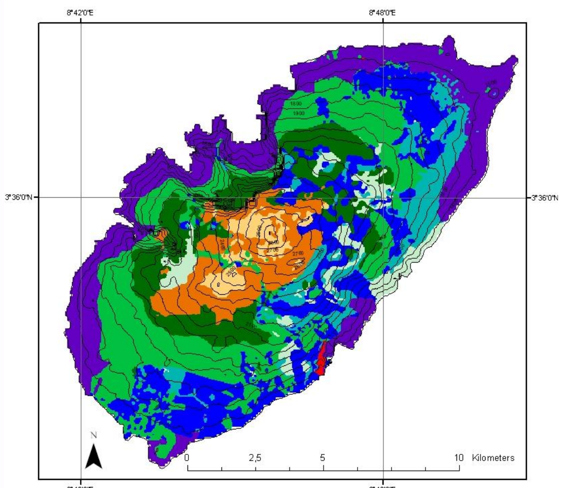


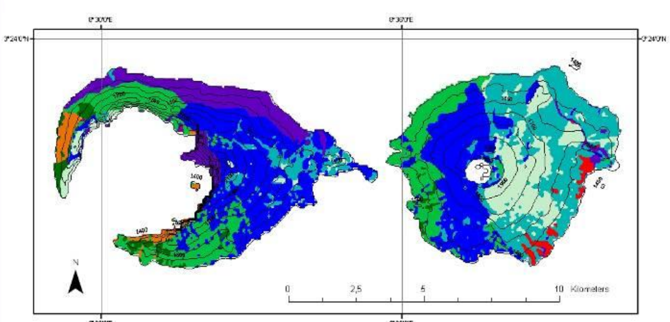
Accuracy 72% (k 0.69)

Altitude range	Ocaña, 1960	White, 1983	Summary review of potential vegetation types
(600) 800 (1000) / 1400-1500 m	Montane rainforest; monsoon forest	Afromontane forest	Lowland afromontane forest: monsoon forest
1400 / 1500-2500 m	Araliaceous forest		Highland afromontane forest (Araliaceae)
2500-2700 m	Ericaceous area	Afromontane shrub area	Afromontane heath forest (Ericaceae)
2700-3000 m	Highland herbaceous prairies	Afromontane herbaceous area	Afromontane herbaceous area

Supervised classification of afromontane forests of Bioko







Vegetation type	Supervised classification (Landsat ETM+ 2003) Pico de Basilé (ha)	Moca and Gran Caldera de Luba (ha)
Guineo-Congolian rainforest mixed with afromontane elements	1568	390
Low afromontane forest	2030	435
Afromontane herbaceous prairies	793	0.5
Afromontane heath shrubbery (Ericaceae)	1131.37	20.25
Grasslands	17	76
Secondary afromontane forest	1735	3443
Herbaceous prairies (degraded afromontane forest)	175	1370
Highland afromontane forest (Araliaceae)	7043	1393
Degraded Guineo-Congolian rainforest	1.5	14
Young Guineo-Congolian rainforest mixed with crops	115	35
Old secondary Guineo-Congolian rainforest	0	0.5
Primary Guineo-Congolian rainforest	0.36	0
Total	14,609.23	7177.25

Accuracy 80% (k 0.81)

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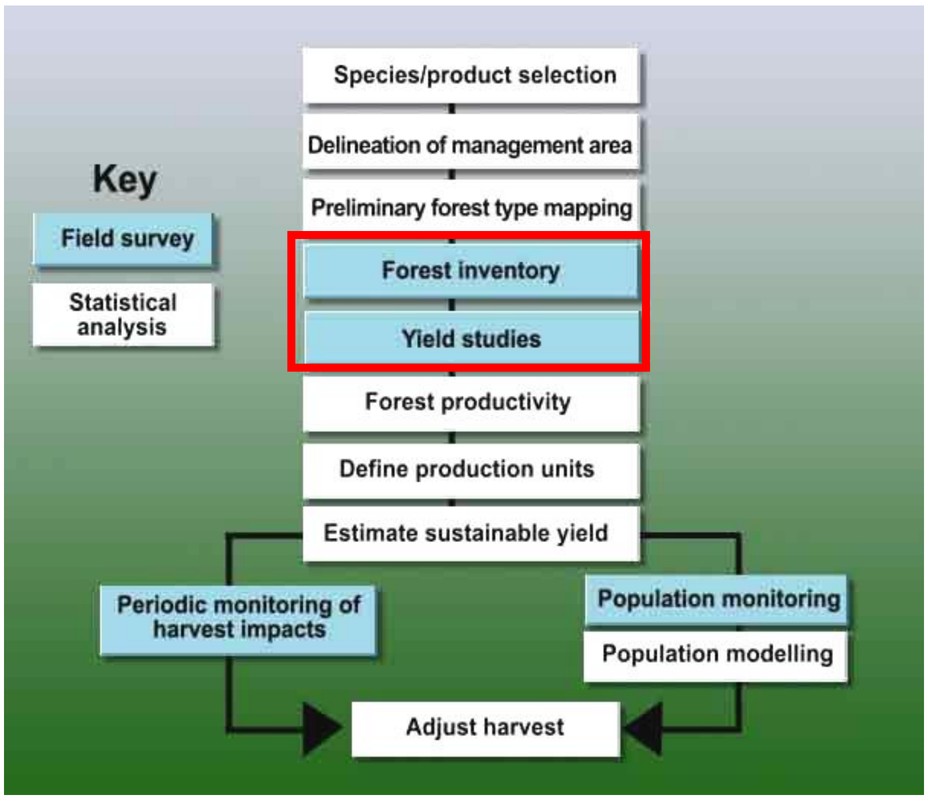
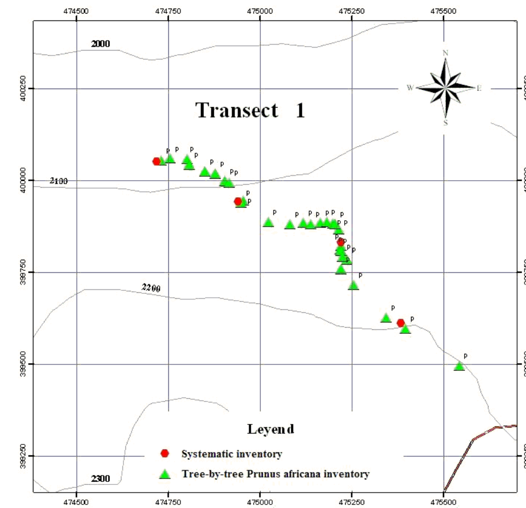


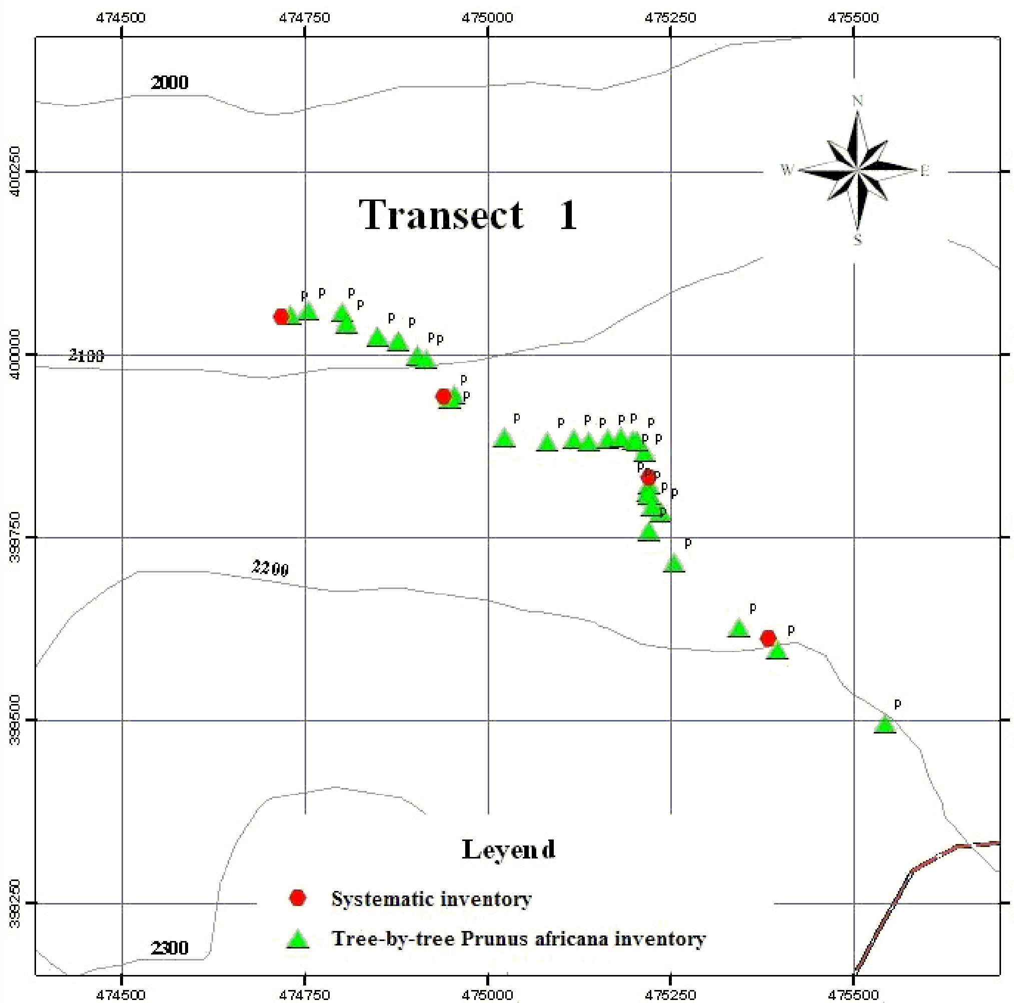


Harvest Area	Yield of the average tree (kg tree^{-1})	Density (stems ha^{-1})	Average dry bark yield by diameter class (kg ha^{-1})*
Pico de Basilé – high area	107.11	15.38	1647.35
Pico de Basilé – low area	115.92	2.65	307.19
Moca – low area	39.68	9.95	394.82
Moca – Monguibus	30.87	5.68	175.34
Moca – Biaó	35.04	6.37	223.21

Forest inventory and population structure of *Prunus africana* forests

Field survey methodology

Prunus africana forests



Systematic and tree survey

1. Number of plots 41

2. Number of trees 264 (Basile, 168; Moka, 96)

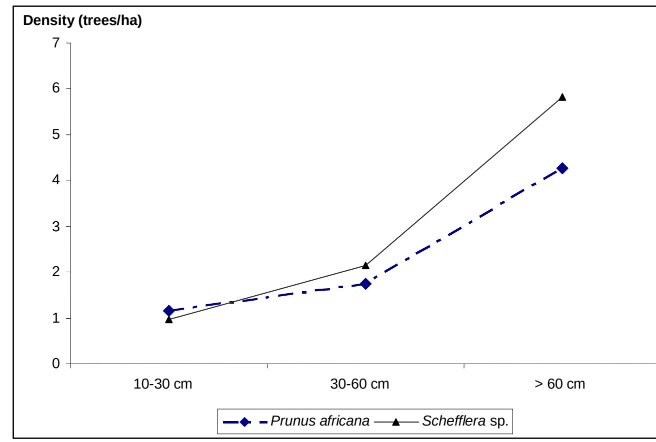
3. Parameters sampled: height (m), DBH (cm) and vertical stand structure.

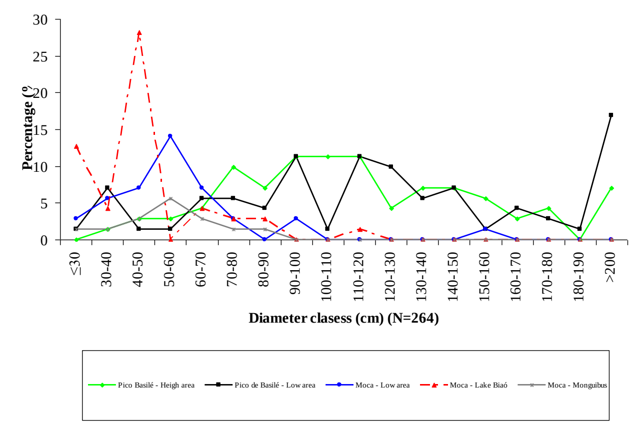
4. Harvesting sampled: bark thickness, bark height, number of harvest.

5. Condition of *Prunus africana* trees in defoliation classes proposed by Sunderland and Tako (1999)

Structural attributes of the vegetation in *Prunus africana* forests by species, showing absolute values for density and basal area (BA)

Taxa	Place	Density (trees/ha)	BA (m^2/ha)
Bersama abyssinica	Moca	4.46	1.43
Crassocephalum mannii	Basilé and Moca	0.39	0.31
Ficus chlamydocarpa var. chlamydocarpa	Moca	1.55	0.46
Ficus sp.	Basilé and Moca	2.72	1.04
Ficus sp.	Basilé	0.39	0.31
Homalium sp.	Moca	0.58	0.26
Hypericum lanceolatum	Basilé and Moca	0.39	0.31
Macaranga spinosa	Basilé	0.58	0.26
Maesa lanceolata	Moca	4.08	1.21
Neboutonia macrocalix	Basilé	6.60	1.91
Nuxia congesta	Basilé and Moca	4.27	1.29
Oxyanthus spp.	Moca	3.49	1.94
Polyscias fulva	Basilé and Moca	2.33	0.51
Prunus africana	Basilé and Moca	7.18	0.94
Psycotria peduncularis	Moca	0.78	0.37
Psycotria sp.	Moca	0.19	0.16
Schefflera spp. (*S. barteri*, *S. mannii*)	Basilé and Moca	8.93	1.65
Trema orientalis.	Basilé and Moca	0.97	0.40
Trichilia prieureana	Basilé	5.05	1.62
Uragoga sp.	Basilé and Moca	0.39	0.22
Xymalos monospora	Moca	2.33	0.87
Zanthoxylun sp.	Moca	0.39	0.22
Other unidentified species (Bubi names)	Basilé and Moca	11.05	5.64
Total Figures		**69.29**	**23.51**





Prunus africana density

Site	Total tree density (trees/ha)	*P. africana* density (trees/ha)	Average stand height (m)	Total tree CCF (%)	*Prunus africana* CCF (%)
Pico de Basilé and Moca	69.29	7.18	24	77.16	14.7

Area	Altitude range (m)	Total density (stems/ha)	*P. africana* density (stems/ha)	Total CCF (%)	*Prunus africana* CCF (%)	Average stand height (m)
Moca	**1429-1997**	**75.79**	**6.82***	**88**	**12**	**23**
Pico Biaó	1833-1997	54.91	6.37	78	13	23
Monguibus	1723-1829	103.45	5.68	96	8	24
Low area	1429-1556	79.58	9.95	100	19	21

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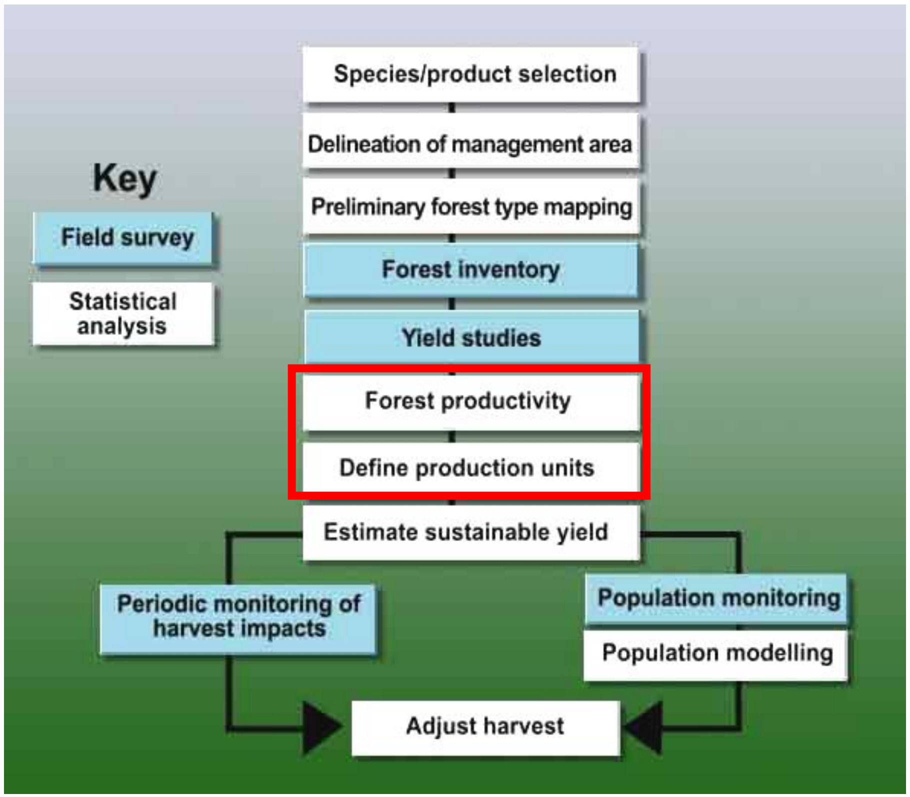


Harvest area	Estimated potential bark yield (t year^{-1}) in unharvested condition, depending on F (nº of years between harvests)		Recommended quota (t year^{-1}) for 2006 following analysis of status in current and new harvest areas	
	F = 10 yrs	F = 8 yrs	F = 10 yrs	F = 8 yrs
Current areas	Current areas	Current areas	Current areas	Current areas
Pico de Basilé highlands	192.38	240.48	0 (bark regeneration period)	0 (bark regeneration period)
Pico de Basilé lowlands	24.4	30.93	0 (bark regeneration period)	0 (bark regeneration period)
Moca lowlands	8.16	10.2	4.8 (2nd harvest)	5.1 (2nd harvest)
Moca Monguibus	1.30	1.62	1.30 (unharvested)	1.62 (unharvested)
Moca Lake Biaó	1.15	1.44	0.58 (2nd harvest)	0.72 (2nd harvest)
Total current areas	**227.73**	**284.49**	**5.96**	**7.35**
New areas	**New areas**	**New areas**	**New areas**	**New areas**
Pico de Basilé (south)	**91.03 (estimated)**	**113.79 (estimated)**	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé (east)	**60.69 (estimated)**	**75.86 (estimated)**	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas	**379.45**	**474.14**	**157.68**	**197**

Production units and estimated yield

Average yield of dry *Prunus africana* bark (kg ha^{-1}) in the different harvest areas

(Hall *et al.*, 2000)	55 Kg. tree^{-1}
(Ndam *et al.*, 2000)	85 Kg. Tree^{-1}
(Walter y Rakotonirina, 1995)	50-200 Kg. Tree^{-1}

Harvest Area	**Yield of the average tree (kg tree^{-1})**	**Density (stems ha^{-1})**	**Average dry bark yield by diameter class (kg ha^{-1})***
Pico de Basilé – high area	107.11	15.38	1647.35
Pico de Basilé – low area	115.92	2.65	307.19
Moca – low area	39.68	9.95	394.82
Moca – Monguibus	30.87	5.68	175.34
Moca – Biaó	35.04	6.37	223.21

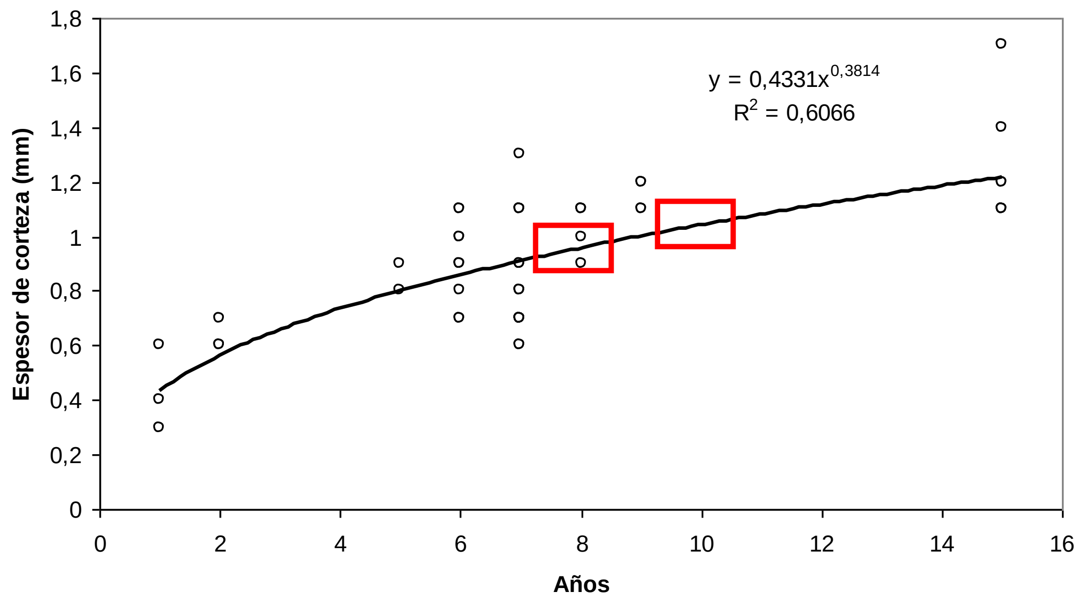
*conversion factor fresh bark/dry bark 0.5

Bark regeneration and extraction

Bark yield

Tabla 16.- Espesores de la corteza (media ± error estándar) de *Prunus africana* obtenidos en función del DAP comparados con los mencionados por Tonye *et al* (2000).

DAP	N	Espesor de corteza (cm.)	Espesor de corteza (cm.) (Tonye *et al.*, 2000)
≤30	4	0,8 (0,05)	
30-40	11	0,96 (0,07)	1,1
40-50	14	1,06 (0,06)	1,2
50-60	9	1,08 (0,07)	1,3
60-70	5	1,22 (0,14)	1,4
70-80	6	1,29 (0,08)	1,5
80-90	-	-	1,5
90-100	3	1,39 (0,06)	1,5
≥100	20	1,59 (0,10)	1,5-1,7



Bark yield

Bark regeneration and extraction

Maximum potential dry bark yield in harvest areas by total surface area, and average dry bark yield

Harvest area	Surface area (ha)	Average dry bark yield by diameter class * (kg ha^{-1})	Maximum potential dry bark yield (t)
Pico de Basilé – high area	1622	1647.35	2672.00
Pico de Basilé – low area	1119	307.19	343.75
Moca – low area	282	394.82	111.34
Moca – Monguibus	103	175.34	18.06
Moca – Biaó	72	223.21	16.07

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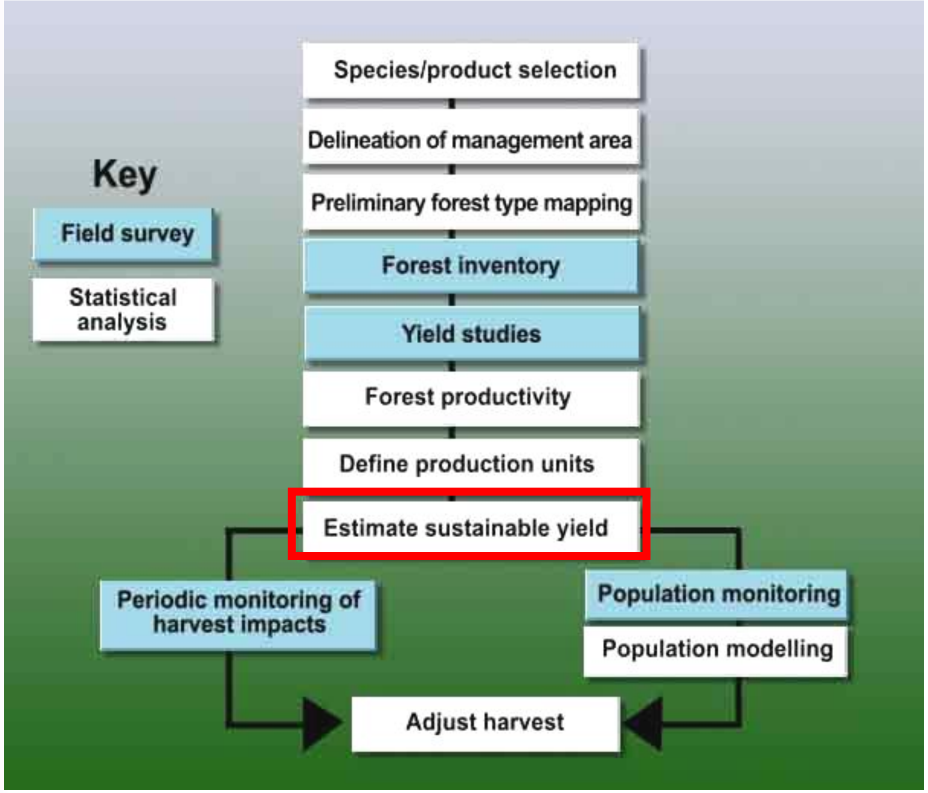


Non detrimental harvesting

Potential annual dry bark yield in current and new proposed harvest areas for return times of F = 10 years and F = 8 years

$$Q = [A \times P \times RME \times Y \times V]\, F^{-1}$$

where: Q = annual quota per management unit (kg of dry material) A = harvest area (ha) P = proportion of area exploited (%) RME = minimum estimated density of *Prunus africana* in the harvest unit (trees ha^{-1}) Y = estimated yield per tree per harvest (kg of dry material per tree) V = proportion of exploitable trees (%) (alive and not over-exploited) F = return times (years)

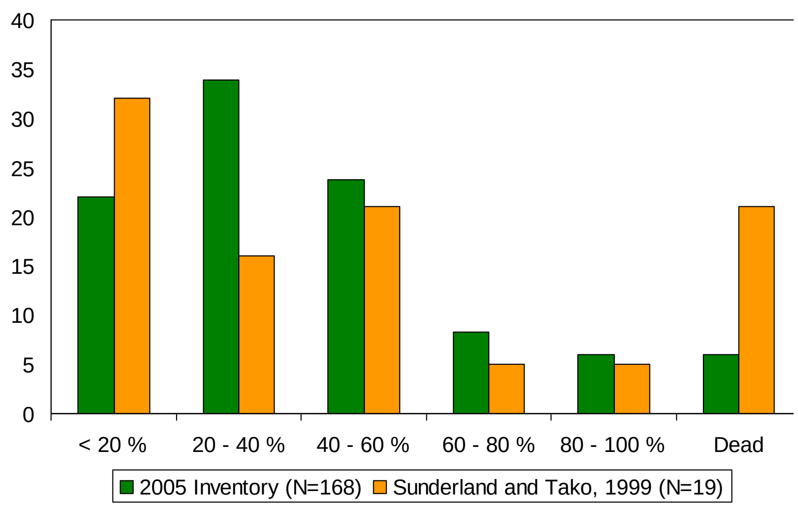
Working area	**A Surface area harvested (ha)**	**P Proportion of area exploited (%)**	**RME *Prunus africana* density (stems ha^{-1})**	**Y Estimated yield per tree (kg tree^{-1})**	**RME x Y Estimated dry bark yield[1] (kg ha^{-1})**	**V Proportion of exploitable trees (%)**	**Estimated potential bark yield[2] (t year^{-1}) in unharvested condition, depending on F (Nº of years between harvests)**	
							F = 10 years	F = 8 years
Current areas							Current areas	Current areas
Pico de Basilé – high area	1622	80	15.38	107.11	1647.35	90	192.38	240.48
Pico de Basilé – low area	1119	80	2.65	115.92	307.19	90	24.74	30.93
Moca – low area	282	80	9.95	39.68	394.82	90	8.16	10.02
Moca – Monguibus	103	80	5.68	30.87	175.34	90	1.30	1.62
Moca – Lake Biaó	72	80	6.37	35.04	223.21	90	1.15	1.44
Total current areas[3]							227.73	284.49
New areas							**New areas**	**New areas**
Pico de Basilé – south area	1500 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé – east area	1000 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas[4]							**379.45**	**474.14**

Current annual dry bark yield in current and new proposed harvest areas for return times of F = 10 years and F = 8 years

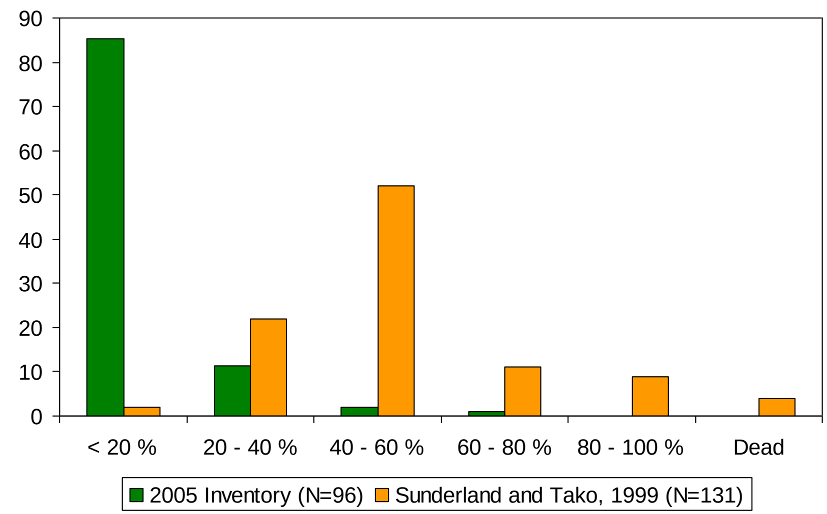
Harvest area	**Estimated potential bark yield ($t\ year^{-1}$) in unharvested condition, depending on F (nº of years between harvests)**		**Recommended quota ($t\ year^{-1}$) for 2006 following analysis of status in current and new harvest areas**	
	F = 10 yrs	F = 8 yrs	F = 10 yrs	F = 8 yrs
Current areas	Current areas	Current areas	Current areas	Current areas
Pico de Basilé highlands	192.38	240.48	0 (bark regeneration period)	0 (bark regeneration period)
Pico de Basilé lowlands	24.4	30.93	0 (bark regeneration period)	0 (bark regeneration period)
Moca lowlands	8.16	10.2	4.8 (2^{nd} harvest)	5.1 (2^{nd} harvest)
Moca Monguibus	1.30	1.62	1.30 (unharvested)	1.62 (unharvested)
Moca Lake Biaó	1.15	1.44	0.58 (2^{nd} harvest)	0.72 (2^{nd} harvest)
Total current areas	**227.73**	**284.49**	**5.96**	**7.35**
New areas	**New areas**	**New areas**	**New areas**	**New areas**
Pico de Basilé (south)	**91.03 (estimated)**	**113.79 (estimated)**	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé (east)	**60.69 (estimated)**	**75.86 (estimated)**	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas	**379.45**	**474.14**	**157.68**	**197**

Detected problems

Damage Caused to Trees as a Result of the Harvest Process



Basile

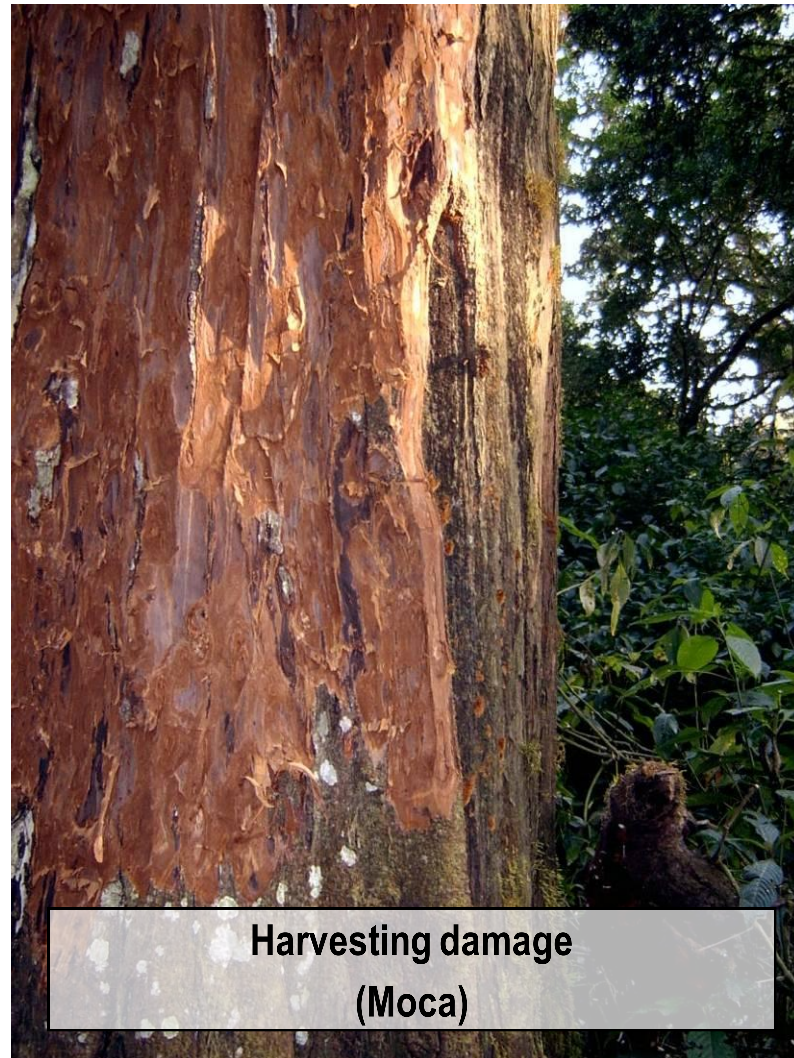


Moca

Damage Caused to Trees as a Result of the Harvest Process

Non detrimental harvesting

Dead tree of *Prunus africana*
(Pico de Basilé)



Harvesting damage
(Moca)

Non detrimental harvesting

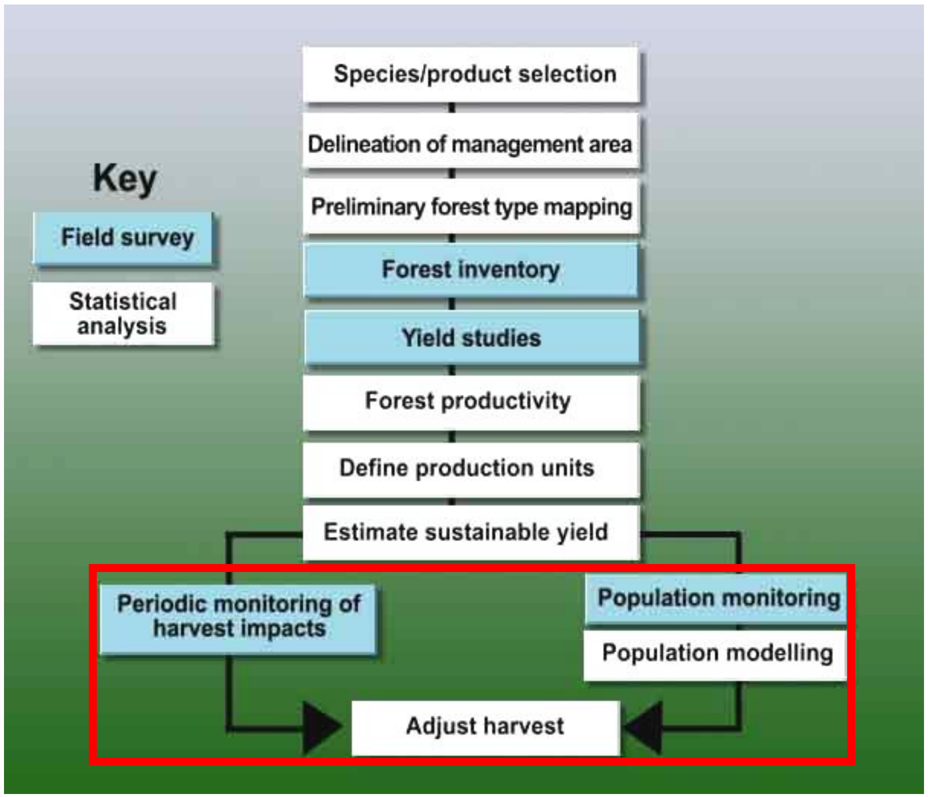
Harvesting techniques and bark regeneration

Tools and techniques

Debarking (peeling) process

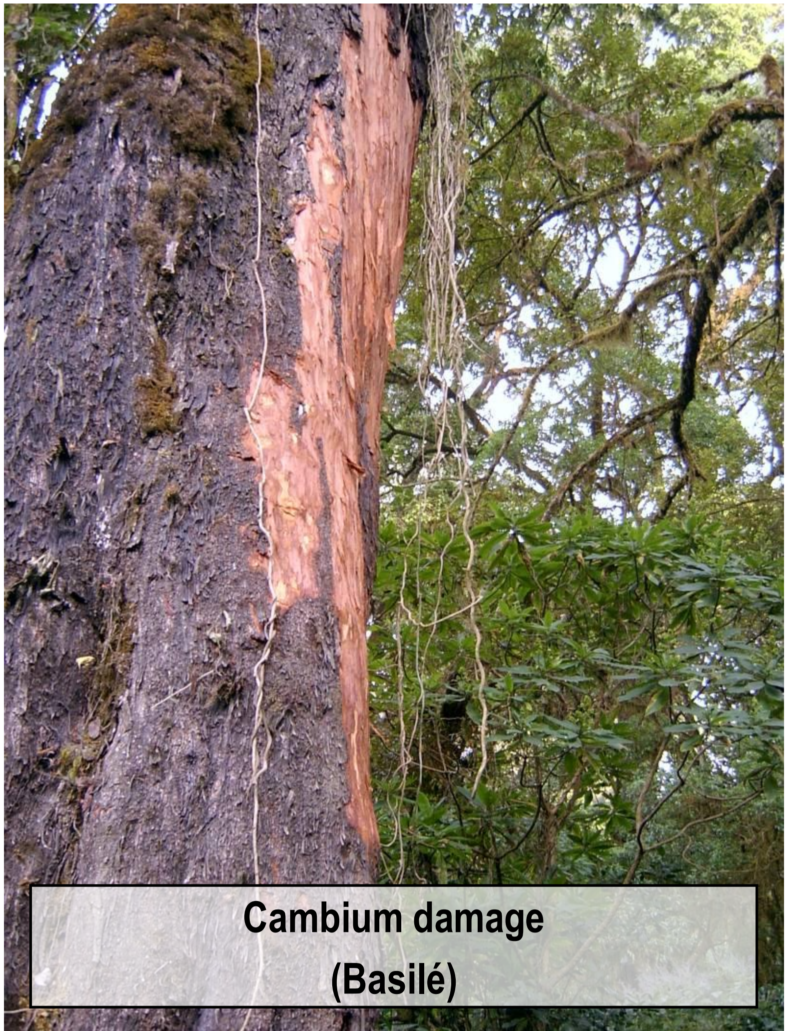

GHANA

Steps of NDF Plan



Monitoring system

Detected problems



Cambium damage
(Basilé)

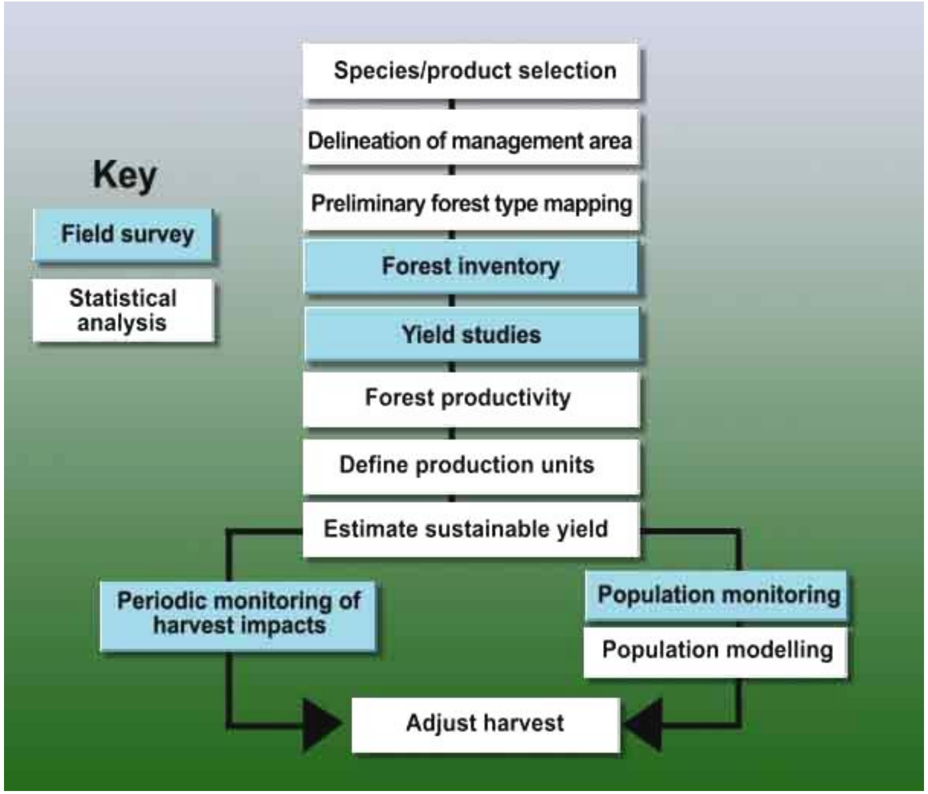
Extraction d<30 cm
(Moca)

Steps of NDF Plan

Germoplasm conservation and agroforestry systems of *Prunus africana*)

Non detrimental harvesting

Steps of NDF Plan



Wong, J L G, Thornber, K and N Baker. 2001. Resource assessment of non-wood forest products: experience and biometric principles. FAO, Rome

Evaluation of the Harvest of *Prunus africana* Bark on Bioko (Equatorial Guinea)

- Guidelines for a Management Plan –

Thank you

Merci beaucoup

Gracias

UNIVERSIDAD DE CÓRDOBA

SETTING EXPORT QUOTAS OF *PRUNUS AFRICANA*: GUIDELINES FOR A NDF PLAN

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BACKGROUND

At its 16th meeting (PC16, Lima, July 2006), the Plants Committee categorized *Prunus africana* from Burundi, Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Kenya, Madagascar and the United Republic of Tanzania as 'of urgent concern'. In consultation with the Secretariat, it formulated recommendations with deadlines for their implementation. These were transmitted to the range States concerned by the Secretariat in August 2006.

At that same meeting, the Plants Committee established an intersessional working group on *Prunus africana* with the task of providing guidance to relevant range States on the implementation of the Plants Committee's recommendations for this species. The Terms of Reference of the working group are described in the PC16 summary record. A workshop involving the Scientific Authority and Management Authority from the relevant range States is planned for September 2008 to assist with implementation of the recommendations. The workshop is being held thanks to financial support from France, Germany, Italy and Spain.

Based on the responses received, and in consultation with the PC Chairman, the Secretariat has made a determination regarding compliance with the PC recommendations by the range States concerned. This determination is summarized as follows and includes recommendations to the Standing Committee.

Burundi (BI)

Within 3 months (November 2006)

a) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, establish a conservative quota for export of *P. africana* bark and other parts and derivatives exported.

b) Clarify reported exports of extract which are likely to be powder, and inform the Secretariat of any facilities to produce extract within the country.

Within 1 year (August 2007)

c) Carry out a preliminary inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific monitoring system of the harvested and unharvested *P. africana* populations.

d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.

e) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

f) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

The MA of BI reported to the Secretariat on 20 November 2006 that only one company exports *P. africana* bark but that investigations had found that the bark had been illegally entering the country from the Democratic Republic of the Congo. Consequently, the MA of BI has advised that they have temporarily stopped all exports and that a zero export quota has been imposed. The quota is to remain in place until inventories of *P. africana* are completed within BI.

Conclusion

Some action towards the full implementation of these recommendations has been undertaken but further updates on progress are required. The zero quota is as an interim measure pending a preliminary inventory, but the remaining recommendations are to be implemented.

Recommended action

If BI seeks to recommence exports of products of this species, it should first provide information to the Secretariat on how the Plants Committee recommendations have been implemented.

Cameroon (CM)

Within 3 months (November 2006)

a) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, review their current export quota and establish a conservative reduced quota for export of *P. africana* parts and derivatives.

b) Clarify whether they have a working facility to process and export extract, in addition to bark and powder and inform the Secretariat of what parts and derivatives they plan to export (bark, powder, extract).

Within 1 year (August 2007)

c) To complement work already carried out on Mount Cameroon, in other areas subject to harvest, carry out a inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific monitoring system of the harvested and unharvested **P. africana** populations.

d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.

e) The MA of CM should collaborate with the MA of Nigeria to enhance the monitoring of trade in *P. africana* between CM and Nigeria.

f) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

g) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

The MA of CM reported to the Secretariat on 17 November 2006, 11 September 2007 and 3 January 2008.

Export quotas of 2,000 tonnes established for 2005, 2006 and 2007 were conservative in their view and were in the event far from fully utilized. The export quota for 2008 was reduced to 1,000 tons pending the results of inventories, which still require funding. The MA notes that, in addition to this 1,000 ton quota, there are accumulated stocks that will have to be taken into account. The current harvest and export quotas of *P. africana* are based on only two production sites.

Regarding recommendation b), the MA explained that CM does not have facilities to produce extract from the bark of *P. africana*. CM only exports bark or powder.

Inventories have been carried out at two sites: Mont Cameroon and in one part of Adamaoua province. Lack of funding has prevented inventories being undertaken in other areas. The MA recognized the need to undertake inventories at other sites and explained that available data from these do not differ much from the established export quota and that the export quota would certainly increase if inventories were done at all production sites.

The MA explained that currently it was not in a position to establish a rigorous harvest and export quota but it called for international cooperation in this regard.

No information has been received concerning collaboration with Nigeria.

CM submitted a package of information which was reported on orally at the meeting.

Conclusion

Some action towards the implementation of these recommendations has been undertaken but further progress is required. Efforts have been made to set a conservative quota based on two production areas only and, more recently, a 50 %

reduction in the past quota has been applied as per recommendation a). However, preliminary inventories are required for all production sites for the quota to be more reliably set as per recommendations c) and d). At the time of preparing this document, no information on recommendations e), f) or g) had been provided.

Recommended action
The deadline for full implementation of all the Plants Committee's recommendations should be extended until 31 December 2008. If these are not implemented to the satisfaction of the Secretariat and Chairman of the Plants Committee, the Standing Committee should recommend that all Parties suspend trade in all specimens of *Prunus africana* from CM until that country demonstrates compliance with Article IV, paragraphs 2 (a) and 3, for this species, and provides full and detailed information to the Secretariat regarding the compliance with the recommendations of the Plants Committee.

Democratic Republic of the Congo (CD)

Within 3 months (November 2006)

a) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, review their current export quota and establish a conservative reduced export quota for export of *P. africana* parts and derivatives exported.
b) Clarify reported exports of extract which are likely to be powder, and inform the Secretariat of any facilities to produce extract within the country.

Within 1 year (August 2007)

c) Carry out a preliminary inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed produ-

The MA of CD reported to the Secretariat on 24 September 2007 that *P. africana* was a rather common species in five of the 11 provinces of CD. Nevertheless, no inventories have been done by the SA because there are no funds to do so and the area of distribution of the species is located in war zones. The SA set the export quota on *P. africana* based on information provided by users and confirmed by the environmental services in the provinces. Considering the recommendations by the Plants Committee and the exports of the last three years, the SA recommended the reduction of the export quota to 600 tons per year, but the export quota notified to the Secretariat and published on the CITES website remains at 1,000 tons. The MA reported that exports were of bark since there were cing trees, and establish a scientific monitoring system of the harvested and unharvested *P. africana* populations.

d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.

e) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

f) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

no facilities to produce powder specimens.The MA had some data provided by users of the species who reported on their inventory of exploitation. These data were to be verified by both the SA and the MA before being communicated to the CITES Secretariat.

Conclusion

Little progress has been made in complying with the recommendations.

Recommended action

The deadline for full implementation of all the Plants Committee's recommendations should be extended until 31 December 2008. If these are not implemented to the satisfaction of the Secretariat and Chairman of the Plants Committee, the Standing Committee should recommend that all Parties suspend trade in all specimens of Prunus africana from DRC until that country demonstrates compliance with Article IV, paragraphs 2 (a) and 3, for this species, and provides full and detailed information to the Secretariat regarding compliance with the recommendations of the Plants Committee.

Equatorial Guinea (Bioko Island) [GQ]

Within 3 months (November 2006)

a) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, establish a conservative quota for export of *P. africana* bark and other parts and derivatives exported. This quota should be based on results of studies conducted in the new harvesting areas.

b) Clarify reported exports of extract which are likely to be powder, and inform the Secretariat of any facilities to produce extract within the country.

The MA of GQ reported to the Secretariat on 30 August 2006 that once other production areas were opened and a non-detriment finding had been completed, they proposed to establish an annual export quota of 197 tons of bark and derivatives.

Conclusion

Little progress has been made in complying with the recommendations.

Recommended action

The deadline for full implementation of all the Plants Committee's recommendations should be extended until 31 December 2008. If these are not implemented to the

Within 1 year (August 2007)

c) Carry out a preliminary inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific monitoring system of the harvested and unharvested *P. africana* populations.
d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.
e) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

f) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

satisfaction of the Secretariat and Chairman of the Plants Committee, the Standing Committee should recommend that all Parties suspend trade in all specimens of *Prunus africana* from GQ until that country demonstrates compliance with Article IV, paragraphs 2 (a) and 3, for this species, and provides full and detailed information to the Secretariat regarding compliance with the recommendations of the Plants Committee.

Kenya (KE)

Within 3 months (November 2006)

a) The MA should report to the Secretariat the result of its actions to implement the provisions of Article IV, and how the SA determines that levels of export are not detrimental to the populations concerned.
b) Clarify reported exports of extract which are likely to be powder, and inform the Secretariat of any facilities to produce extract within the country.
c) Clarify whether wood or plywood of *P. africana* is or is likely to be exported from Kenya.
d) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, establish a conservative quota for export of *P. africana* bark and other parts and derivatives exported.

On 18 November 2006, KE advised the Secretariat that concerns about increased exports of *Prunus* bark without scientific undertaking resulted in the MA declaring a moratorium on the issuance of export permits in 2002. However, permits to export two shipments of *Prunus* bark were issued in 2003.

All exports of *P. africana* authorized by KE have been of bark. The MA strongly feels that the data in the CITES trade database showing exports of extracts from KE is erroneous.

KE is in the process of undertaking non-detriment finding studies on *P. africana* and establishing sustainable harvesting levels. The Scientific authorities will be supporting a PhD student to undertake detailed studies on the species. The findings will guide the MA and the Scientific Authorities in

Within 1 year (August 2007)

e) Carry out an inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific monitoring system of the harvested and unharvested *P. africana* populations.
f) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.
g) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.
h) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

making scientifically informed decisions regarding setting of harvesting and export quotas on the species. The moratorium on harvesting from the wild for export purposes will continue to be in force until the non-detriment finding studies are completed and recommendations made.

Conclusion

Some action towards the full implementation of these recommendations has been undertaken but further progress is required if exports are to recommence.

Recommended action

If KE seeks to recommence exports of products of this species, it should first provide information to the Secretariat on how the Plants Committee recommendations have been implemented.

Madagascar (MG)

Within 3 months (November 2006)

a) Report to the Secretariat on the implementation of the National Action Plan for sustainable production of P. africana and how this contributes to its SA's determination that levels of export are not detrimental to the populations concerned.
b) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, establish a conservative quota for export of *P. africana* bark and other parts and derivatives exported.

Within 1 year (August 2007)

c) Update their inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific monitoring

The MA of MG reported to the Secretariat on 16 November 2006 and 19 March 2008. The MA explained that there was a moratorium currently in place until inventories were completed and an export quota could be set. It reported work done in recent years, including the establishment by Ministerial decree of a coordination committee chaired by the Director General at the National Forestry Commission; a National Plan of Action for the Sustainable Management of *P. africana*; the creation of communication products; and regulations for *P. africana*. After a public tender process, two inventoried lots in the Sofia region had been allocated to a company for exploitation. The company completed an Environmental Impact Assessment, which was approved, and an environmental licence was granted subject to conditions. The process for issuing an exploitation licence under the new regulations is system of the harvested and unharvested *P. africana* populations.

d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.

e) The MA should report to the Secretariat the result of its actions to implement the provisions of Article IV, and the current means by which the SA determines that levels of export are not detrimental to the populations concerned.

f) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

g) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

being finalized.The new licence will also be the subject of a test for tracing the origin of products within the system. Research activities underway include acquisition of knowledge of the biology and ecology of *P. africana* and also a study on the genetic and chemical diversity of the species. A small scale experiment on vegetative propagation of *P. africana* is underway with early positive results.

Conclusion

Action towards the implementation of these recommendations has been undertaken, but further progress is required before a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take can be established.

Recommended action

If MG seeks to recommence exports of products of this species, it should first provide information to the Secretariat on how the Plants Committee recommendations have been implemented.

United Republic of Tanzania (TZ)

Within 3 months (November 2006)

a) In consultation with the CITES Secretariat and the Chairman of the Plants Committee, establish a conservative quota for export of *P. africana* bark and other parts and derivatives exported.

b) Clarify reported exports of extract which are likely to be powder, and inform the Secretariat of any facilities to produce extract within the country.

Within 1 year (August 2007)

c) Carry out a preliminary inventory of standing stock, establish estimates of sustainable off-take, taking into account the need to conserve large seed-producing trees, and establish a scientific

TZ responded to the recommendations in a letter of 24 April 2008. The letter indicates that some steps have been taken to implement the recommendations, including that only part of the bark of trees over 40 years old are harvested and no trees are felled in the process of collecting bark. The letter reports that the United Republic of Tanzania is looking forward to implementing the Plants Committee recommendations. The letter indicated that a stock assessment would be undertaken over the next 2 months.

Conclusion

It appears that little progress has been made in implementing the recommendations of the Plants Committee.

monitoring system of the harvested and unharvested *P. africana* populations.

d) Establish a revised conservative export quota based on the inventory of standing stock and the estimates of sustainable off-take.

e) Provide a timetable to carry out peer-reviewed ecological studies and appropriate population modelling of *P. africana* in order to establish a long-term management plan for the sustainable use of this species.

Within 2 years (August 2008)

f) The Management and Scientific Authorities should report to the Secretariat the final version of the long-term management plan and progress made against that plan.

Recommended action

The deadline for full implementation of all the Plants Committee's recommendations should be extended until 31 December 2008. If these are not implemented to the satisfaction of the Secretariat and Chairman of the Plants Committee, the Standing Committee should recommend that all Parties suspend trade in all specimens of *Prunus africana* from TZ until that country demonstrates compliance with Article IV, paragraphs 2 (a) and 3, for this species, and provides full and detailed information to the Secretariat regarding compliance with the recommendations of the Plants Committee.

The recommendations were supported by the Standing Committee (July, 2008).

OBJECTIVE: ESTABLISHMENT OF THE LONG TERM NON-DETRIMENT FINDINGS PLAN

A management model for Non-Timber Forestry Resources (NTFR) formed the basis for the proposed methodology, which was designed to prepare the necessary guidelines for implementation of a Non-detriment Findings Plan for the species on Bioko (Equatorial Guinea).

The guidelines provided are the culmination of a series of stages in work oriented towards evaluating the forest resource: *Prunus africana* specimens and their current status following bark-harvesting activities.

In recent years, great effort has gone into proposals of management plans for sustainable use of *Prunus africana* in several Range States. However, integral methodology must be established to evaluate the current situation, to know whether bark harvest is suitable or whether it is affecting the conservation status of the species, and propose corrective measures as needed to achieve sustainable use. The study was devised as a pilot project, covering a pre-selected area under 150,000 ha in Equatorial Guinea; it could give rise to a survey model and be applicable to other countries.

The general goal of the project was to determine the potential and current range of *Prunus africana* on Bioko. Based on this range data, stocks could be assessed, bark harvest evaluated, and proposals made with necessary recommendations to consider in drawing up a management plan for sustainable use of the species. The following specific objectives were established to achieve the general goal (Figure 1):

1 Survey of the distribution of dominant types of vegetation by means of remote sensing
2 Characterisation of the forests where Prunus africana occurs in current and potential harvest areas, in terms of their structure, species composition and diversity of tree species
3 Estimate of bark yield, and
4 Establishment of silvicultural criteria for sustainable use of Prunus africana forests

Figure 1 and 2 summarises a framework to establish national quota of *P. africana*. This outline is synoptic of the main results and conclusions of Equatorial Guinea project to guide possible improvements and final recommendations for consideration in designing a National Management Plan.

This practical case has been organized as a questionnaire following a methodology proposed by ISSC-MAP:

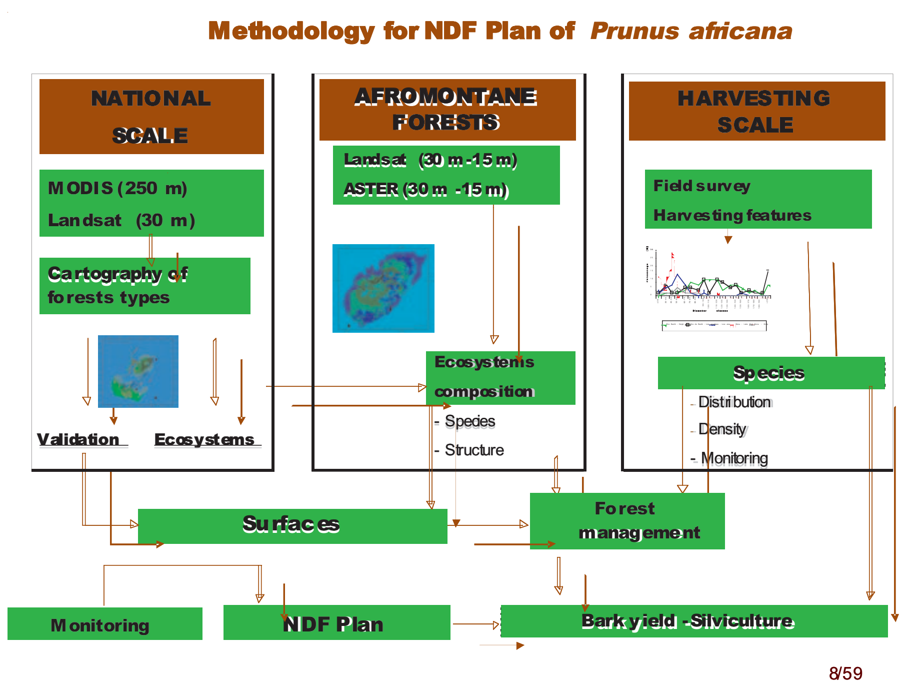


Figure 1. Framework to establish national quota of *P. africana*

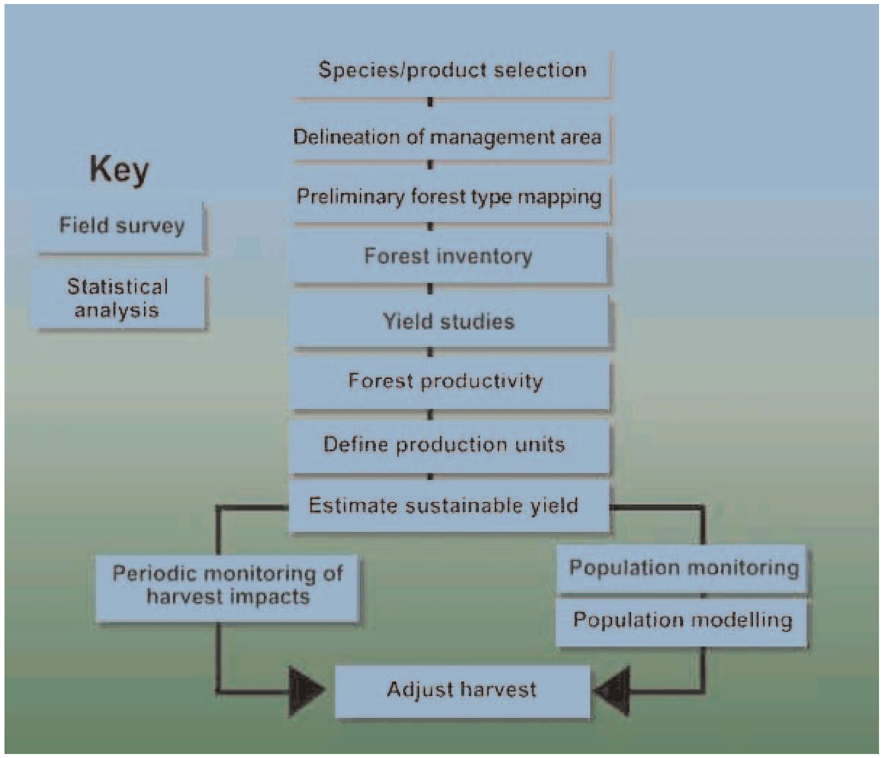
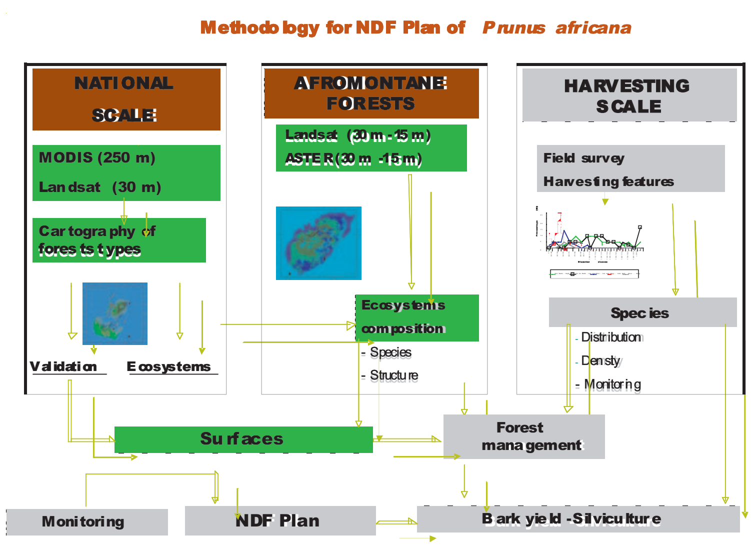


Figure 2. Stages of a modular management strategy for sustainable harvest of non-timber forest products (adapted from Wong, 2000)

WONG, J L G, THORNBER, K and N Baker. 2001. Resource assessment of non-wood forest products: experience and biometric principles. FAO, Rome

STEP 1: Definition and Preliminary Mapping of Distribution Areas



1.1 NATIONAL DISTRIBUTION OF THE SPECIE

Objective 1. National forest cartography

Survey of the distribution of the dominant vegetation types at National level by means of remote sensing and additional sources.

Evaluation of national distribution of dominant types of forests

- Is there a Governmental Department in charge of Natural Resources Evaluation and cartography (Geographic Information System and Remote Sensing Laboratory)?
- Is there a forest national cartography available? If yes, which is the map scale? Which is the data format (paper map, digital, etc.) ?[Example, Figure 3]
- Is this information accessible?
- Is this cartography based on field surveys? is it possible to access to a vegetation description of the forest types?

Sources of information:

Spatial data infrastructure (www.gsdi.org) African cartography ww.kew.org/giswww/website/mad/madveg)African cartography (www.africover.org/webmap)

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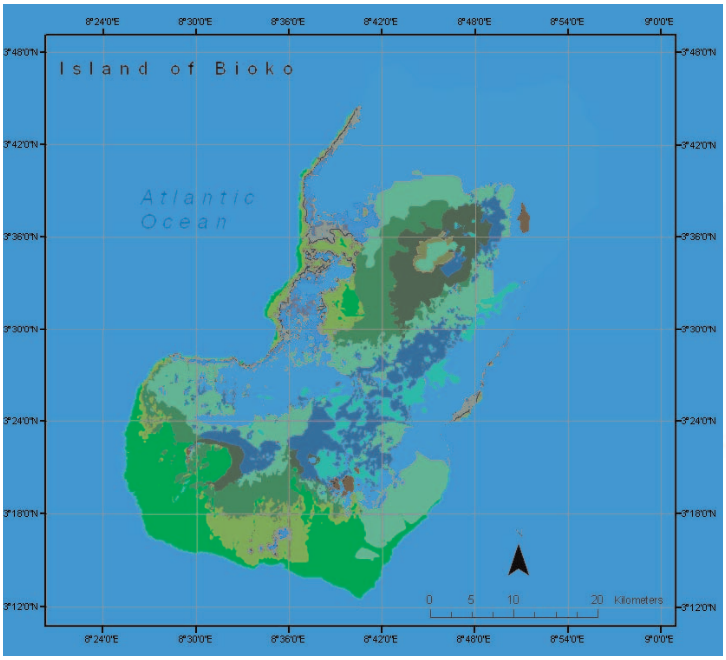
White, F. (1983). The Vegetation of Africa. UNESCO Natural Resources Research, 20: 1-356.



Altitude range	Ocaña, 1960	White, 1983	Summary review of potential vegetation types
(600) 800 (1000) / 1400-1500 m	Montane rainforest; monsoon forest	Afromontane forest	Lowland afromontane forest: monsoon forest
1400 / 1500-2500 m	Araliaceous forest		Highland afromontane forest (Araliaceae)
2500-2700 m	Ericaceous area	Afromontane shrub area	Afromontane heath forest (Ericaceae)
2700-3000 m	Highland herbaceous prairies	Afromontane herbaceous area	Afromontane herbaceous area

Figure 3. - Vegetation Map of the Bioko Island (Equatorial Guinea)

Results of National distribution of the specie

Task 1 Range States of *Prunus africana*, summarizing the available cartography. Source of information must be included as well as data format (paper, report, scientific paper, computer format).

1.2 REGIONAL DISTRIBUTION OF THE SPECIE

Objective 2. National forest cartography

Survey of the distribution of forest types where Prunus africana exists by means of remote sensing and additional sources.

- Is there detail cartography of forests with current (or potential) distribution of Prunus africana forests?
- If yes, what is the scale? How recent is this assessment?) [Example, Figure 4]
- Have the cartography been based on field populations assessments? (Field survey, botanical collection data, etc.)?

Sources of information:

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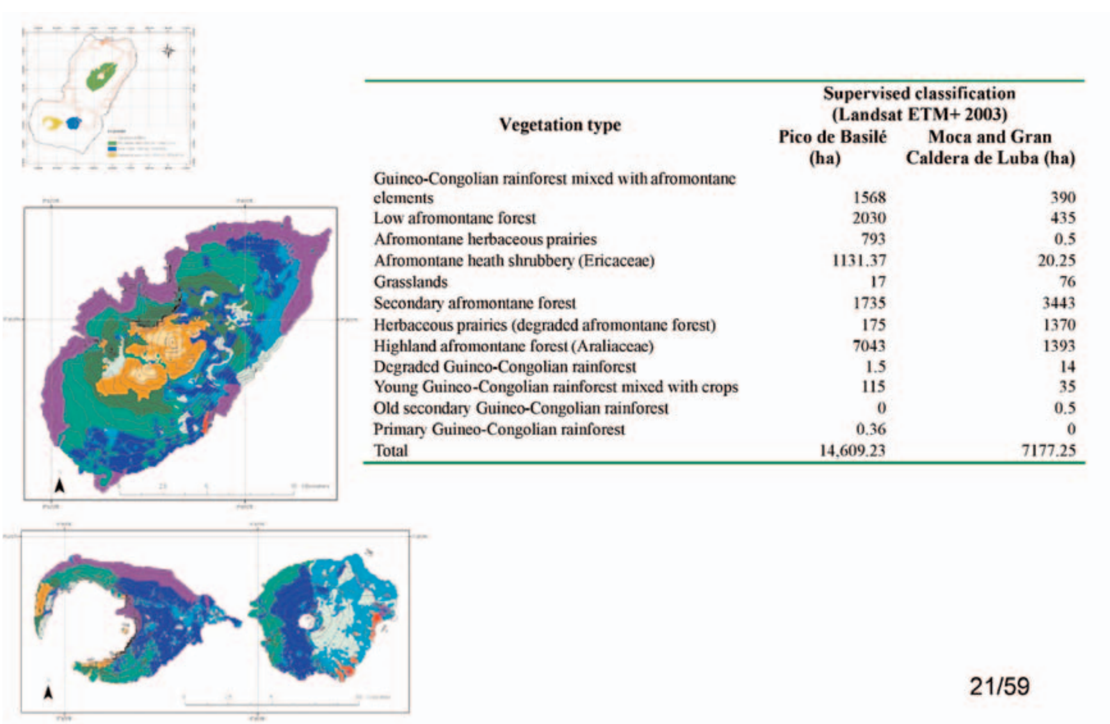
Results of Forest type's distribution with presence of Prunus africana

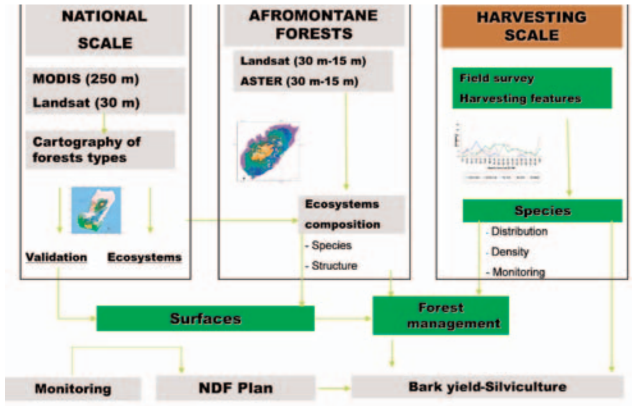
Task 2.- Forest types where Prunus africana exits, summarizing the available cartography. Source of information must be included as well as data format (paper, report, scientific paper, computer format).



Vegetation type	Supervised classification (Landsat ETM+ 2003) Pico de Basilé (ha)	Moca and Gran Caldera de Luba (ha)
Guineo-Congolian rainforest mixed with afromontane elements	1568	390
Low afromontane forest	2030	435
Afromontane herbaceous prairies	793	0.5
Afromontane heath shrubbery (Ericaceae)	1131.37	20.25
Grasslands	17	76
Secondary afromontane forest	1735	3443
Herbaceous prairies (degraded afromontane forest)	175	1370
Highland afromontane forest (Araliaceae)	7043	1393
Degraded Guineo-Congolian rainforest	1.5	14
Young Guineo-Congolian rainforest mixed with crops	115	35
Old secondary Guineo-Congolian rainforest	0	0.5
Primary Guineo-Congolian rainforest	0.36	0
Total	14,609.23	7177.25

Figure 4 .- Distribution of vegetation types in Pico Basilé at altitudes above 1400 m according to supervised classification (WGS 84; Zone 32 N) (Bioko-Equatorial Guinea) and surfaces for vegetation type by using a Landsat 7 ETM+ imagine (Clemente et al., 2006).

STEP 2: VEGETATION AND STRUCTURAL FEATURES OF *PRUNUS AFRICANA* FORESTS



2.1 SURVEY DESIGN AND ASSESSMENT

Objective 3. Inventory of the Prunus africana forest

Survey of the species and structural features of the Prunus africana in the distribution area by means of field inventory and assessment.

- Have any inventories or assessments of this species been conducted in the distribution area? What is the survey design? [Example, Figure 5]
- Have any ecological approach of this species been conducted in the distribution area?
- Describe the resource inventory the density and silvicultural features for this species?

Sources of information

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Results of forest inventory of Prunus africana

Task 3 Ecological studies conducted in the areas where Prunus africana exits. Source of information must be included.

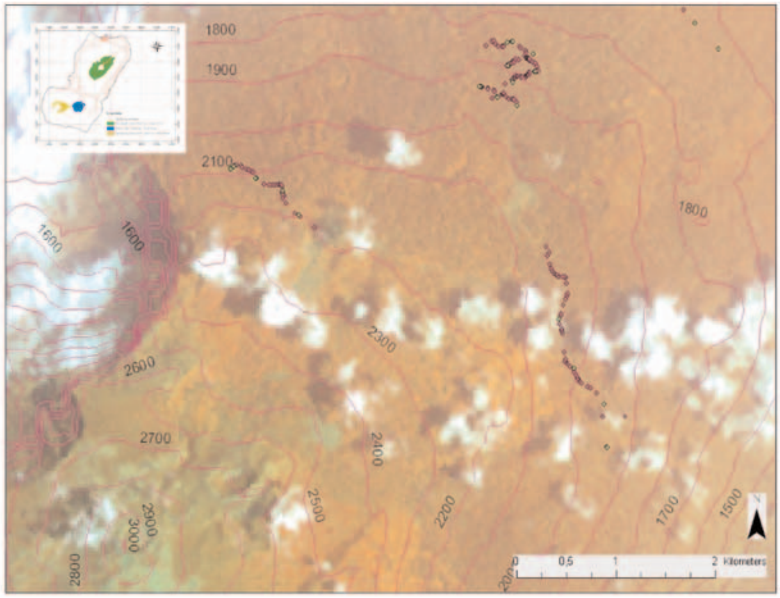

Figure 5 – Location of transects on Pico de Basilé and Moca-Lake Biaó: *P. africana* trees are marked with red dots and the systematic inventories are marked with yellow dots. (WGS 84; Zone 32 N).

2.2. KEY STRUCTURAL FEATURE: NUMBER OF TREES PER HECTARE AND DIAMETRIC DISTRIBUTION

Objective 4. Population statistics

Determination of stocking levels and tree features of Prunus africana trees in the distribution area by means of field inventory.

- Is the population statistics of distribution areas known (e.g. density, tree size)? [Example, Figure 6]
- Have any species regeneration assessments been conducted?
- Have any long-term ecological monitoring assessments been conducted?

Sources of information

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Results of forest inventory of Prunus africana

Task 4 Prunus africana population: density, tree size. Source of information must be included.

Taxa	Place	Density (trees/ha)	BA (m^2/ha)
Bersama abyssinica	Moca	4.46	1.43
Crassocephalum mannii	Basilé and Moca	0.39	0.31
Ficus chlamydocarpa var. chlamydocarpa	Moca	1.55	0.46
Ficus sp.	Basilé and Moca	2.72	1.04
Ficus sp.	Basilé	0.39	0.31
Homalium sp.	Moca	0.58	0.26
Hypericum lanceolatum	Basilé and Moca	0.39	0.31
Macaranga spinosa	Basilé	0.58	0.26
Maesa lanceolata	Moca	4.08	1.21
Neboutonia macrocalix	Basilé	6.60	1.91
Nuxia congesta	Basilé and Moca	4.27	1.29
Oxyanthus spp.	Moca	3.49	1.94
Polyscias fulva	Basilé and Moca	2.33	0.51
Prunus africana	Basilé and Moca	7.18	0.94
Psycotria peduncularis	Moca	0.78	0.37
Psycotria sp.	Moca	0.19	0.16
Schefflera spp. (*S. barteri, S. mannii*)	Basilé and Moca	8.93	1.65
Trema orientalis.	Basilé and Moca	0.97	0.40
Trichilia prieureana	Basilé	5.05	1.62
Uragoga sp.	Basilé and Moca	0.39	0.22
Xymalos monospora	Moca	2.33	0.87
Zanthoxylun sp.	Moca	0.39	0.22
Other unidentified species (Bubi names)	Basilé and Moca	11.05	5.64
Total Figures		**69.29**	**23.51**

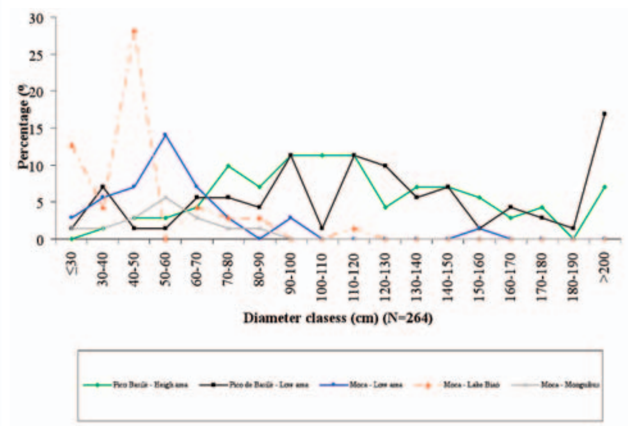
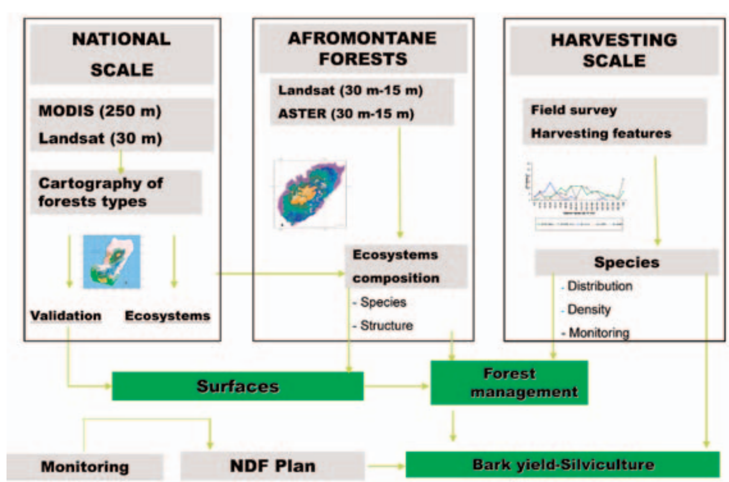


Figure 6 – Density and percentage distribution of *Prunus africana* individuals by diameter class in each of the harvest areas studied on Bioko

STEP 3: Silvicultural Knowleadge of *Prunus africana* Forests



3.1. BARK YIELD

Objective 5. Average bark yield and harvesting

Calculation of tree features related to yield bark production: diameter, harvesting height, and bark thickness

- Are current collection based on quantitative bark estimation? [Example, Figure 7]
- Is there any estimation of fresh bark weight/dry bark weight?
- Are there debarking methods in place?
- Has bark thickness been estimated in natural trees?, has bark regeneration period been studied? [Example, Figure 8]

Sources of information

Acworth J.M., B.J. Ewusi and D. Ngatoum (1998) Sustainable Exploitation of *Prunus africana* on Mt. Cameroon. Paper distributed at the Symposium on the Conservation of Medicinal Plants in Trade in Europe. Royal Botanic Gardens Kew, London. 22 - 23 June 1998.

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Results of forest inventory of Prunus africana

Task 5 Bark yield parameters: density, diameter, harvesting height, and bark thickness. Source of information must be included.

Average yield of dry *Prunus africana* bark (kg ha^{-1}) in the different harvest areas

(Hall *et al.*, 2000)	55 Kg. tree^{-1}
(Ndam *et al.*, 2000)	85 Kg. Tree^{-1}
(Walter y Rakotonirina, 1995)	50-200 Kg. Tree^{-1}

Harvest Area	Yield of the average tree (kg tree^{-1})	Density (stems ha^{-1})	Average dry bark yield by diameter class (kg ha^{-1})*
Pico de Basilé – high area	107.11	15.38	1647.35
Pico de Basilé – low area	115.92	2.65	307.19
Moca – low area	39.68	9.95	394.82
Moca – Monguibus	30.87	5.68	175.34
Moca – Biaó	35.04	6.37	223.21

Figure 7 – Bark yield related to density, diameter and harvesting height on Bioko (Equatorial Guinea) (Clemente *et al.*, 2006).

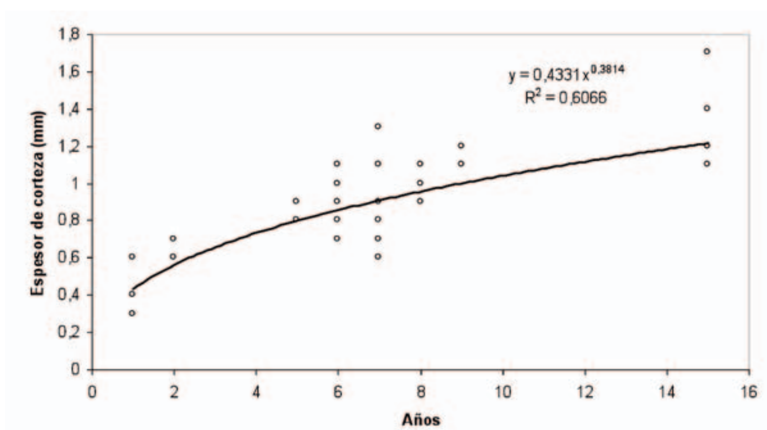

Figure 8 – Bark thickness by number of years since harvest on Pico de Basilé (Clemente *et al.*, 2006).

3.2. Regeneration models

Objective 6. Regeneration models

Although regeneration models are not part of the quotas assessment, several studies have demonstrated the impacts of bark harvest on *Prunus africana* populations in natural regeneration. Therefore, research on model population must be promoted following previous works (Stewart, 2001, 2003) to predict population decline.

Sources of information

Fashing, P J. 2004. Mortality trends in the African cherry (*Prunus africana*) and the implications for colobus monkeys (Colobus guereza) in Kakamega Forest, Kenya. Biological Conservation 120:449-459

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STEP 4: ASSESMENT OF EXPORT QUOTAS OF *PRUNUS AFRICANA*

4.1. Maximal potential bark quotas

Objective 7. Calculation of potential Prunus africana bark yield in harvest areas

A potential harvest quota should be determined for the accessible sites using Ondigui's proposed equation (2001), assuming an unharvested stand [Example, Figure 9]:

$$Q = [A \times P \times RME \times Y \times V] F\text{-}1$$

where: Q = annual quota per management unit (kg of dry material) A = harvest area (ha) P = proportion of area exploited (%) RME = minimum estimated density of Prunus africana in the harvest unit (trees ha-1) Y = estimated yield per tree per harvest (kg of dry material per tree) V = proportion of exploitable trees (%) (alive and not over-exploited) F = return times (years)

- Is potential bark yield calculated by the use of population and bark yield data? [Example, Table 5]
- Is the current bark extraction quota known in harvest areas?

Sources of information

Acworth J.M., B.J. Ewusi and D. Ngatoum (1998) Sustainable Exploitation of *Prunus africana* on Mt. Cameroon. Paper distributed at the Symposium on the Conservation of Medicinal Plants in Trade in Europe. Royal Botanic Gardens Kew, London. 22 - 23 June 1998.

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Results of forest inventory of *Prunus africana*

Task 6 Identify a numeric approach to calculate bark yield quota at the National and local level.

Figure 9 – Estimated potential annual dry bark yield for an unharvested stand, by surface area to be harvested, proportion of area exploited, Prunus africana density, estimated dry bark yield in current and new proposed harvest areas, proportion of trees exploited, and return times (F = 10 years and F = 8 years). Values for the new proposed harvest areas are shown in boldface type.

Working area	A Surface area harvested (ha)	P Proportion of area exploited (%)	RME *Prunus africana* density (stems ha^{-1})	Y Estimated yield per tree (kg tree^{-1})	RME x Y Estimated dry bark yield[1] (kg ha^{-1})	V Proportion of exploitable trees (%)	Estimated potential bark yield[2] (t year^{-1}) in unharvested condition, depending on F (N° of years between harvests)	
							F = 10 years	F = 8 years
Current areas							Current areas	Current areas
Pico de Basilé – high area	1622	80	15.38	107.11	1647.35	90	192.38	240.48
Pico de Basilé – low area	1119	80	2.65	115.92	307.19	90	24.74	30.93
Moca – low area	282	80	9.95	39.68	394.82	90	8.16	10.02
Moca – Monguibus	103	80	5.68	30.87	175.34	90	1.30	1.62
Moca – Lake Biaó	72	80	6.37	35.04	223.21	90	1.15	1.44
Total current areas[3]							227.73	284.49
New areas							**New areas**	**New areas**
Pico de Basilé – south area	1500 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé – east area	1000 (estimated)	80	7.56 (estimated)	111.5 (estimated)	842.94 (estimated)	90	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas[4]							**379.45**	**474.14**

4.2. Current available quotas

Objective 8. Calculation of current quotas of Prunus africana in harvest areas

The potential quota must be compared to the current extraction in harvest areas [Example, Figure 10].

- Are current bark yield calculated by the use of population and bark yield data? [Example, Figure 10]
- Is there any estimation of fresh bark weight/dry bark weight?

Sources of information

Acworth J.M., B.J. Ewusi and D. Ngatoum (1998) Sustainable Exploitation of *Prunus africana* on Mt. Cameroon. Paper distributed at the Symposium on the Conservation of Medicinal Plants in Trade in Europe. Royal Botanic Gardens Kew, London. 22 - 23 June 1998.

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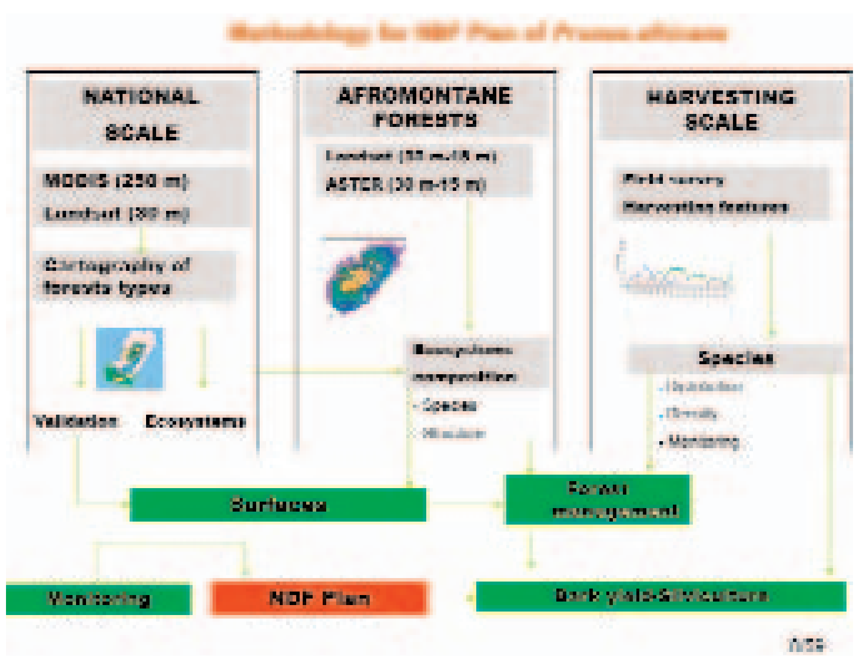
Results of forest inventory of *Prunus africana*

Task 7 To discuss the current national quotas with the estimated quotas using the Ondigui's equation.

Figure 10.– Current annual dry bark yield for an unharvested stand, by surface area to be harvested, proportion of area exploited, Prunus africana density, estimated dry bark yield in current and new proposed harvest areas, proportion of trees exploited, and return times (F = 10 years and F = 8 years). Values for the new proposed harvest areas are shown in boldface type

Harvest area	Estimated potential bark yield (t year^{-1}) in unharvested condition, depending on F (n° of years between harvests)		Recommended quota (t year^{-1}) for 2006 following analysis of status in current and new harvest areas	
	F = 10 yrs	F = 8 yrs	F = 10 yrs	F = 8 yrs
Current areas	Current areas	Current areas	Current areas	Current areas
Pico de Basilé highlands	192.38	240.48	0 (bark regeneration period)	0 (bark regeneration period)
Pico de Basilé lowlands	24.4	30.93	0 (bark regeneration period)	0 (bark regeneration period)
Moca lowlands	8.16	10.2	4.8 (2nd harvest)	5.1 (2nd harvest)
Moca Monguibus	1.30	1.62	1.30 (unharvested)	1.62 (unharvested)
Moca Lake Biaó	1.15	1.44	0.58 (2nd harvest)	0.72 (2nd harvest)
Total current areas	**227.73**	**284.49**	**5.96**	**7.35**
New areas	**New areas**	**New areas**	**New areas**	**New areas**
Pico de Basilé (south)	**91.03 (estimated)**	**113.79 (estimated)**	**91.03 (estimated)**	**113.79 (estimated)**
Pico de Basilé (east)	**60.69 (estimated)**	**75.86 (estimated)**	**60.69 (estimated)**	**75.86 (estimated)**
Total with new areas	**379.45**	**474.14**	**157.68**	**197**

4.3. Monitoring system



Objective 9. NDF Plan and Monitoring System

Once the national current quota has been established, the NDF Plan should describe aspects related to operational harvesting and monitoring:

- Are the Management plans adapted depending of the situation observed through monitoring?
- How do stakeholders participate in the day-to-day implementation of the management plan (need to find out specifically how affected communities, collectors, middlemen are involved)?
- How is processing carried out by the harvesters before the material is sold?
- Are the main stages in the commodity chain from harvesting to export or sale known and documented (e.g. harvesters in the communal areas sell to intermediate buyers, or sell to exporters directly)?
- Are the main actors in the commodity chain identified?
- Can the processed product in the market place be traced back to its point of collection?
- Resource managers and collectors have adequate skills (training, supervision, experience) to implement the provisions of the management plan, and to comply with the requirements of this standard.
- Resource assessment and monitoring?
- Adaptive management process?
- Participatory processes (working with collectors to assess and monitor harvest impacts)?

References

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SETTING EXPORT QUOTAS OF *PRUNUS AFRICANA*: GUIDELINES FOR A NDF PLAN

AUTHORS:
Dr. Rafael Mª Navarro-Cerrillo
Dra. Margarita Clemente-Muñoz
Dr. Alfonso García-Ferrer-Porras

A management model for **Non-Timber Forestry Resources** (NTFR) formed the basis for the proposed methodology, which was designed to prepare the necessary guidelines for implementation of a Management Plan for the species on Bioko (Equatorial Guinea). The results presented are based on the pilot project "Evaluation of the Harvest of *Prunus africana* Bark on Bioko (Equatorial Guinea): Guidelines for a Management Plan".

The guidelines provided are the culmination of a series of stages in work oriented towards evaluating the forest resource: *Prunus africana* specimens and their current status following bark-harvesting activities.

In recent years, great effort has gone into proposals of management plans for sustainable use of *Prunus africana* in several Range States. However, integral methodology must be established to evaluate the current situation, to know whether bark harvest is suitable or whether it is affecting the conservation status of the species, and propose corrective measures as needed to achieve sustainable use. The study was devised as a pilot project, covering a pre-selected area under 150,000 ha in Equatorial Guinea, it could give rise to a survey model and be applicable to other countries.

The general goal of the project was to determine the potential and current range of *Prunus africana* on Bioko. Based on this range data, stocks could be assessed, bark harvest evaluated, and proposals made with necessary recommendations to consider in drawing up a management plan for sustainable use of the species. The following specific objectives were established to achieve the general goal:

1. Survey of the distribution of dominant types of vegetation by means of remote sensing
2. Characterisation of the forests where *Prunus africana* occurs in current and potential harvest areas, in terms of their structure, species composition and diversity of tree species
3. Estimate of bark yield, and
4. Establishment of silvicultural criteria for sustainable use of *Prunus africana* forests

NON-DETRIMENT FINDINGS REPORT ON *PRUNUS AFRICANA* (ROSACEAE) IN CAMEROON

AUTHOR:
Dr Jean Lagarde BETTI
ITTO/CITES Project Africa Regional Coordinator.

1. INTRODUCTION

Prunus africana is a species of the Rosaceae family, known under its trade/pilot name as pygeum or African chery. It is a montane tree species of the tropical Africa including the Côte d'Ivoire, Bioko, Sao Tome, Ethiopia, Kenya, Uganda, South Africa, Madagascar, Congo, the Democratic Republic of Congo, and Cameroon.

Prunus Africana is classified by the World Alliance for Nature (IUCN) as vulnerable species, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). This decision had a significant impact on the revenues produced from this non timber forest product in the range countries. Since October 2007, the European Commission has banned the importation of *Prunus* Africana coming from Cameroon in Europe. This measure impacts both the economic operators and the local people for whom *Prunus* represents an important non timber forest product.

In various African countries, policies have been established to ensure the sustainable management of forests having *Prunus africana* stands in them. However, enforcement issues and control problems do persist. The development of clear procedures to deliver Non-Detrimental Findings (NDFs) remains a priority for most producer countries.

This work aims to gather and analyse data for dressing a Non-Detriment Findings Report on *Prunus africana*. The main objectives are to summarize the basic information on this plant species, its management, utilization and trade, and to present a comprehensive description on the procedure followed to make the non-detriment findings for *P. africana*.

The document is prepared to be presented at the International Expert Workshop on CITES Non-Detriment Findings, projected in Mexico, November 17th-22th, 2008. It is divided in two parties: Back ground information on the taxa, and the Non-detrimental Finding procedure.

2. MATERIAL AND METHOD

2.1. Method

Data presented in this report are based on the literature revue, discussions with different stake holders, and my own field experience.

Literature revue focused on published paper dealing with *Prunus Africana* in Cameroon. Occurrence extent and area of occupancy were estimated based on the important work conducted by Vivien et Faure in 1985 on African trees (Vivien et Faure 1985). The *Prunus* map drawn by these two authors was then completed with results of the work done by the National Forestry Development Office (ONADEF) in 1999 and 2000. This work consisted of identifying occurrence sites of *Prunus* based on interviews conducted in different ones of Cameroon.

I largely used technical papers and the Proceedings of the Workshop on "a strategy for the conservation of *Prunus africana* in Mount Cameroon", organised 21st and 22nd February 1996 in Limbé, by the Mount Cameroon Project. The objective of the workshop was to develop a strategy for *Prunus* Conservation on Mount Cameroon. The workshop brought together 46 participants including Government officials, private sector, and villagers. Experts presented papers on all field concerning *Prunus* in Mount Cameroon including biology, ecology, exploitation (legal and illegal), and inventories (Glyn 1997). I also used the recent report of the *Prunus* inventory made in Mount Cameroon, Mount Manengoumba, and Mount Oku. This work was conducted within the platform on *Prunus* conservation in Cameroon (FAO/SNV/CIFOR/ICRAFT 2008). The comparison of data presented in the two documents (Glyn 1997 and FAO/... 2008), allowed me to appreciate the trends in Mount Cameroon in terms of population size and other parameters in spite of differences observed in the methods and some critics made on the previous inventories (Glyn 1997).

In 2001, ONADEF conducted an inventory in the Adamaoua province, using the "adaptive cluster sample method". The study proposed sustainable quotas for Tchabal Mbabo and Tchabal Gang Daba, two sites of *Prunus* in the Adamaoua.

I exploited data from special permits issued by the Forest administration since 2004 to companies dealing with the exploitation of special products.

In 2007, I had the opportunity to conduct two important field trips to assess the exploitation of special products in Cameroon. The first trip was financed by the FAO and consisted of gathering and analysing statistical data on non timber forest products (NTFP) in Cameroon, (Betti 2007b). This study allowed me to understand the circuit of forest products and the related problems in Cameroon. The second trip was financed by the Cameroon forest administration, the CITES management authority to be précised (Akagou et Betti 2007). The trip aimed to establish the state-of-the-art on the exploitation of *Prunus africana* in Cameroon. I therefore had the opportunity to visit four provinces including Adamaoua, West, North west, and South west provinces. In each province, we discussed with all stake holders including exploiters, local forest services, local authority, and local population. We also visit certain forests to appreciate the exploitation of *Prunus africana*.

In Yaoundé, I largely discussed with the Director of Forest, the CITES management authority, the Chief service in charge of agreements and permits, the president of the national syndicate for special products permit holders.

2.2. Limits

2.2.1. On the document

Data used in this report are not enough for a full and complete assessment of Non-detrimental Findings on *Prunus africana* in Cameroon.

Appreciation of trends in *Prunus* distribution in Cameroon is based on the work done by Vivien et Faure in 1985, and the one undertook by the National Office for Forest Development (ONADEF) in 1999 and 2000 (letter réf N° 0352/MINEF/SG/DF/SDAFF/SN of 09 March 2005 addressed to the CITES Management Authority of Spain). The problem is that the methods used for identifying sites of extend occurrence differ from one author to another, which cannot authorize to be fix on the extension or declining of the distribution of *Prunus* in Cameroon.

Population abundance has never been conducted in all sites of exploitation of *Prunus* in Cameroon. For some scarce sites where the inventories have been conducted, authors used different methods (sample rate and designing) which cannot authorize to make any comparison. Mount Cameroon appears to be the only zone where inventories were made at least twice, in 1992 and 2008. Same is said to have been made for the North west province (Mount Oku) by the forest administration (Akagou. Pers. Com.) but reports are not published. The problem in Mount Cameroon is that inventories were made by different structures using different methods. Additionally data from the 1992 inventories have been criticised (Cunningham and Mbenkum 1993), for being biased towards the areas rich in *Prunus africana* thus giving over-estimates of the average population density over the entire area. All these problems constitute limits for appreciating any trends in population abundance.

2.2.2. *Concerning the IUCN checklist for Non Detriment Findings*.

The IUCN checklist is largely based on two global parameters: the abundance and the spatial distribution. No thing is said concerning author parameters such as the morphology, the mod of scattering, and external parameters.

In nature, the presence/absence of a given species in a précised milieu is regulated by diverse mechanisms which inter-act as "constraints". The notion of constraints reminds that all is not possible for a given species according not only to its proper nature, but also to many pressures that the species faces (Barbault 1997, Betti 2001, 2002). Constraints can therefore be distinguished in two broad groups including the external constraints and the internal constraints.

Globally, the ecological impact of the exploitation of forest resources is function of social factors (preference for example), economic factors (trade), the floristic composition of the forest and the nature of exploited species (Cunningham 1991, 1994, Peters 1997 cit. Betti 2001, 2002). The most threatened species are those which will be more popular, those which grow slowly, those which meet difficulties in their production system, those which prefer fragile or threatened habitats, and those which have a limit distribution area (Cunningham 1993. cit Okafor & Ham 1999).

3. BIOLOGICAL DATA

The genus *Prunus* belongs to the Rosaceae family group and consists of about 400 species mostly distributed in the north temperate one of America, Europe, and Asia. There are about 75 tropical species, mainly tropical Asiatic and tropical American (Mabberley cit. Nouhou Ndam 1996).

3.1. Scientific and common names

Prunus Africana (Hook.f.) Kalman (formerly *Pygeum africanum* Hook.f.) known under its trade/pilot name as *Pygeum* or African cherry, is the only sub-Saharan African species of the genus and is widely spread in mountain tropical Africa from west and East Africa to South Africa and Madagascar. Range countries include Côte d'Ivoire, Bioko, Sao Tome, Ethiopia, Kenya, Uganda, South Africa, Madagascar, Congo, the Democratic Republic of Congo, and Cameroon (Vivien et Faure 1985).

Prunus africana Hook f. (Rosaceae)

Common names: Pygeum, Iron Wood, (Red) Stinkwood, African Plum, African Prune, African Cherry, Bitter Almond.

Local or vernacular names for *Prunus africana* by region (Cunningham, 2006)
Southern Africa: *muchambati* or *muchati* (Central Shona), *umdumezulu, inkhokhokho, umlalume, ingobozinyeweni* (isiZulu), *umkhakhazi, inyazangoma* (Xhosa and Zulu), *mulala-maanga* (Venda), *mogotlhori* (North Sotho), rooistinkhout (Afrikaans) (Wild, Biegel and Mavi, 1972; Palmer and Pitman, 1972; Pooley, 1993).
South-Central Africa: *Dedzi* (chiChewa), *msista* or *mkunu* (Yei), mzumira (Tu), *mmdondole* (Ngoni) and *mpuema* (Mg) (Williamson, 1975).
East Africa (Kenya, Uganda, Tanzania): *Muiru* (Kikuyu), *Mutimailu* (KiKamba), *ol-Koijuka* (Maa), *Tenduet* (Elgony, Kipsigis, Ndorobo), *Mueri* (Stand), Mweria (Meru), *Twendet* (Nandi), *mkonde-konde, msendo, muuri* and *mudy* (Chagga), *konde-konde* (Meru), *mdundulu* (Nguu), *ligambo* (Nyiha), *wami* (Rangi), *gwaami* (Fiome), *mufubia* (Zinza), *mfila* (Fipa), *mwiluti* (waHehe), *Murugutu* (Watende), *Armaatet, Oromoti* (Sebei), *Kiburubura* (Kisii), *Mwiritsa* (Luhya); *Ntasesa* (Luganda), *chiramat*, *chirumandi, gulumati, gumwirumani, namwini* (Lugisu), *mukombo* (Rukiga) *ngoti* (Lukonjo), *mugote* (Runyankole), *ntasera* (Lunyoro), *oromoti* (Sebei) (Beentje, 1994; Hamilton, 1991; Mbuya et al, 1994).
Ethiopia highlands: Tikur inchet (Amargna), *Beru* (Gimirigna), *Arara* (Haderigna), *Bouraio*, *Buraya, Homi* and *Mukoraja* (Oromugna), *Mrchiko* (Sidamgna) and *Garba* or *Onsa* (Wolayeigna) (Bekele-Tesemma, 1993).
West Africa: *Bihasa* (Buhi), used on Bioko. In Cameroon, *wotangue* (Bakweri) *dalehi* (Fulani), *eblaa* (Oku), *elouo, mowom* and sola (Kom), *kanda stick* (Pidgin) and *kirah* (Banso).
Madagascar: *Kotofihy* (most widespread name), also *sofintsohihy* (and *kotofihy*) in the Amparafaravola, Brickaville and Vohimena areas, *tsintsefintsohihy* (and *kotofihy*) in Ambatondrazaka area, *saripaiso* or *sary* (Bealanana, Mandritsara and North Befandriana, Paisoala (Betsileo area) and *tsipesopeso* (Moramanga).

3.2. Distribution

Table 1.- Distirbution of *Prunus africana* in Range State (Cunningham, 2006)

Range State	Distribution in Range State
Angola	Bailundu highlands, Mt. Moco
Burundi	Montane forest, Albertine Rift, possibly from Mt. Heha/Ijenda, Mt. Bururi or Teza forest.
Cameroon	Bamenda highlands (Mt Kilum, Oku, Mt. Manenguba, Adamawa plateau and Mt. Cameroon
DR Congo*	Kivu region, Rwenzori and Virunga mountains, and within Kahuzi-Biega National Park, probably also on Itombwe

Range State	Distribution in Range State
	massif.
Equatorial Guinea	Pico Basilé and Grand Caldera de Luba on the island of Bioko
Ethiopia	NW highlands to Lake Tana and SE Highlands to Harar. Widespread in montane and valley forests of Harerge (eg: Dindin forest), Illubabor, Kefa, Arsi, Wolega and other regions 1500-2300m asl.
Kenya	Mt. Kenya, Mt Elgon, Mau forests
Lesotho	One collection from Rock pools area, Sehlabathebe, but that tree no longer survives. One specimen reported from Maphotong Gorge (2)
Madagascar	Patchy distribution in moist Montane forests (1000-2000m asl) such as Zahamena Strict Nature Reserve, Mantadia, Antsevabe and Manakambahiny-Est.
Malawi	Mt Mulanje, Zomba and Vipya planteaus
Mozambique	Mt Chiperone and Chimanimani mountains and Mt. Gorongosa
Nigeria	Mambila plateau, SE Nigeria
Rwanda	Virunga mountains, Mukura and Nyungwe forests
Sao Tome e Principe	Central Principe, near the volcanic plugs of Joao Dias Pai e Filho and montane Sao Tome from 1200-1400m asl.
South Africa	Afromontane forest patches from Mpumalanga through KwaZulu/Natal to the Knysna forest
Sudan	Imatong mountains (1)
Swaziland	Forest patches near Malolotja (Forbes Reef) and Mbabane.
Tanzania	Moist evergreen forests in NE Tanzania, including Mt Kilimanjaro
Uganda**	SW Uganda, particularly Kalinzu, Bwindi, Mgahinga and Mt. Elgon and in the Imatong mountains on the Sudan border
Zambia	Relict forest patches in fire maintained upland grasslands
Zimbabwe	Chimanimani mountains and Inyanga

References (Cunningham, 2006): 1 = Friis, 1992; 2 = Golding, 2002; 3 = Songwe, 1990; 4 =Katende, 1995; 5 = Fa, 2000; 6 = DGEF, 2003; 7 = Tesfaye et al (2002); 8 = Sunderland and Tako, 1999.

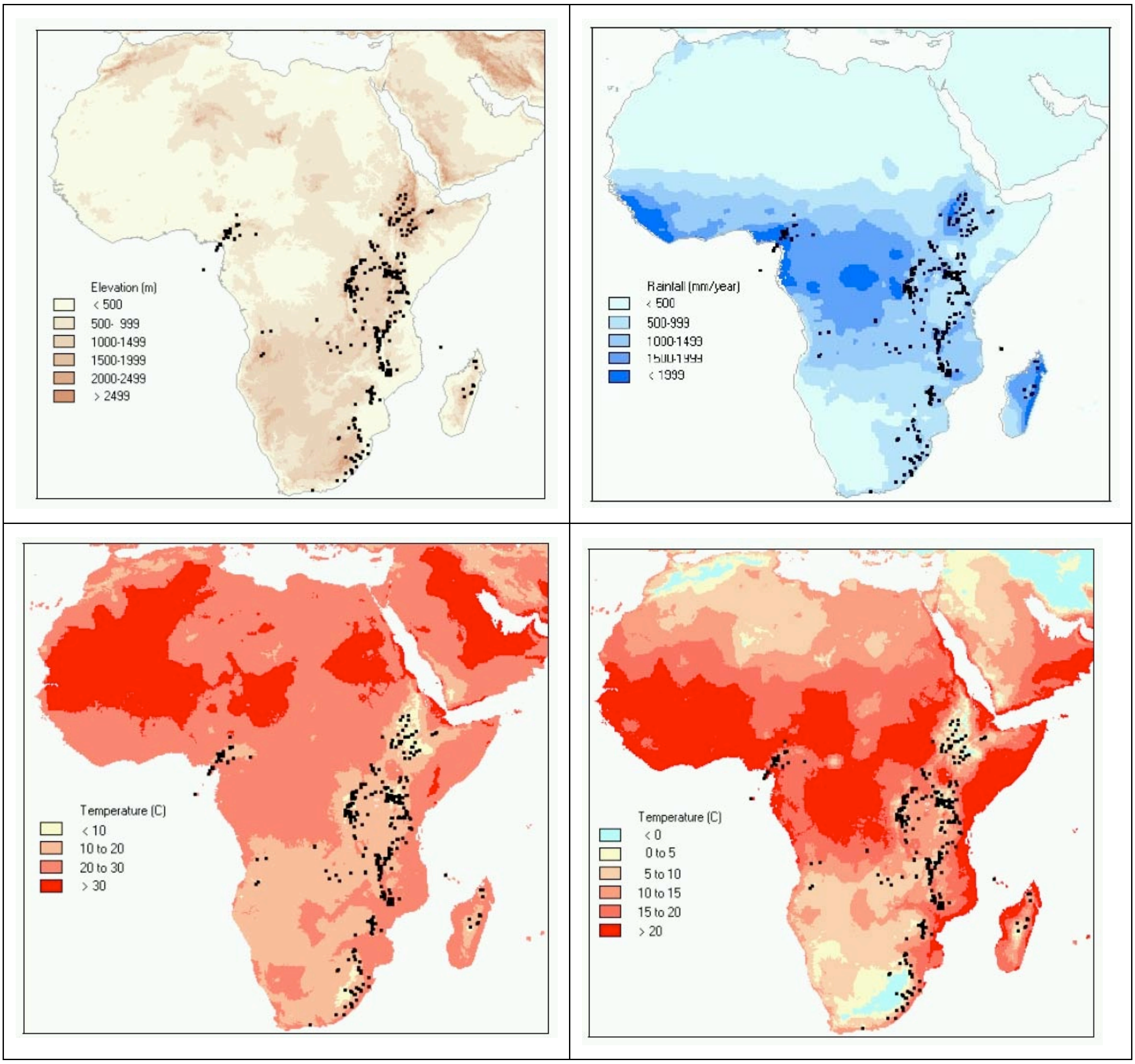

Figure 1.- Pan-african distribution of Prunus africana (Hall et al., 2000).

In the distribution area the natural range of *Prunus africana* is discontinued. Pygium forests appear fragmented in several isolated sub-stands distributed in afromontane forests (see Annex for Cameroon distribution)

3.3. <u>Biological characteristics</u>

3.3.1. *Life history*

Prunus africana is an evergreen canopy tree to 30 m tall with thick, fissured bark and straight bole that can reach a diameter of 1.5 m. its leaves are alternate and simple. The flowers are small, white and fragrant. The fruit, which is intensely bitter, is a small pinkish-brown bilobed drupe. Fruits are 11 mm x 9-10 mm, ellipsoid or transversely ellipsoid, indehiscent drupe, deep red to purple-black, 0.5 g, Stalk round, 6-7 mm x 0.1 mm. skin (epicarp) squeezes off easily in fingers, exposing green flesh (mesocarp) surrounding the bony endocarp. Glabrous. Seeds have same shape as fruit, contained in a bony endocarp. Cotyledons are white, with a thin papery, dry, pale yellow-brown testa. There exists one seed per fruit. Germination is epigeal. (Fraser et al. The flowering period extends from June to November and fruiting period from February to May. It is light demanding and responds well to cultivation (Vivien et Faure 1985, Fraser et al. 1996, Tchouto 1996).

The bark is black to brown, corrugated or fissured and scaly, fissuring in a characteristic rectangular pattern. The leaves are alternate, simple, long (8-20 cm.), elliptic, bluntly or acutely pointed, glabrous and dark green above, pale green below, with mildly serrate margins. A central vein is depressed on top, prominent on the bottom. The 2-cm petiole is pink or red. The flowers are androgynous, 10-20 stamens, insect-pollinated, 3-8 cm., greenish white or buff, and are distributed in 70-mm axillary racemes. The plant flowers October through May. The fruit is red to brown, 7-13 mm., wider than long, two-lobed with a seed in each lobe. It grows in bunches ripening September through November, several months after pollination.

Poor establishment conditions for the seedlings, is known to be one of the main causes of the species population decline. Seedlings grow well when they are established on exposed sites with good moisture such as road collapse (Ndam 1996). On Mount-Cameroon, a study has indicated a density of 5.5 trees ≥ 20 cm dbh par ha with a low level of recruitment such as seedling density of about five individuals/m^2 (Ewusi et al. 1992). The same study also showed that seedlings were most abundant where there was a good light penetration into the forest and the undergrowth was sparse.

3.3.2. *Habitat type*

According to Vivien et Faure (1985), *Prunus africana* grows well in the sub-montane and montane forests at an altitude of 1500 – 3000 m). For (Tchouto 1996), *Prunus* is found at an altitude of 900 – 2500 m above sea level, though it has been observed to grow at lower altitude of 600 m. Studies conducted within the Mount Cameroon project suggested that fallows are the suitable habitat type than primary forest for *Prunus africana* in terms of density (4.69 seedlings/m^2), survivorship/mortality (48.18%), recruitment, growth rate (11.52cm/year) (Ndam 1966).

Although *Prunus africana* is reported to be a light demanding species, it is present in closed-canopy forest (up to 20% of canopy composition) on Mount Oku. The lack of associated recruitment in such closed-canopy forest suggests that it is a mid to late secondary successional species (Eben-Ebai cit. Tchouto 1996). This lack of recruitment is evidence that in closed-canopy forest Pygeum is not replacing et al mature individuals coming to the end of their reproductive life. This supports the theory that in fact, the presence of Pygeum in mature phase forest may indicate that these individuals represent a relic population from mid-late successional processes, with little or no reproductive future without significant disturbance and opening successional opportunities (Sunderland and Nkefor 1996). Light is said to be needed for the promotion of regeneration (Eben-Ebai et al. cit. Tchouto 1996) although Geldenhuys (1981) cited by Tchouto (opcit.) reports that direct light inhibits seed germination and subsequent seedling development. Light is not necessary for germination but is vital for seedling development (Sunderland and Nkefor 1996).

3.3.3. *Role of the species in its ecosystem*

The fruits of *Prunus africana* are drupaceous, fleshy and red-purple in colours and are said to be eaten by a variety of birds and mammals (Cunningham and Mbenkum 1993). Most notable of these being the primate, Preuss Guenon (*Cercopithecus preussii*) and the Mount Cameroon Greenbul (*Andropogon montanus*) a montane bird, both of which are endemic to massif. According to Sunderland and Nkefor (1996), the suggestion by Cunningham and Mbenkum (1993) that the destruction of *Prunus africana* in a given area will affect frugivorous faunal populations significantly was an overstatement due to the irregularity of *Prunus* fruit production. It would be impossible to determine the reliance, and hence the effect of forest disturbance through the removal of Pygeum, of particular animal or bird on *Prunus* fruits given the masting fruiting characteristics exhibited by the species.

Frugivorous birds and mammals, however, must play an important role in seed dispersal. Observations indicated that dispersal from the parent tree was negligible and the majority of fruits had fallen within the crown line. Some villagers suggest that this might be due to intense hunting pressure, with not enough mammalian presence to disperse the fruits. However, caching of seed by small rodents seems to be common and this appears to account for the majority of predation of the seed set, although predation per seeds seems to be minimal (Sunderland and Nkefor 1996).

3.4. Population

3.4.1. *Global population size*

See Table 1

3.4.2. *Current global population trends*

Many authors outlined the decline in *Prunus africana* populations due to over-harvesting (Ewusi et al. 1992, Tchouto 1996, FAO/ICRAFT/SNV/CIFOR 2008). First observations regarding the declining of natural population inherent to overexploitation were made by Ewusi et al. (1996). Reports confirmed the fact that the natural population has suffered major damage from both legal and illegal exploitation (Ewusi et al. 1996), reducing the population from all previous inventory estimates by up to 50% in two years (1994 – 1996) (see fig. 2).

3.5. Conservation status

3.5.1. *Global conservation status*

Table 2.- Status of *Prunus africana* population in Range State (Cunningham, 2006)

Range State	Status of *Prunus africana* population
Angola	IUCN Category status **Vulnerable (VUA1cd)** (2). Small population, no effective protection yet Mt. Moco and the Bailundu highlands have been affected by over 20 years war
Burundi	**Data deficient,** research needed due to current commercial trade. May be threatened and in long-term decline.
Cameroon	**Vulnerable** (4). Current harvest levels considered unsustainable by Stewart (2001). Few large trees alive in NW and West Cameroon, and Western. Commercial exploitation has now spread to the remote Adamawa plateau.
DR Congo*	**Data deficient**. Bark harvest is opportunistic and unregulated. Densely populated surrounding area (up to 300 people/km2). Controlled harvest not possible due to armed conflict.
Equatorial Guinea	Harvest considered unsustainable given impacts of large trees and current level of trade (8). More recent research conducted with funding from Spain, but report unavailable for this review.
Ethiopia	Probably not threatened. Subsistence use of bark only, although considered as a source of supply to France in the 1970's. Direct impacts due to fuelwood, charcoal and timber use (3). Poor recruitment of *Prunus africana* in Bale mountains (7)
Kenya	Needs non-detriment assessment of current bark harvest by sole exporter.
Lesotho	**Rare**. Only known from one sighting and one collection record.

Range State	Status of *Prunus africana* population
	IUCN Category status **Data Deficient (DD).**
Madagascar	**Vulnerable.** Poor recruitment, few young trees and poor compliance with Forestry regulations. This could improve under the National Action Plan for *Prunus africana* (6)
Malawi	IUCN Category status **Vulnerable (VUA1cd)** (2)
Mozambique	**Data deficient.**
Nigeria	**Data deficient.** Not recorded as a Range State by WCMC-UNEP, but small population may occur in this locality. Needs further investigation.
Rwanda	**Data deficient.** Populations probably secure in the Virunga mountains and Nyungwe forest unless commercial bark harvest starts.
Sao Tome e Principe	**Data deficient,** probably not threatened unless commercial harvest starts. Habitat destruction the biggest threat.
South Africa	**Not threatened.** Internal commercial trade in *Prunus africana* bark for traditional medicines, but most populations relatively secure
Sudan	**Data deficient.** Status unknown due to warfare, montane forests in upland grassland vulnerable to felling and fire.
Swaziland	IUCN Category status **Endangered C2aD** (2). Small populations vulnerable to bark exploitation for traditional medicine traded internally and cross-border trade to markets in Johannesburg, South Africa.
Tanzania	**Data deficient.** Status of populations unknown and needs investigation due to increased commercial trade.
Uganda**	**Not threatened.** Healthy populations secure in Bwindi-Impenetrable National Park and Kalinzu Forest Reserve.
Zambia	IUCN Category status **Lower Risk-nt,** widespread but uncommon habitat (2).
Zimbabwe	Rare and restricted to small montane forest patches in eastern Zimbabwe. Secure at present.

References: 1 = Friis, 1992; 2 = Golding, 2002; 3 = Songwe, 1990; 4 =Katende, 1995; 5 = Fa, 2000; 6 = DGEF, 2003; 7 = Tesfaye et al (2002); 8 = Sunderland and Tako, 1999.

3.5.2. *Main threats*

Table 3.- Mean threats of *Prunus africana* forests in Range State (Cunningham, 2006)

Range State	Main threats
Angola	Forest islands in montane grassland vulnerable to fire and clearing for farmland.
Burundi	Additional threats are deforestation and unregulated timber felling by pit-sawyers, both of which have been worsened by warfare
Cameroon	The spread of large scale commercial *Prunus africana* bark harvest to the Adamawa plateau is of serious concern. Forest clearing outside Forest Reserves is a major threat in these densely populated highlands.
DR Congo*	Kahuzi-Biega NP is declared a UNESCO World Heritage site in danger. Additional threats are deforestation and unregulated timber felling by pit-sawyers, both of which have been worsened by warfare. Hunting and fuelwood harvesting for or by Rwandan 0.5 million refugees has also been issue near Kahuzi-Biega.
Equatorial Guinea	Forests a focus of a massive bushmeat trade (5).
Ethiopia	Livestock and clearing of forests
Kenya	
Lesotho	Marginal habitat, forest patches vulnerable to fire.

Range State	Main threats
Madagascar	Forest clearing for farming, charcoal and fuelwood collection.
Malawi	Harvesting for medicinal bark and timber.
Mozambique	Habitat loss to clearing for subsistence farming.
Nigeria	Forest clearing for farming.
Rwanda	Forest clearing for farming, timber cutting by pitsawyers.
Sao Tome e Principe	
South Africa	
Sudan	Forest within the Imatong Mountains Central Forest Reserve, but not accessible due to warfare.
Swaziland	
Tanzania	
Uganda**	
Zambia	Fire and forest clearing.
Zimbabwe	Fire and clearing of forest habitat.

3.4.2. *Harvest and International Trade in* Prunus africana *bark*

Table 4 (Cunningham, 2006). Range States of *Prunus africana*, showing those countries which are exporting *Prunus africana* bark and those where only subsistence use of this tree species take place. Although *Prunus africana* is distributed in montane "islands" across Africa and Madagascar, restricted to high altitude (1500-3100m) montane forests in tropical Africa, many of which have been cleared for farming. Major exporting countries, in order of importance are Cameroon, Kenya, Madagascar, Equatorial Guinea (from the island of Bioko), followed by the DRC and Burundi. The most important importers are France, Italy, Belgium and Spain. Sources of information on uses numbered below.

Range State	**Recorded Bark Export (1995-2004)**	**Export > 1000 kg /bark*/yr**	**Importing countries (Including re-exports)**	**Other uses of *Prunus africana* in Range State**
Angola	NO	NO	-	No data, but subsistence use for fuelwood and traditional medicine likely
Burundi	YES	YES	Belgium, France	Traditional medicine, timber, fuelwood
Equatorial Guinea (Bioko)	YES	YES	Spain	No data
Ethiopia	NO	NO	-	Firewood, charcoal, poles, timber, medicine (leaves, bark), bee forage, mortars (1).
Cameroon	YES	YES	France, Spain, Canada*	Firewood, traditional medicine
DR Congo	YES	YES	Belgium, France, Madagascar, India	Firewood, traditional medicine, timber (2)
Kenya	YES	YES	France, China, USA	Timber for house building and furniture & traditional medicine (3)
Lesotho	NO	NO	-	Only 2 trees known, one of which has died (9)
Madagascar	YES	YES	France, Italy, India, Slovenia*	Fuelwood, charcoal, medicine
Malawi	NO	NO	-	Used for timber (4)
Mozambique	NO	NO	-	No data, but use for

Range State	**Recorded Bark Export (1995-2004)**	**Export > 1000 kg /bark*/yr**	**Importing countries (Including re-exports)**	**Other uses of *Prunus africana* in Range State**
				traditional medicine and fuelwood likely
Nigeria	NO	NO	-	No data
Rwanda	NO	NO	-	Fuelwood, timber, traditional medicine
Sao Tome and Principe	NO	NO	-	No data
South Africa	YES*	NO	Germany*, Netherlands*, Switzerland*	Commercially traded for traditional medicine (5)
Sudan	NO	NO	-	No data
Swaziland	NO	NO	-	Use for traditional medicine
Tanzania	YES	YES	USA, plus <5kg to Madagascar and South Africa	Firewood, charcoal, construction timber, poles, utensils (mortars), medicine (6)
Uganda**	NO	NO	-	Beer fermentation troughs ("beer boats"), traditional medicine, fuelwood, building poles, timber (2)
Zambia	NO	NO	-	No data.
Zimbabwe	NO	NO	-	Traditional medicine, timber (7, 8)

References: 1 = Bekele-Tesemma, 1993; 2= Cunningham, 1996; 3=Bentje, 1994; 4=Williamson, 1975; 5=Cunningham, 1993; 6= Mbuya et al, 1994. 7=Gelfand et al, 1985; 8=Goldsmith and Carter, 1992; 9= Golding, 2002.

Notes to Table 2 above: *Quantity 50 kg in 2003 for entire period (1995-2003). **In 1992, prior to CITES App.II listing, Uganda exported *Prunus africana* bark to France via Kenya, but this was stopped due to destructive effects on Kalinzu-Maramagambo Forest Reserve. Uganda has recently applied for a CITES permit. This needs to be considered with caution. The integrity of Kalinzu-Maramagambo Forest Reserve, which has high conservation value, but is under threat by illegal activity (hunting, charcoal burning, small-scale gold panning)) (Howard, Davenport and Balzer, 1996) and Bwindi-Impenetrable National Park has recovering *Prunus africana* stocks and vulnerable mountain gorillas popuations, this recent request from Uganda needs to be carefully considered.

4. *PRUNUS AFRICANA* MANAGEMENT IN CAMEROON

4.1. National population size

Many independent inventories have been carried out in South west (Mount Cameroon) and Adamaoua (Tchabal Gang Daba and Tchabal Mbabo) provinces.

Two inventories were carried out in the Mount Cameroon (Ewusi et al. 1992, Tchouto 1996). Ewusi et al. (1992) recorded a total of 249 trees in 18 plots at between two and four elevations on seven transects. They estimated an average of 5.5 stems/ha of *Prunus africana* in Mount Cameroon. The population is not evenly spread on Mount Cameroon, with denser populations at higher altitude. While most of the 249 trees surveyed had survived debarking, some had died either from over-harvesting or from fire damage at the forest savannah boundary. The total exploitable population (with diameter 30 c m), was estimated at 3.5 stems/ha.

Tchouto (1996) reports the results from a general forest inventory conducted in 1992 in the Etinde Forest area, under the Limbe Botanic Garden and Rainforest Genetic Conservation Project. The density was 0.76 stems/ha with a mortality rate of 22%. The exploitable population is 7.2 stems/ha.

Results obtained from the recent inventories conducted within the project GCP/RAF/408/EC in the South west (Mount Cameroon and Mount Manengouba) and North west (Mount Oku) are presented as follow (FAO/SNV/CIFOR/ICRAFT 2008):

- Mount Cameroon:11.40 stems/ha and 1.66 exploitable stems/ha;
- Mount Manengoumba: 1.89 stems/ha and 1.00 exploitable stem/ha;
- Mount Oku: 3.52 stems/ha and 3.35 exploitable stems/ha.

Inventories conducted by the National Office for Forest Development (Pouna & Belinga 2001) in two harvesting sites in the Adamaoua province revealed following results:

- Tchabal Mbabo: 12.29 stems/ha with 8.22 exploitable stems/ha;
- Tchabal Gang Daba: 2.15 stems/ha with 0.99 exploitable stems/ha.

The recent national forest resources assessment conducted by FAO/ICRAFT/SNV/CIFOR from 2003 to 2004 suggests the density of 0.01 stem/ha and the relative frequency of 0.00 % for *Prunus africana* in the whole country, which tends to show that this plant species is threatened in Cameroon (MINFOF - FAO 2005). This low density may be due to the fact that, the 2003 inventory covered many ecological zones of Cameroon, including those where *P. elata* does not occur. Also, this density includes trees with diameter less than 20 cm.

4.2. National population trends

Many authors outlined the decline in *Prunus africana* populations due to over-harvesting (Ewusi et al. 1992, Tchouto 1996, FAO/ICRAFT/SNV/CIFOR 2008). First observations regarding the declining of natural population inherent to overexploitation were made by Ewusi et al. (1996). Reports confirmed the fact that the natural population has suffered major damage from both legal and illegal exploitation (Ewusi et al. 1996), reducing the population from all previous inventory estimates by up to 50% in two years (1994 – 1996) (see fig. 2).

In 2007, the SNV Highlands in collaboration with the Western Highlands Nature Conservation Network (WHINCONET) assessed *Prunus* individuals in one transect of 3 km x 6 m covering the community forest of Emfveh Mii, Kedjem Mawes, meadows, and Mt Oku in the North west province (*Prunus* platform Meeting Report, Bastos Yaoundé, 16 January 2008). This work aimed to assess the impact of the exploitation on the fate of Prunus trees. Results indicated that about 90% of trees have been harvested using irrational techniques (debarking from roots to the branches) and 25% of those trees died or were dying.

Data compiled from the 1995 inventories conducted in the Mount Cameroon showed that the summit of the curve of overall distribution by diameter class was at 40-50 cm diameter class (Sunderland and Nkefor 1996), while the 2008 inventory revealed that this summit was reduced to 20-30 cm diameter class (FAO/SNV/CIFOR/ICRAFT 2008) in the same area (Figure 3a and 3b), which is a reduction of two diameter classes. This means that, the populations of *Prunus africana* are continuously declining due to over harvesting and inadequate techniques practised. Mature trees have been destroyed following over exploitation with inadequate harvesting techniques such as debarking and total cutting.

Several threats can be observed for *Prunus africana* in Cameroon: habitat loss/degradation, inadequate techniques of harvesting, over harvesting.

Prunus bark exploitation started in 1972, and many trees around the Mt. Cameroon have been exploited several times with four-year intervals. Legally for all trees above 30 cm dbh, only two quarters of the bark are taken from the main stem up to the first branch. However, since 1985, many people were involved in the exploitation and the harvesting was done by untrained villagers. Many trees were debarked up to the smallest branches and others were felled with negative impact on the limited wild population of this tree species.

Forest clearance leading to population fragmentation, slash and burn cultivation, burning of the upper grassland, and commercial plantations are said to be also threats for *Prunus africana* (Ndam 1996).

Annual quotas proposed for the sustainable exploitation of *Prunus africana* in the Adamaoua province was 493 tons/year (Pouna Belinga 2001). These quotas are not currently applicable, due to over harvesting.

To promote the conservation of *Prunus* in the North west province, some initiatives (Birdlife project, and SNV) have assisted local people in the process of community forests. The problem is that, the harvesting campaigns were not monitored in good manner. Many of those community forests were totally debarked, before their simple management plans have been approved by the forest administration.

Although available data do not allow to establish the decline in extent area of occurrence, it is clear that *Prunus* population decreases over the time in Cameroon in term of tree density, declining in area of occupancy, decline in habitat quality, and decline due to actual level of exploitation. In Cameroon, *Prunus africana* can therefore be considered at least as **an endangered plant species according to population reduction as outlined in the** IUCN check list for Non-Detriment Findings (IUCN 2001). This explains the ban recently pronounced by the European Commission on Cameroon's *Prunus*.

4.3. Management measures

4.3.1. *Management history*

4.3.1.1. The legal Framework

Some important official texts drawing the legal framework for the exploitation of *Prunus* are presented in table 5.

Table 5. Important official Texts

Reference number	**Date of Signature**	**Observation**
Decree No. 74/357	17 April 1974	(Sections: 74, 97, 98) to regulate the exploitation of medicinal plants. - a "factory (cahier d'entrée des produits à l'usine) to monitor the quantity of bark which enter the factory was made available.

Reference number	Date of Signature	Observation
Law No. 81-13	27 November 1981	To lay down Forest, Wildlife and Fisheries Regulations
Decree No. 83-69	12 April 1983	To lay down Forestry Regulations
Arreté No. 11/A/MINAGRI/DF/SEF	28 February 1991	To ban the exploitation of *Prunus* in Cameroon (except Plantecam)
Arreté No. 48/MINAGRI/DF	14 February 1992	To lift ban on the exploitation of *Prunus* exploitation
Decision No. 0045/D/MINEF/DF	11 January 1993	To ban felling in the exploitation of *Prunus*
Law No. 94/01	20 January 1994	To lay down Forestry, Wildlife and Fisheries Regulations
Decree No. 15/531/PM	23 August 1995	To lay down forestry Regulations
Decision No. 0336/D/MINFOF/DF	06 July 2006	To fix the list of special products of a "particular interest"

4.3.1.2. Procedure for the exploitation of Prunus africana according to the law No. 81-13 of 27 November 1981 (Former law)

Any person or Company interested in the exploitation of *Prunus* had to be holder of a special permit. They had to submit, and file an application to the Ministry in charge of Forest.

Attached documents

1) Stamped application specifying:
    a. full name, nationality, occupation and place of residence (for individuals);
    b. name, articles of Association, Head Office, Registered Capital and its distribution, and name of the Director or Manager (for companies).
2) The capita
3) Invested (Attestation):
4) The investment plan and the financing guarantee (means of transportation envisaged, existing storage facilities and other facilities to be set up. Measures taken to process part of the products locally).
5) List of species and quantities to be exploited as well as the location.
6) A statement of honour stipulating that the applicant has acknowledged the laid down regulations; that he undertakes to respect them and to co-operate with the forestry services.

In case of renewal of permit the attached documents are as follows:

4. A stamped application;
5. a copy of a former permit;
6. Receipts testifying the payment of the registration fee and the selling price of the product;
7. Copies of certificates of origin if the holder exports the product;
8. A detailed report of the activities of the previous season, specifying the quantities of products exported or produced locally.

The application was forwarded to the Minister in charge of forest (Ministry of Agriculture) with comments from the Provincial Chief of forestry (Conservator of Forests).

The special permit was issued by the Minister in charge of forest following recommendations of the technical commission.

Holders of special permit had to obtain from Forestry services specifications whose clauses indicate:

- the conditions of exploitation of the products;
- the conditions of transporting them;
- the terms and conditions of paying taxes.

The permit was notified by the Provincial chief of Forest (Conservator of Forest) following the presentation of a copy of the permit and the receipt of payment of taxes. (This was not however stated in the law).

4.3.1.3. Procedure for the exploitation of Prunus according to the current law (Republic of Cameroon 1994, 1995).

The procedure is almost the same with only two main changes:

1. The applicant must be granted approval first for forest exploitation activities;
2. The Provincial Chief of Forest must attach his technical report. This technical report specifies the species to be exploited, their quantities as well as the area and the harvesting modalities.

According to Ndibi (1996), three main causes explained the irrational exploitation of *Prunus africana* in the Mount Cameroon.

4.3.2. Management plan

If the Cameroon policy is sufficiently well defined for what concerns timber, wildlife and more recently community forestry, the policy concerning Non timber forest products (NTFPs) remains globally vague and lack of some precisions (Betti 2004).

Although the Cameroon Government has recognised the promotion of NTFPs as a means to alleviate poverty in rural areas and to generate revenue for the national economy, no adequate management regimes have been developed.

Cameroon Government distinguishes therefore two categories of Non timber forest products. The first group is composed of non timber forest products that the Government does not require any taxes from the harvesters, and the second group is those products from which the Government perceives taxes from any person willing to harvest or commercialize them. *Prunus africana* belongs to the second group, also known as “special products”.

The exploitation of special products is regulated in Cameroon mainly by the forest administration, Ministry of Forest and Wildlife. Two main Directorates are concerned in this administration: the Directorate of forests is in charge of the management of the resource, while the Directorate of promotion and processing is concerned with the valorization of that resource. The Ministry of Economy and Finances ensures the collection of taxes and fees through the Forest Revenue Enhancement Program (FREP). The only tax fixed till date by the national financial law for the exploitation of special products is called the regeneration tax, which is 10 FCFA/kilogram of the product (1 euro = 650 FCFA), while the fee perceived is 5% of any product exported.

Prunus africana has been recognized as a “special product with particular interest”. The article n° 2 of the Decision n° 0336/D/MINFOF of the 06th July 2006 giving the list of “special products with a particular interest” states that, those are products that are relatively less abundant in the forest or for which some additional measures are indispensable, due to the threatening caused by the non sustainable harvesting methods used by harvesters. The quotas of "special products with particular interest" are granted by an inter-ministerial commission comprising representatives from the forest administration, environment, research, finance, and other administrations.

In addition, the forest administration has identified *Prunus africana* as one of the six most important NTFPs in Cameroon that needs to be promoted for socio-economic development.

Prior to 1987, Plantecam Medicam, as it was known then, operated within a strict monopoly in the exploitation of *Prunus africana* in Cameroon. They set and adhered to strict harvesting guidelines such as no felling and no girdling but only the stripping of opposite quarters of the tree to allow for bark regeneration. Thereafter, a breakdown in this monopoly came with the issuance of licenses to a number of companies and individuals. This led to a dramatic increase in field operatives working in an area with corresponding increase in unsustainable practices, notably the felling of trees, total bark removal and non-respect for quotas set.

The lesson to be learnt here may be that increasing commercial competition without putting in place adequate management regimes, based on sound inventory data may probably lead to a corresponding increase in the amount and intensity of bark exploited. Therefore, the issuance of permits is not necessarily a guarantee of sustainability, especially when permits are issued with no harvesting controls being implemented (Sunderland and Tako, 1999 cit. Tieguhong & Ndoye 2004).

4.3.3.*Restoration alleviation measures*

4.3.3.1. EVOLUTION IN THE ALLEVIATION MEASURES ON PRUNUS

Moreover, the forest administration has often shown a great concern for the sustainable exploitation of *Prunus africana*. This concern could be well illustrated by the frequency of the regulation changes since 1972, suggesting that the administration is in permanent searching for the best way to manage the resources.

These changes and measures include among others: the conception of a field book in 1986 (Ndibi 1996), and recently in 2007 (Akagou 2008, Betti 2007). This field book enables the forestry services to monitor the exploitation weekly.

The partial ban of *Prunus* exploitation of 1991 which was lifted in 1992, the ban of felling decided in 1993, and the reduction of quotas in 2008 following the ban on the importation of Cameroon's *Prunus* in the Europe, after the decision undertook by the European commission in October 2007.

But, even when the regulations were quite good, they were unfortunately insufficiently implemented, or not at all. Most often, the measures were prescribed only in the face of a tragedy such as the recent destruction of *Prunus* in Mount Cameroon and North west, when the tendency was to consider only the immediate causes, forgetting the root of the problem. For example, despite the official ban in 1991, a greater quantity (3900 tons) of *Prunus africana* was harvested and exported between 1991 and 1992 than in any preceding year, indicating the lack of law enforcement and a high level of corruption in the production zone (Cunningham, 1997 cit. Tieguhong & Ndoye 2004).

Concerns on the future of *Prunus africana* led to its listing in Appendix II of the Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES) in 1994, becoming effective in 1995 (Sunderland and Tako, 1999 cit. Tieguhong & Ndoye 2004). The impact of listing *Prunus africana* by CITES has been partially effective in reducing threats because it has helped to raise awareness about the problems posed by international trade. Several nongovernmental, governmental and international bodies were involved in programmes to promote sustainable management of wild populations, cultivation and monitoring of the trade. For example, for some years the Mount Cameroon Project has been working with villagers to promote the sustainable management of *Prunus* South west provinces. Villagers were involved in monitoring the forest to guard against *Prunus* poachers and to help ensure, in the event of legal harvest, that only a part of the bark is removed (Ndam, 2004 cit. Tieguhong & Ndoye 2004).

Same initiatives were conducted in the North west province by the Birdlife International. Birthlife initiated two main projects in the North west province. The first project led from 1987 to 1992 and covered 10 000 ha in the Bui division, while the second project led from 1992 to 2004 and covered the same area in the Boyo division. The project aimed to protect the mountain forests as the principal habitat of two birds, endemic and threatened in the Mount-Cameroon: Banded-water eye and Banama Touraco. For this, the project focused its activities on the conservation of *Prunus africana*, important plant species for local people and for the two birds. The project adopted two main approaches: delimitating the perimeter of the 20 000 ha of the forest covering the two divisions by a *Prunus* hedge and promoting the rural forestery.

Prunus africana was planted together with *Podocarpus sp*, another useful plant species for local people, along the perimeter of the forest using a distance of 5 m within the trees.

The strategy of the rural forestry consisted of encouraging villagers in the domestication and development of *Prunus* plantations in their own forests. For that, the project confectioned nurseries from seeds, and distributed seedlings or small plants of 8 months (high to 50 cm) to villagers. To encourage villagers to plant and conserve their *Prunus* against the bush fires and against cheeps (cheeps appreciate to eat seedlings and young *Prunus*), the project provided incentives to those of the villagers who presented good results. The incentives were as follow: 25 FCFA/plant at the end of the first year, 15 FCFA/plant at the end of the second year, 10 FCFA/plant at the end of the third year, and 5 FCFA/plant at the end of the fourth year. The idea here was to allow the young plants to attend a certain age and high as to be able to resist to the concurrence of undesired plant species. The dead plants were not paid. So, the villagers built fences to protect their plantations against bushfire, identified as one of the main threat on *Prunus* in those humid savannas.

Birdlife project also trained local people on the suitable techniques of harvesting of the barks of *Prunus*, such as: harvesting trees of at least 17 years old, move the ½ opposite side, and return 4 – 6 years later to move the remaining sides on the same trees. According to Mr NKENGLA, the local divisional delegate of forest and wildlife for the Bui division who has been working for the Birdlife project for a long time, research activities conducted within the Birdlife project revealed that the length of the rotation varies with the zone (division). Hence, in the Boyo division where the weather is too hot, results obtained tend to show that the harvester can return to the same tree after 4-5 years, while in the Bui division where it is too cold, this harvester must wait 5-6 years before returning back to the same tree. At 15 -17 years old without any fertlizer, *Prunus* can reach a diameter of 30-35 cm at high breast.

The problem is that, the villagers did not feel responsible for the development of those plantations. They did not wait till the plants get 17 years old as suggested before engaging in harvesting their *Prunus*. This exploitation started early by 1999 – 2000 (at 12-13 years old), so the product was not good in term of both quantity (volume of the barks) and quality (concentration on active compound). By 2002, so 15 years after the first plantations have been settled (1987), the forest administration who was working in partnership with the Birdlife project, initiated a circular letter asking to villagers to wait the control of the forest officers before harvesting their *Prunus* barks. The terms used in this letter were not appreciated by the villagers, who thought that the forest administration was trying to have the total control of their plantations. Also, the problem of distinction between the conditions of harvesting domestic *Prunus* and wild *Prunus* was not clarified by the forest administration. According to the current forest legislation, products of domestic origin are not subject to the payment of the regeneration tax. This tax is only required for the wild *Prunus*. But the forest administration has never applied this in the field. As a consequence of all those problems, villagers started engaging negotiations with some companies to harvest their

Prunus out of the control of the forest administration. Villagers sold their plantations to the companies who used easily to fell trees and move the maximum of barks. The price of tree varied from 4000 FCFA to 8000 FCFA, while that of the kilogram of the barks oscillated between 60 FCFA and 100 FCFA.

For the *Prunus* hedge strategy, the trees were destroyed more early, at 8-10 years old, than the rural forestry strategy. Villagers knew that the *Prunus* hedges did not belong to a specific person, but to the forest administration or to Birdlife. Thy therefore decided to destroyed those plantations and sell the products to companies, which illustrates once again the problem of lack of responsibility observed for those *Prunus.*

It is in such a situation that all the *Prunus africana* trees planted by the Birdlife project and villagers were destroyed in the North west province.

By 2000, when the planted trees were destroyed in the two former strategy, Birdlife profit of the clauses of the new forest law (Republic of Cameroon 1994, 1995) and the publication of the manual of procedures for community forests. The project therefore decided to experiment a third strategy, which was the community forestry. This strategy aimed to enhance the implication of villagers in the forest management, to enhance the appropriation of their plant trees, and to facilitate the transition between the project management phase and the local community management phase.

To make the villagers more responsible of their trees, Birdlife divided the 20 000 ha of the space in 17 community forests, with the *Prunus* exploitation being the main activity to conduct in those forests. As an international NGO, Birdlife made lobbying towards other NGOs and international organisms to ban the exploitation of *Prunus africana* barks in this forest. All was done well, as planned, since the forest administration did not allocated any special permits for Prunus in this forest. Birdlife financed and assisted local communities in the development of the simple management plans of those community forests. The first management plans were developed in 2002, the last in 2003. The inventories conducted for drafting those plans were the multi-resource inventories types, consisting mainly of prospecting the forest. The beginning of the activity in the community forests is conditioned by the approbation of the simple management plan and the signature of the management convention by the forest administration. Birdlife incited the forest administration to quickly approve those management plans and sign the convention. But the condition made by the forest administration was that, Birdlife should assisted communities in the realization of a fair and rigorous systematic inventory (at 100%) in each forest, before the villagers begin to harvest. This was possible, since the Birdlife project was planned to end by 2008. The five-years management scheme drawn in each simple management plant was as follow:

- year 1 (2003): organization of the community;
- year 2 (2004): systematic inventory (100%) of the community forest;
- year 3 (2005): research of the market, waiting that the forest administration approves the inventory;
- year 4 (2006): beginning of the exploitation of *Prunus* barks in the forest;
- year 5 (2007): exploitation of *Prunus* barks continues.

The problem is that, in 2004, the Birdlife project was closed. The only project on which was built all the hopes of the local populations ended, before the villagers have realized the systematic inventories planned the same year (2004). Local people started therefore to harvest the Prunus in their community forests with irrational techniques. Villagers faced the lack of funds to realize the systematic inventories.

Some communities such as the Emfveh-mii Forest Management Common Initiative Group (EMIFOMA) were assisted by the local forest administration to conduct their systematic inventories and win their annual certificate of exploitation. But these inventories were not conducted in fair manner. It consisted mainly to “the research of the resource”, than to a systematic inventory. Only trees with diameter 35 cm were counted. In spite of those weakness in the realization of the inventory, the forest administration delivered the annual certificate of exploitation to EMIFOMA. It is in such a way that, many community forests received their annual certificate of exploitation, which will be in the future detrimental to the conservation of the resource in the North west.

By 2005, some companies which exploit special products were informed by the departure of the Birdlife project. They also were informed by the existence in the area, of many community forests which were under management convention with the Government. And the companies were informed of the detention by those communities, with the annual certificate of exploitation. The companies therefore made pressure to the forest administration, to obtain to exploit *Prunus* barks in these zones. By February 2006, the forest administration signed four special permits to the following companies: CEXPRO, CATRACO, NNA & SONS, and FONGANG. Harvesting of *Prunus* barks began well, and the funds generated from the exploitation were used to develop community projects.

The problem is that, in two permits (FONGANG and NNA & SONS), the precision was not made to the target community forest. The forest administration has just put, the Kumbo forest, in the Bui division. This detail encouraged those companies to practice illegal harvesting, with some villagers. In fact, some villagers who were not satisfied with the way by which the funds raised towards the exploitation of the community forest, were used, used to return in the forest by night and move barks on the sides left by legal harvesters during the day. The poachers, used to sell their products to the two companies (FONGANG and NNA & SONS), which was detrimental to the conservation of *Prunus* in the North west province.

Also, legal permits holders used to stay far from the harvesting sites, often in the city of Kumbo. Some poachers used to come to Kumbo to sell their products to these permit holders. The permit holders were not often in the field to control and monitor the harvesting of barks. Due to the weakness observed in the realisation of the systematic inventories, many communities have finished all their *Prunus* potential before the term of the management plans in the North west province. The local forest services did not undertook any control.

The SNV Highlands in collaboration with the Western Highlands Nature Conservation Network (WHINCONET) examined the impact of the exploitation on *Prunus* trees (*Prunus* platform Meeting Report, Bastos Yaoundé, 16 January 2008). About 90% of trees have been harvested using irrational techniques (debarking from roots to the branches) and 25% of those trees died or were dying, which confirms what is saying here.

Following what precedes, it can be observed that both legal and illegal exploitation have led to the destruction of *Prunus* population in the North west province.

It was hoped that these and similar efforts made by both the Mount Cameroon project in the South province and the Birdlife project in the North west province, will suffice to ensure that future supplies of the bark are harvested in sustainable ways. But it was not the case, since these efforts stopped with the close of those projects.

Unsustainable harvesting of *Prunus* was also observed in the Adamaoua province where some sites hosting *Prunus* have been totally destroyed due to high poaching (Akagou & Betti 2007).

The lesson to be learnt here may be that inviting local communities to earn the community forests is not enough. The Government may explore associated measures to assist these communities in the development and implementation of those management plans.

4.3.3.2. SIMULATION OF SUSTAINABLE YIELD OF *PRUNUS AFRICANA*

Simulation of sustainable yield of *Prunus africana* was proposed for the Thabal Mbabo and Tchabal Gang Daba in the Adamaoua province (Pouna & Belinga 2001) and for Mount Cameroon in the South west province (Ewusi et al. 1996).

In the two provinces, a prediction of the sustainable yield of *Prunus* bark was made from estimates of the natural population, the average yield per tree and the length of time between successive debarkings required to allow total recovery of the bark.

Ys = (D x A x H)/R.

Ys = sustainable yield of bark per annum for the area;

D = population density of exploitation trees (stems/ha);

A = area of exploitable forest containing *Prunus*;

H = average sustainable yield of bark per tree (kg freshweight/tree/harvest);

R = rate of total recovery of the bark (in years).

In Mount Cameroon, quotas proposed are presented in table 6.

Table 6. Sustained Yield calculation in Mount Cameroon: most pessimistic and most optimistic estimates (Ewusi et al. 1996)

	(D) Population density (stems/ha)	**(A)** Area of exploitable forest (ha)	**(H)** Sustained yield per tree (kg)	**®** Rate of recovery (years)	**(Ys)** Sustained Yield (tons/year)
Lowest Estimate	3.5	12 000	55	7	**330**
Highest Estimate	7.2	18 000	137	4	**4 438**

Estimates from the results of inventory conducted in the Adamaoua province are presented in table 7.

Table 7. Sustained yield calculation in the Adamaoua province (Pouna & Belinga 2001)

	(N) Exploitable stems	**(D)** Population density (stems/ha)	**(H)** Sustained yield per tree (kg)	**®** Rate of recovery (years)	**(Ys)** Sustained Yield (tons/year)
Tchabal Mbabo	833	8.22 (5.45 – 11.57)	55	10	**493.6** (at the lowest estimate)
Tchabal Gang Daba	29	0.99 (0.41 – 1.57)	55	10	**8.8**(at the lowest estimate)

For the both provinces, a wide range was extremely observed between the lowest estimate and the highest estimate, illustrating the lack of information on the size of the population (3.5-7.2 stems/ha in Mount Cameroon, 0.41-1.57 in Tchabal Gang Daba and 5.45-11 for Tchabal Mbabo), the sustained yield per tree and the rate of recovery of harvested trees. The calculation for Mt-Cameroon was based on inventory data from 1992, which have already been criticised (Cunningham and Mbenkum cit. Ewusi et al. 1996) for being biased towards the areas rich in *Prunus africana* thus giving over-estimates of the average population density over the licence area. Moreover, up to 50% have been reported to be dying or already dead, due to previous over-exploitation. Large scale felling by illegal exploiters has also taken place in extensive areas (Ewusi et al. 1996).

The Tchabal Gang Daba site has never been subject to any exploitation. Trees were not debarked. But the Tchabal Mbabo site has been subject to large and irrational exploitation. Poachers attacked trees (23.67%) with diameter less than the minimum exploitable diameter (MED) fixed by the forest administration and which is 30 cm. Further, 11.3% of trees were fell or totally debarked till branches (Pouna & Belinga 2001).

Comparison of harvests with estimates of sustainable yield in Mount Cameroon

1970s to 1994

During this period exploitation was done by Plantecam employees from the west province, and the quantity granted in their exploitation licence was 6 500 tons over a period of five years (1 300 tons/year). This quota was initially given for three provinces including South west, North west, and West. But at subsequent renewal, this same quota has been maintained for much restricted zone of Mt-Cameroon. Available data from Plantecam records indicated that they have been exploiting below this figure. The estimated yields for ten year period are 4.478 tons, or 448 tons per annum (Ewusi et al. 1996).

1994-1996

Since June 1994, a major outbreak of illegal exploitation has considerably increased the offtake of bark of *Prunus* from Mt-Cameroon. From their figures, during the period 1 January 1994 to 30 June 1995, Plantecam harvested 1 388 tons of bark. This corresponds to an annual harvest of 926 tons (Ewusi et al. 1996).

During almost the same period (June 1994 to December 1995), reports from villages around Mt-Cameroon estimated a further 884 tons of bark exploited illegally. This corresponds to an annual harvest of 590 tons (Ewusi et al. 1996).

Thus over 1994 – 1995, total annual exploitation levels from Mt-Cameroon have increased to 1.516 tons per annum. This is more than three times higher than the previous exploitation level of the previous ten years, and is much higher than the lower estimate of the sustained yield from Mt-Cameroon which was 330 tons/year.

Reports confirmed the fact that the natural population has suffered major damage from both legal and illegal exploitation (Ewusi et al. 1996), reducing the population from all previous inventory estimates by up to 50% in two years (1994 – 1995).

4.3.3.3. SYNTHESIS AND RECENT ALLEVIATION MEASURES

Data discussed in the precedent section tend to show that, the exploitation of *Prunus africana* has never been conducted in sustainable manner in Cameroon, in spite of the effort made by the forest administration.

The development of simple development plans for the sustainable harvesting and trade of *Prunus* and other special products remains the gap and the challenge for the Cameroon Government.

Sustained yields of bark must be based on more accurate up to date estimates for all factors in the equation. It must also err on the side of caution given the uncertainty surrounding the rates of recovery of trees subject to 50% bark removal. Until these accurate figures are available from inventories and further studies, no quotas should be authoritatively given for any area.

Since 2007, the forest administration took some important measures to alleviate poaching in the exploitation of *Prunus africana*. These measures include: the restoration of the field book for the companies and harvesters, the instauration of specific way bills for the circulation of Special products, the erection of an important part of the Mount Cameroon in national park, and the reduction of quotas granted for *Prunus*.

5. UTILIZATION AND TRADE

5.1. Different uses

In Cameroon, *Prunus* is used in traditional medicine and for confectioning different materials.

The use for medicine varies between regions. In the North west, the leaves and roots, along with bark, are used to treat fever, as an infusion in hot water. In the Mt-Cameroon region, an infusion of the bark is used to treat chest infections or as a tonic. A tea from the bark is drunk in significant – unspecified – quantities. The patients epiglottis is then stimulated with the feather of a cock to induce vomiting (Sunderland and Nkefor 1996). *Prunus* was identified as the fouth most popular plant species used to treat malaria, fever and stomach ache around the Mt-Cameroon (Jeanrenaud cit. Ndam 1996). The bark is the major source of an extract used to treat benign prostatic hyperplasia, an increasingly common health problem in older men in the western world. Bark extracts contain fatty acids, sterols and pentacyclic terpenoids (Cunningham and Mbenkum 1993). The drugs processed from the bark extracts are sold under the brand-name of "Tadenan" in France by Laboratoire Debat, "Pygenil" in Italy by Idena Spa, and "Proscar" in UK by Merck Sharp and Dohme Ltd (ICRAFT cit. Nouhou Ndam 1996).

In both North west and South west provinces, the timber is valued as hoe, pick and axe handles. The poles are used for fencing and the wood is also used as firewood and for charcoal. The wood is hard and heavy, weighing about 720 to 768 kg/m3 when dried (Sunderland and Nkefor 1996, Vivien et Faure 1985).

Although some villagers have planted *Prunus* in their forests, the important quantity of bark currently export comes from wild populations.

5.2. Harvest and international trade in *Prunus* bark

5.2.1. Attribution of quotas

Plantecam was the largest single exploiter of *Prunus* bark in Cameroon. This firm had the monopoly on exploitation until 1987 (Table 8).

Table 8. Quotas of *Prunus* attributed to Plantecam company between 1972 and 1986 (Ndibi 1996).

COMPANY	QUANTITY	YEAR	AREA
PLANTECAM	500	1976	NWP, SWP
PLANTECAM	500	1977	SWP
PLANTECAM	500	1978	NWP
PLANTECAM	500	1978	SWP
PLANTECAM	500	1979	NWP
PLANTECAM	500	1979	SWP
PLANTECAM	500	1980	NWP
PLANTECAM	200	1980	W
PLANTECAM	300	1980	SWP
PLANTECAM	1000	1982	NWP, SWP, W
PLANTECAM	800	1983	NWP, SWP, W
PLANTECAM	1300	1986	NWP, SWP, W

Plantecam had an interest in protecting the existing resource and adhered to the forestry Department recommendations for bark stripping.

The economic crisis in the latter half of the 1980s and the structural adjustments implemented subsequently contributed in enhancing massive forest operations (both timber and non timber forest products) and accelerating the forest degradation. All economic sectors being affected by the crisis, the forest sector (timber and non timber forest products) sector was representing the one that was still going well and was attracting everybody. The importance of the forest sector at this period did not only attract formal companies, but also citizens from towns and villages, thus leading to the proliferation of illegal logging and poaching in *Prunus africana*.

As a result of the high demand, in 1987, 50 new licences were issued to contractors who began to sell to Plantecam themselves. This led to an increase in exploitation, much of it uncontrolled.

The 50% devaluation of CFA, was now worth only 400 CFA. It then became far more profitable for other companies, especially in Italy, to import bark from Cameroon. The national contractors, eager to supply, began to exploit *Prunus* bark around Mount Cameroon. The majority of this exploitation was illegally undertaken with entire trees being felled and/or stripped completely (Sunderland and Nkefor 1996).

Table 6 presents the quotas (tons) of *Prunus* barks attributed by the inter-ministerial Commission for quotas for the period 2004 – 2007.

A total of 33 companies have been authorized to exploit *Prunus africana* between 2004 and 2007 (table 9). Some 6 544 tons of barks were granted to those companies, with the year 2005 being the most important in terms of the quantity of bark (2000 tons).

Table 9. Attribution of quotas (in tons) in *Prunus* to different companies by the Inter-ministerial Commission of Quotas from 2004 to 2007.

COMPANY	**YEAR-2004**	**YEAR-2005**	**YEAR-2006**	**YEAR-2007**	**TOTAL**
ETS EFFA JBP & Cie	50	50			100
ETS ERIMON	50	75	50		175
ETS ESSAM & FILS		10			10
ETS ESSAMA	10				10
ETS FONGANG & FILS	30	100	50		180
ETS IK NDI & BROS Enterprise	50	50			100
ETS KAMDEM	30				30
ETS KOPGUEP	50	50		44	144
ETS MEDOU NJEMBA & FILS	50	50	40		140
ETS NAH & SONS	50				50
ETS NFORKEMBA	20	5			25
ETS NGAH DIMA DAMIEN	50	50			100
ETS NGAKO & FRERES	50	50			100
ETS NGUENANG EMMANUEL	50	50	20		120
ETS SOCAMBA	20	20			40
ETS TAY & FRERES	20	20			40
STE AFRICA PHYTO INTERNATIONAL	50	200		160	410
STE AFRIMED	500	500	520	550	2070
STE BOIS & METAL DU CAMEROUN			50		50
STE CATRACO	100	100	10		210
STE CEXPRO	100	100		200	400
STE CRELICAM	20				20
STE GENERALE DES PRODUITS				300	300
STE ITTC	100	100		50	250
STE MARCO				20	20
STE MOCAP		100			100
STE MPL	100				100
STE MUKETE PLANTATION		100	10		110
STE PHARMAFRIC			170	170	340

COMPANY	YEAR-2004	YEAR-2005	YEAR-2006	YEAR-2007	TOTAL
STE PRODEGON				20	20
STE SACO	50	50			100
STE SGPA	150	150	340		640
STE SIFAM	20	20			40
TOTAL	**1770**	**2000**	**1260**	**1514**	**6544**

As it can be observed in figure 2, the number of companies decreases from 2004 (25 companies) to 2007 (9). Many companies which have not paid their taxes for the previous years were eliminated by the Commission.

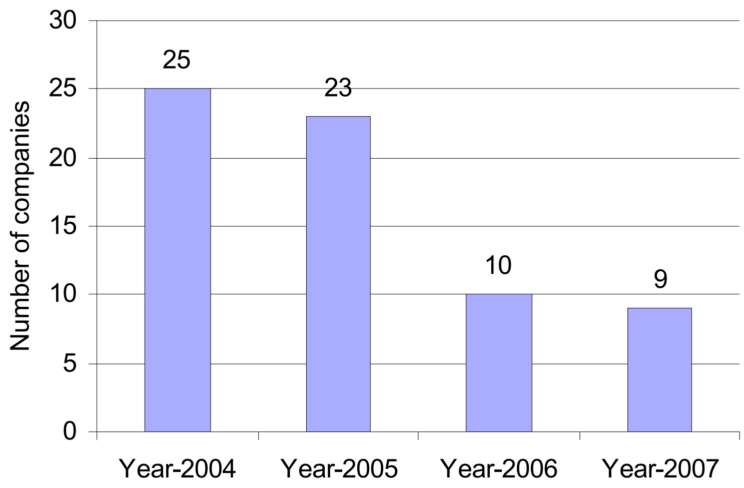

Figure 2. Distribution of number of companies per year

Figure 3 illustrates the relative importance of companies in term of percentage of quotas attributed during the four years. Only the ten most important companies were selected. AFRIMED (31.63% of quotas) and SGPA (9.78%) appear to be the two most important companies to whom the Government has allocated quotas for *Prunus* between 2004 and 2007.

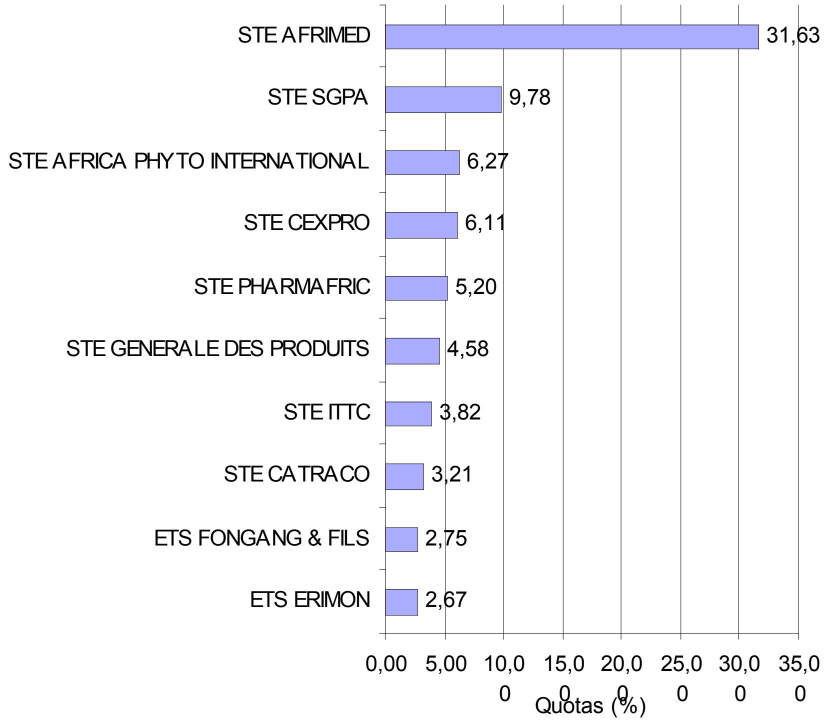

Figure 3. Relative importance of companies according to quotas allocated between 2004 and 2007.

5.2.2. *Harvest zones, seasons and harvesting techniques*

Informations presented in this section are based on my own experience, following the monitoring mission which I participated in 2007 (Akagou et Betti 2007). Permits for *Prunus* barks as for other special products are granted to companies for one year. The area of exploitation is vague, just at the level of the province. Before, permits were allocated for three provinces: West, North west, and South west. Now, those permits are restricted to the two last provinces. Nothing is said about the precise site where the product may be collected. This is one of the causes of weakness in the actual system of control and monitoring at the local level.

The season of harvesting is not specified also in the permits. This depends on the conditions of the milieu. For example, exploitation on Adamaoua can only be possible during the dried season, due to the bad conditions of roads. This problem was largely outlined by Mr MBIYNDZENYUN Julius, a representative of the company AFRIMED, one of the two societies who are working in harvesting *Prunus* barks in the Adamaoua province. Mr MBIYNDZENYUN Julius, 34 years old, is the Chief of exploitation of AFRIMED. He was sent in Banyo (Adamaoua) in 2003 Contrary to the North west and South west provinces where vehicles can rich the site of harvesting for transporting products, in the Adamaoua the situation is too difficult, mainly in the Mayo Banyo and Faro Idéo divisions. The only vehicle which is used in these zones is called "STYR". This is a sort of military truck which is used in dried season to climb hills and transport barks. Due to the bad conditions of the roads, some stocks of *Prunus* barks are often abandoned in the forest. The dry season is the suitable period for harvesting Prunus barks in the Adamaoua hills, during the month of April, May, June, and rarely December.

For Mr MBIYNDZENYUN Julius, the stems of *Prunus* are harvested at 1 m height, until the first large branch, and only on trees of 30 – 40 cm of diameter. The first harvesting collects the first ½ of the stems at opposite sides. The harvester may be careful and should avoid to injure the sapwood. The second harvesting comes to the same stem after 4-5 years to collect the remaining ½ of the barks at the other opposite sides. This time (4-5 years) is known to be enough to allow the two former sides which were debarked to regenerate a little bit as to permit the tree to resist to the second harvesting. The regenerate side can also be used, but according to Julius, the juice (active compound) is not yet good for medicines. Also, the quantity of the barks is still small for exploitation. The minimum period required for a bark to regenerate and be good for harvesting is 8 years.

The problem is that, these regulations are not often practised in the field by harvesters. The chain of harvesting of Pygeum in the Adamaoua province is as follow (table 10): the harvester – the Chief of team (chief of harvesters) – the Chief of exploitation - the Representative of the company – the Director of the Factory (Company).

Table 10. Chain of exploitation of Prunus in the Adamaoua province, from the tree to the factory

Level	Task
Harvester: often from the North west origin, "anglofone people"	He is based in the forest. He removes barks from trees; transports the barks first to the forest park and then to the Car. Sometimes they can transport the products on 15 km before reaching the car.
Team Leader	He is based in the forest and more often in the surrounding villages. He coordinates the work of harvesters; dresses the financial report for any harvester for the Company
Chief of exploitation	He is based in the city of Banyo. He ensures the liaison between the harvesters and the representative of the company. He supervises the job of two to three teams of harvesters in the area. He goes to the forest once a month to pay the harvesters, distributes logistics (goals, cutlass, …) and food, and transport the green products from the hills (forest) to the city of Banyo by a specific vehicle called "STYR". This car of about 2.5 tons is often rented at 150 000 FCFA/tour. In Banyo, the Chief of exploitation dries the products and put them in bags. The price of one kilogram of the green product is 50 FCFA in the forest, and 150 FCFA if the harvester has transported it by himself to Banyo.
Representative of the Company	He is based in Bafoussam, at the factory. He comes in Banyo once a month to pay people, gathered dried products and transports them to the factory settled at Kamkop Palace, in the city of Bafoussam by big trucks (12 tons).
The Director of the factory	The factory of AFRIMED is based in Bafoussam, at Kamkop Palace quarter to be précised. The factory is built on a surface area of 0.7 ha and deals mainly on the primary processing of the barks of *Prunus* (Ø 04 mm and Ø 25 mm).

As it can observed, neither the representative of the Company, neither the chief of exploitation, and nor the team leader do not know with exactitude, how the harvesters operate really in the field. One thing is certain for the harvester: more he gets the product, more he will be paid. Consequently, the harvester collects the maximum of barks, using sometimes felling techniques in order to obtain the tonnage he has fixed or required by his patrons. This confirms what was observed by the National Office of Forest Development (Pouna Belinga 2001) during the field inventory conducted in this zone in 2001. In fact, in the Tchabal Mbabo site, 23.67% of trees with diameter less than the minimum exploitable diameter (MED) were attacked by poachers. To conserve the products against the humidity (rains), harvesters use to bury (enterrer in french) the barks in the soil and wait the arrival of the "STYR".

Mr WANKY, 34 years old, is also coming from the North west province. He is the equivalent of Mr MBIYNDZENYUN Julius for the ERIMON company, based at Bamenda. He is supervising the activities of two teams of harvesters of the *Prunus* barks in the same province and zones. For Mr WANKY, the problem of road remains the main limiting factor for the exploitation of *Prunus* in the Adamaoua hills. Due to the bad conditions of transport, ERIMON has already lost about 2.5 tons of products following the accident of its STYR. For that reason, the company has decided to wait the dried season (December) before transporting the 8 tons of the products harvested and stocked in the hills since the month of Jully. Such a situation is currently observed in the harvesting sites, which is not good for both the company and the Government. For the Representative of AFRIMED (Julius), this practice is not good, since the after 3 – 4 months of stocking in the forest, the product degenerates and loses its active compounds.

One of the problems outlined by both the chief of exploitation and the Director of the factory of AFRIMED in Bafoussam was related to the administrative procedures. The Administrative procedures for issuing special permits are lengthy and complicated. These procedures are not adapted to the local context. Special permits are issued for one year. Really, the holder of this permit works for only three to four months during the year, since he cannot work in the rainy season. More often, the inter-ministerial Commission in charge of attribution of quotas holds its meeting by the month of January, and permits are issued by February or March of the year. By November, the holder of the special permits is requested to submit his annual activity report to the forest administration. This means that the months of January and December which are considered as dried months are not effectively exploited by the company.

Mr SOULEYMANOU is native from the Sambo Labo village, in the Mayo Banyo division. He was elected by local populations at the post of fourth deputy of the Mayor. Mr SOULEYMANOU firstly outlined the irrational techniques of harvesting used by the harvesters, before denouncing the conflict relations existing between the local populations and the companies and harvesters. Mr SOULEYMANOU reminded that the exploitation of *Prunus* began in their area since 10 years ago, in 1997. The previous sites of exploitation have totally been destroyed due to inadequate and irrational techniques of harvesting used by the harvesters. The techniques of harvesting used were the systematic felling of trees and total debarking of stems. Consequently *Prunus* population declined drastically. Two forests have in such away, been totally damaged including the site of Danwark and that of Dadawal, next to Sambo Labo. The permit holders used to go into the forest without contacting local authorities (the Mayor, the Lamido and the chiefs of villages). These declarations were confirmed by the local Chief of forest and wildlife control post of Sambo Labo.

When the permit holder was asked to contribute to the local development projects, he used to refuse, claiming that he has nothing to treat (deal) with the villagers, since he has already paid all his taxes to the forest administration in Yaoundé. For Mr SOULEYMANOU, the permit holders do not respect the local populations because they are not educated enough to make any claim. This situation generated many conflicts and tensions among the two groups of stake holders. Mr SOULEYMANOU said that he has dressed many letters to the Government to claim the payment of some taxes for the benefice of local people for the exploitation of *Prunus* barks in their area. No reaction has been done by the Government. Finally the “Sous Prefet” of Banyo invited all stake holders in Banyo for a meeting of reorganisation of the sector of *Prunu*s in the Banyo subdivision. Any company willing to harvest *Prunus* in the Banyo subdivision was requested to pay some additional taxes. These taxes include: a fix sum of 300 000 FCFA per year to the local Council (the Mayor), a sum of 5000 FCFA per vehicle transporting the product (STYR) to the Council. Also, the company was asked to engage local young people in the harvesting activities as to combat unemployment in the area. AFRIMED began paying regularly their taxes. They also proposed to engage some young persons, who finally ran away following the hard conditions of harvestings. In fact, harvesters have to resist to the high degree of cold in the Mayo (hills), and they have to transport huge quantity of barks (about 70 kg) on a distance of 15 km to reach the vehicle (STYR). These conditions can only be supported by the “anglofone boys” who come from the North west province, but not by the local young persons who prefer work on livestock.

The local Divisional Delegate of Forestry and Wildlife for the Mayo Banyo division together with the local Chief of forest control post of Sambo Labo recognised their incapacity to monitor efficiently the harvesting the *Prunus* barks in the hills of Mayo Kélélé and others. They underlined the problem of collaboration with the companies. Often, harvesters are working in the forest without any signalization to the Delegate or the local Chief of the Forest control. They use to treat only with the provincial Delegate who is based at Ngaoundéré, too far from Banyo. Same situation was made for the Faro Idéo division, that is next to Mayo Banyo and which also gets some *Prunus*. Another problem outlined by the local forestry services was that of lack of vehicle to transport them to the harvesting site to undertake control and monitoring. This problem together with that of lack of precision in specific sites of harvesting in the permits cannot allows the local forest services to gather statistics on *Prunus* in the Adamaoua, which is detrimental to the conservation of the resource.

The lesson to be learnt here may be that the procedure of issuing the special permits should be in accordance with the reality of the sector, aiming to maximise the exploitation of the *Prunus* barks during the dried months which include: January, April, May, June, and December. Also, the forest administration should enhance the synergy between its external services and provide them with sufficient logistics for enhancing control and monitoring of the harvesting of *Prunus* bark in the Adamaoua province.

5.2.3. *Exportation*

Data recorded for two years (2005-2006) by the Trade forest products database (COMCAM) based at Douala, are presented in table 7. These data are recorded from the specific bulletins (bulletins de specification in french) dressed by the Chief of Forest and Wildlife post n°1 based in the entrance of the Port of Douala.

A total of 2558.37 tons of *Prunus* bark exported from the Douala port was recorded by the COMCAM database. The most important quantity of the barks was exported in 2005 (1498.5 tons) and the remaining (1059.87 tons) was exported in 2006.

Table 11. Exportation of *Prunus* from the Port of Douala (COMCAM cit. Betti 2007)

COMPANY	**Weight (tons)**	**Destination**	**Year**
AFRIMED	346,87	France	2006
AFRIMED	270	Espagne	2006
CEXPRO Sarl	160	France	2006
CEXPRO Sarl	38	Madagascar	2006
PHARMAFRIC	60	France	2006
SGPA	185	France	2006
AFRICAPHYTO	50	France	2005
AFRICAPHYTO	60	Espagne	2005
AFRIMED	361	France	2005
AFRIMED	662	Espagne	2005
CEXPRO Sarl	139	France	2005
CEXPRO Sarl	27	Madagascar	2005
CEXPRO Sarl	18,5	Maroc	2005
CEXPRO Sarl	14,5	Espagne	2005
ETETKAM	3,5	USA	2005
IK NDI & BROS	13	France	2005
SGPA	150	France	2005
TOTAL	**2558.37**		

What ever be the year, AFRIMED, CEXPRO Sarl, and SGPA are in this order, the three most important and regular companies exporting *Prunus* barks from the Douala port (figure 4).

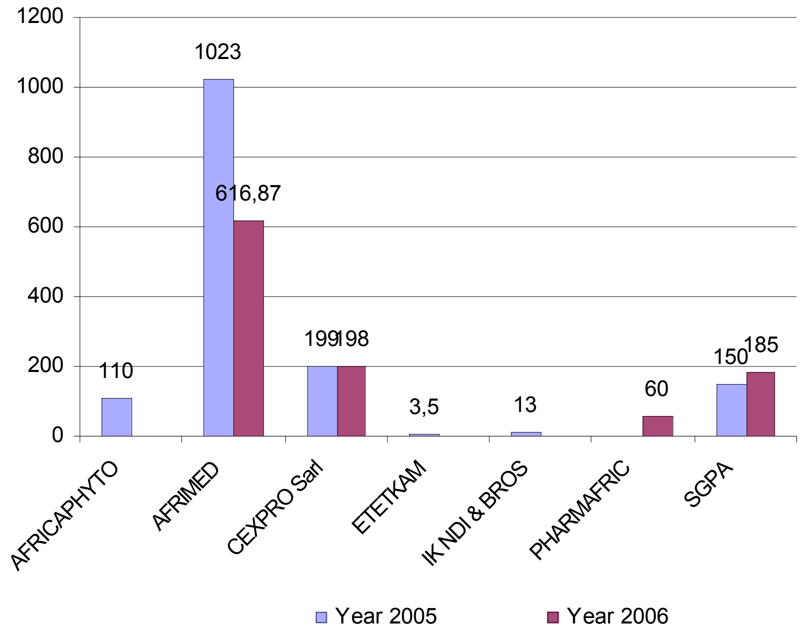

Figure 4. Distribution of quantity of *Prunus* barks in different companies in 2005 and 2006.

Table 12 presents data from the CITES permits issued by the Forest administration in 2006 and 2007.

According to the Cameroonian CITES management authority, a total of six companies exported 2144 tons of *Prunus* barks from Cameroon in 2006 and 2007. The most important quantity was exported in 2006 with 1497.5 tons, which is largely different from the records of the COMCAM database (1059.87 tons).

Only 646.5 tons were exported in 2007, following the ban observed by the European Commission on the Cameroon *Prunus* in October 2007.

Table 12. Records from the CITES permits on *Prunus* for 2006 and 2007.

COMPANY	QUANTITY (ton)	YEAR
AFRIMED	**709**	2006
AGRODENREE	**40**	2006
CEXPRO	**284,5**	2006
IK NDI	**9**	2006
PHARMAFRIC	**120**	2006
SGP	**335**	2006
AFRIMED	**245**	2007
CEXPRO	**161,5**	2007
PHARMAFRIC	**120**	2007
SGPA	**120**	2007
TOTAL	**2144**	

Six companies obtained CITES permits on *Prunus* in 2006, which is less than the 10 companies to whom the inter-ministerial commission allocated quotas of the same product.

Figure 5 illustrates the repartition of the quantity of *Prunus* barks within the six exporting companies in 2006. AFRIMED, SGPA, and CEXPRO appear to be in this order, the three most important companies which exported *Prunus* bark from Cameroon in 2006.

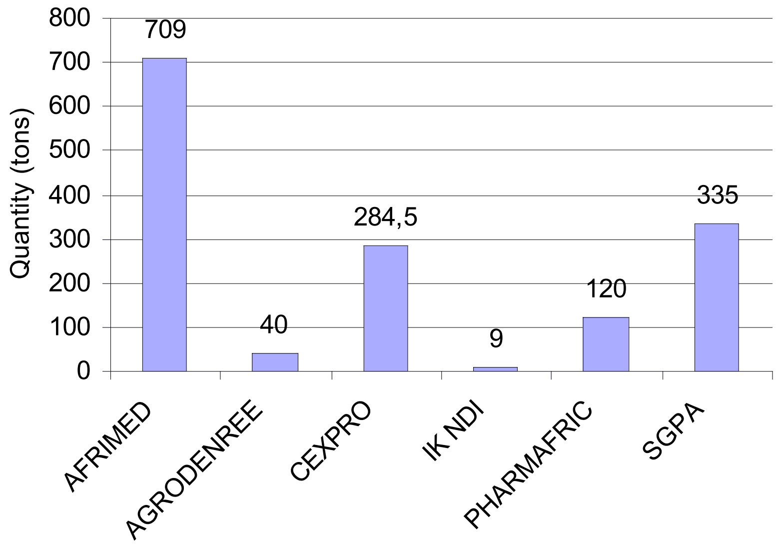

Figure 5. *Prunus* barks recorded in CITES permits and per company in 2006.

Data from the COMCAM database and from the CITES management authority are presented in table 13. As it can be observed, the quantity of *Prunus* bark recorded by the CITES management authority is more high (1497.5 tons) than those recorded by the COMCAM database (1059.87 tons). Some 437.63 tons of *Prunus* barks exported in France (270.63 tons), Spain (120), Madagascar (38) and China (9) were not registered in the COMCAM database, which tends to confirm the weakness of the control and monitoring system of the Cameroon Government on forest products. COMCAM/Douala is for the moment, the only database in charge of gathering forest products trade data for the forest administration, forest companies, and the National Institute for Statistics in charge of the compilation of data on trade products in the whole country.

Table 13. Comparison of data recorded by the trade products database (COMCAM) and the CITES Management authority for the year 2006.

COUNTRY	COMCAM	CITES PERMITS	DIFFERENCE
Espagne	270	390	120
France	751,87	1022,5	270,63
Madagascar	38	76	38
Chine		9	9
TOTAL	**1059,87**	**1497,5**	**437,63**

But what ever be the source of data, France, Spain, Madagascar, and China are in this order the main importing countries for *Prunus* barks coming from Cameroon.

The lesson to be learnt here may be that issuing the special permits without a good system of traceability to monitor the quotas is detrimental to the resource.

6. MONITORING SYSTEM

6.1. Circuit of special products in the country

The main services working in the classical circuit of exploitation, transport, and exportation of special products belong to the Ministry of Forest and Wildlife/Fauna (MINFOF), Ministry of Agriculture and Rural Development (MINADER), and Ministry of Economy and Finances (MINEFI). This circuit is described as follow:

- MINFOF/Service in charge with agreements and titles: issuing of agreements and titles (special permits);
- MINEFI/ Forest Revenue Enhancement Program (FREP): issuing of receipts of the payment of the regeneration tax;
- MINFOF/Service in charge with the management of the forest database: issuing of the carnets for the way bills, monitoring of the quotas;
- MINFOF/ Provincial Delegation: issuing of the notification for the beginning of the exploitation (harvesting) of the resources granted and listed in the permit at the scale of the province;
- MINFOF/Divisional Delegation: issuing of the notification for the beginning of the exploitation (harvesting) of the resources granted and listed in the permit at the scale of the division;
- MINFOF/Control post n°1: issuing of the notification for the beginning of the exploitation (harvesting) of the resources granted and listed in the permit at the level of the post, monitoring of the exploitation of the resource in the field (respect of the standards according to the current forest law, rigorous planning of harvesting in the space and time taking in to account, the rhythm of growing of individuals to avoid over exploitation), respect of the quotas attributed, issuing of the certificate of origin and signature of the way bill;
- MINFOF/ Control post n°2: verification of the authenticity of the way bill, verification of the conformity of data of way bill with the products really transported by the vehicle, signature (or visa) of the way bill and report of the data of the way bill in the register of the post;
- MINFOF/ Control post n°3: same;
- MINFOF/ Subdivision for Non Timber Forest Products: issuing of the certificate for exportation after having verified that the exporter has present the permit and the receipts for the payment of the regeneration tax issued by the FREP ;
- MINFOF/ Control post of the Port n°1 at Douala: verification of the way bill, and the receipts issued by the FREP, issuing of the specification bulletins after verifying that the tonnage is in conformity with data contained in the way bill, report of the data of the way bill in the register of the post;
- MINFOF/ Control post of the Port n°2 at Douala: verification of the bulletins for specification, signature of the report of "connaissement" together with the customs service, issuing of "See Good or Vue Bon" before the packing of the products in the container;
- MINFOF/ Trade products database or COMCAM at Douala: registering data of the permits, way bills, bulletins for specification, reports of "connaissement", production and dispatching of reports to the forest administration, and economic operators (exploiters and exporters);

- MINADER/Post for plants health police: verification plants health documents accompanying the products inside or outside the country, issuing of plants health certificates;
- MINEFI/Customs service: issuing of the "connaissement" and perception or gathering of export allowances.

Documents required for the exploitation of special products in Cameroon are précised in the forest law (Republic of Cameroon 1994, 1995).

In 2000, a Unité Centrale de Contrôle (UCC) was set up by the forest administration to coordinate forestry controls nationally and to support provincial Brigades de Contrôle. Since 2004, that unit (UCC) became the National Brigade of Control (Brigade Nationale de Controle in French). To reinforce transparency in control measures the forest administration has appointed an independent observer, Global Witness (MINEF, 2002). Global Witness is currently working together with the National Brigade for Control to ensure the sustainable harvesting of forest products (timber and Non timber forest products).

6.2. Problems observed in the field of control

Many problems were observed in the monitoring of the exploitation and exportation of special products in Cameroon (Betti 2007). Problems were observed at all levels of the control, from the forest till the points of exports, and from the central administration to the external services.

At the level of the central services (in Yaoundé), the quotas attributed by the inter-ministerial Commission are based on no scientific data. Further, the Commission does not take in consideration the reports coming from the external services or from the legal harvesters, and giving an approximate situation of the abundance of the products in their zone. The forest database (SIGIF) settled in the Directorate of Forests only gathers data on logs. Data regarding special products are not concerned. Reports published every year by the National Institute for Statistics do not reflect the real data on special products in Cameroon.

In the field, and mainly at the level of control posts and check points, control on special products is not done in fair manner. The lack of precisions on the area of harvesting in the permits, the multiples prolongation of some permits, the lack of security on way bills (contrary to what is done for logging with the way bill being issued by the forest administration, way bills for special products are edited by harvesters and companies themselves), the lack of sufficient norms and standards for the sustainable harvesting as tools for control and monitoring, the lack of sufficient and qualified personal, and the lack of motivation for the forest agents are among many problems observed in the field of special products.

Along the transport routes, problems observed include the lack of sufficient and qualified personal, the lack of material of control, the lack of motivation for the forest agents, the competence conflicts with other administration. In many forest posts and check points settled along the road, there are one, two or three forest agents who are currently doing control. This number is not enough to ensure the control of log trucks all days and nights (24 hours/24). Also, many of the agents affected in those posts are too old now and do not get sufficient material for staying awake and resisting to cold all night long. Many forest agents do not record data from checking in their register book, as required by the forest administration. So many of these register books cannot be used, for further verifications.

Special products can be exported from the ports of Douala, Kribi, Limbé, Tiko. The first and main problem observed here is the lack of synergy between the custom officers and the forest officers. Often, the custom officers, who are posted at the end of the exportation chain, refuse to consider the specific bulletins dressed by the forest officers. Also, they used to refuse that the forest officers check the final container and co-signs the transport document “connaissement in french”. In this condition, some products are exported without the visa of the forest officers.

The second problem in export is at the level of the chief of post N°1. Normally, the chief of forest and wildlife post n°1 must transmitted all specific bulletins to the Trade products database (COMCAM). This is not always the case, since some specific bulletins do not exist or disappear. Such behaviour which is certainly link to corruption is detrimental to the monitoring, and checking of statistical data on the trade wood.

The third problem is that of the non existence of COMCAM database in other ports. Only COMCAM Doula has functioned till date. COMCAM Limbé, Kribi, Tiko have not been functioning in fair manner. COMCAM Kribi has just started working.

The fourth problem is that of lack of such a system for monitoring domestic trade in wood and special products. Till date, the forest administration has never developed a fair system for controlling and monitoring domestic trade, which cannot help to get a global trade volume of forest products in the country.

The fifth problem observed in the control of timber products is that of the proliferation of the “criques”. “Criques” are informal points of export, found in many localities settled along the frontier Cameroon – Nigeria, in the south province of Cameroon. These are unsafe sites, where forest officers cannot undertake any control mission (Betti 2007). A total of 1265/1281 tons of special products were exported from five “criques” based in the Akwaya subdivision (South west province) to Nigeria between March and Jully 2002. Those products were sold for 413.1 millions of FCFA (Ojong Ayuk 2002).

The sixth problem is related to confusion made between the domestic and wild products. The actual forest legislation does not clarify management issues concerning each group of products. The Government continues to perceive tax for *Prunus* coming from some plantations settled in the North west province.

The seventh problem is related to the activities of the National Brigade of Control and the independent observer, Global Witness. These two structures focus their activities on forest logging, and not on special products.

CONCLUSIONS

Prunus africana is classified by the World Alliance for Nature (IUCN) as a vulnerable plant species in Cameroon, which led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). The annual quota of export volume attributed to the Cameroon government is 2000 tons.

Natural populations of *Prunus africana* are continuously declining in Cameroon due to over-harvesting and inadequate techniques practised. Several reports confirmed the fact that the natural population has suffered major damage from both legal and illegal exploitation, reducing the population from all previous inventory estimates by up to 50% in a short period.

Since 2007, the forest administration took some important measures to alleviate poaching in the exploitation of *Prunus* including: the restoration of the field book for the harvesters, the instauration of specific way bills for the circulation of Special products, the erection of an important part of the Mount Cameroon in national park, and the reduction of quotas granted for *Prunus*. But many problems still remain in the monitoring of the exploitation and exportation of *Prunus* in Cameroon. Problems are observed at all levels of the control, from the forest till the points of exports, and from the central administration to the external services.

This report tends to confirm that *Prunus* is a threatened plant species in many areas in Cameroon. We can even consider that *Prunus africana* is at least an endangered plant species in Cameroon according to the IUCN check list for NDFs, and due to the level of exploitation and the monitoring measures currently used by the forest administration.

The elaboration and implementation of simple development plans for the sustainable harvesting and trade of *Prunus* and other special products remains the gap and the challenge for the Cameroon Government.

The main problem encountered in the process of dressing the NDFs report was the lack of scientific and published data on the area of extent occurrence, area of occupancy, abundance, mortality rate, and others. Also, due to lack of financial support, It was not possible to undertake some field trips for verifications. All these limits did not allow to conduct some analyses and appreciated different trends.

The IUCN checklist for NDFs is largely based on two global parameters: the abundance and the spatial distribution. No thing is said concerning parameters such as the morphology, the mod of scattering, and external parameters. The popularity of the species used, the type of plant part used, the mod of harvesting are some external parameters that should be used to better appreciate the endangerment of a given plant species.

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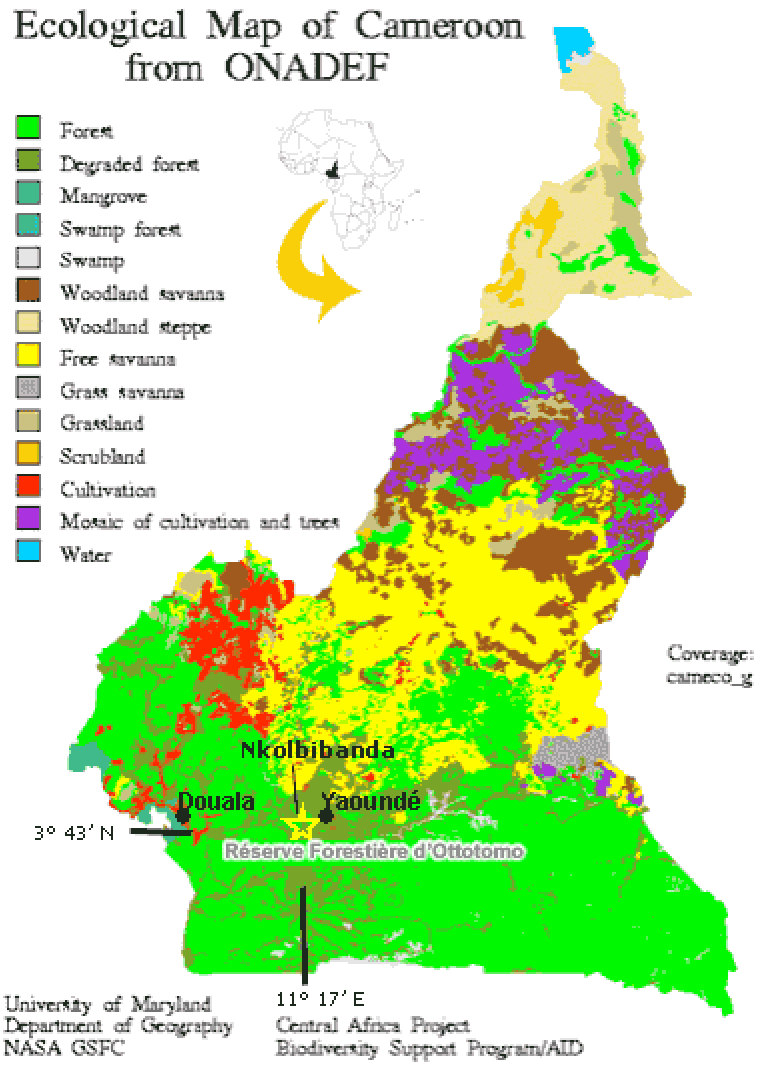
Annexe 1

In 1999 and 2000 (letter réf N° 0352/MINEF/SG/DF/SDAFF/SN of 09 March 2005 addressed to the CITES Management Authority of Spain), the National Office for Forests Development (ONADEF) conducted some field trips to identify different sites of occurrence of *Prunus africana*. A total of 64 sites were identified. They are distributed in 23 divisions and 6 provinces (Table 1). North west (27 sites), west (15), South west (8) and Adamaoua (7) are the four most important provinces in terms of number of sites of occurrence.

Table A.1. Occurrence sites of *Prunus africana* in Camaroon

Province	**N° of locality**	**Locality (Division)**
Adamaoua (7 sites)	1	Tchabal Mbabo (Mayo Banyo)
	45	Tchabal Gang Daba (Faro & Déo)
	46	Gandoua (Mayo Banyo)
	47	Nyamsounré (Mayo Banyo)
	48	Sambo Labo (Mayo Banyo)
	49	Mayoke Lélé(Mayo Banyo)
	2	Galim Tignère (Faro et Déo)
West (15 sites)	23	Santc hou (Ménoua)
	20	Owafa (Ménoua)
	26	Malantouen (Noun)
	18	Bangourain (Noun)
	39	Kutupit (Noun)
	40	Massif du Mbam (Noun)
	19	Mt Bamboutos(Bamboutos)
	17	Babadjou (Bamboutos)
	30	Mt Bana (Haut Nkam)
	42	Bangangté (nde)
	25	Baham (Nde)
	27	Bapa(Nde)
	28	Badenkop (Nde)
	24	Bafang (Haut plateau)
	41	Mboébo – Foyentcha (Ht plateau)
Littoral (3 sites)	34	Mt Nlonako (Mbungo)
	29	Mt Manengouba (Nbungo)
	31	Mt Koupe (Mbungo)
South west (8 sites)	32	Mt Cameroun (Fako)
	33	Mt Cameroun (Mfeme)
		Mt Kupe (Kupe Manengouba)
		Mt Kupe (Kupe Manengouba)
		Mt Manengouba (Kupe)
	43	Mt Bakossi (Kupe Manengouba)
	22	Fontern (Lebialem)
		Wabane (Lebialem)
	7	Akwaya (Manyu)
North west (27 sites)	10	Kumbo (Bui)
	11	Mbiarne (Bui)
	12	Jakiri (Bui)
	9	Oku(Bui)
	6	Korn (Bui)
	50	Kilum Ijim (Bui)
	51	Nvem (Bui)

Province	N° of locality	Locality (Division)
	52	Vakovi (Bui)
	5	Fundong (Boyo))
	8	Njinikom (Boyo)
	13	Belo (Boyo)
	53	Njini Kijem (Boyo)
	54	Sabga (Ngoketunjia)
	15	Njikwa (Momo)
	55	Acha – Tugi (Mono)
	56	Mfenka (Mono)
	57	Oshey (Mono)
	14	Santa (Mezam)
	58	Awing(Mezam)
	59	Bafouchu (Mezam)
	60	Mbot (Mezam)
	61	Abizenaku (Menchun)
	62	Abor (MENCHUN°
	63	Adou (Menchum)
	3	Furawa (Donga Mantung)
	64	Akweto (Donga Mantung)
	65	Tabenkem (Donga Mantung)
Centre (4 sites)	38	Mt Ngora (Mbam et Kim)
	37	Mt Yangha (Mbam et Kim)
	36	Mt Golep (Mbam et Kim)
	35	Mt Eloumdem (Mefou Akono)


Ecological Map of Cameroon
from ONADEF
Forest
Degraded forest
Mangrove
Swamp forest
Swamp
Woodland savanna
Woodland steppe
Free savanna
Grass savanna
Grassland
Scrubland
Cultivation
Mosaic of cultivation and trees
Water
Coverage:
cameco_g
Nkolbibanda
Douala
Yaoundé
3° 43' N
Réserve Forestière d'Ottotomo
11° 17' E
University of Maryland
Department of Geography
NASA GSFC
Central Africa Project
Biodiversity Support Program/AID

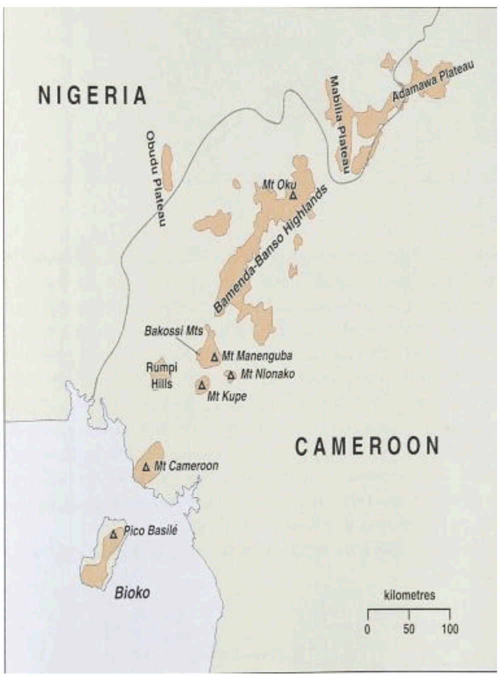

NIGERIA
Mabilla Plateau
Adamawa Plateau
Obudu Plateau
Mt Oku
Bamenda-Banso Highlands
Bakossi Mts
Mt Manenguba
Rumpi
Hills
Mt Nlonako
Mt Kupe
CAMEROON
Mt Cameroon
Pico Basilé
Bioko
kilometres
0
50
100

Table A.2 Summary of Cameroon Inventories.

Province	**Division**	**location**	**Inventory merhodology**	**Total hectares estimated Prunus zone (CIFOR 08)**	**inveotiried by**	**financed by**	**date of inveotry**	**validated**	**total Hectare of zone**	**Density per hectare**	**Density expoitable per hectare (DME > 30 cm)**	**yield per stem Kg/stem**	**Sampling Zone hectares**	**qunatity epxloitable m3**	**wider zone e prunus**	**qunatity epxloitable m3**	**estmaited qty TONNES per year**	**Timescale validity inventory**	**Reference**
Adamaoua	mayo banyo	Samba Pelmali Boudounga (par Nyamsoure)			MinfoF Adam	?	2008	?	35	21.75	21.75		12	28.21	213	4632.75			report in French document for CITES
Admaoua	mayo banyo	Tchabal Mbabo	ACS Transects	27446	Anafor	GTZ	2001	Y meeting Aug 08	44	12.29	8.22		101.38				493	2011	onadef
Admaoua	mayo banyo	Tchabal Gang Daba	ACS Transects	10060	Anafor	GTZ	2001	Y meeting Aug 08	101375	2.15	0.99		29.5				8.8	2011	onadef
NW	Bui, Boyo	Kilum Ijum	ACS Transects	480.52	CIFOR - Encodev	FAO project	2008	Y meeting Aug 08		3.52	3.35		42	1.04		1.04		2013	cifor
NW	Bui, Boyo	Kilum Ijum			Whinconet	self	2007	N	18	12.83	5.4								
SW	Fako				MinFoF SW	Plantecam	1992	Y?		5.5	3.5		5						
SW	Fako				LBG	MCP	1992	Y?		10.25	3.5		10						
SW	Fako				ONADEF	Plantecam	1996	Y?	48609	0.76	0.76	69					300		
SW	Fako		ACS Transects		LBG	GTZ	1999/2000	Y meeting Aug 08	23383	0.66	7.2	43					209	2005	
SW	Fako	Mt Cameroon	transects	9324	Studnet K Meurs	GTZ	2007	N	9324	0.24									gtz

SW	Kupe Muanengouba	Mt Kupe	ACS Transects	6 237.88	CIFOR - Encodev	FAO project	2008	Y meeting Aug 08		1.89	1		66	0.25		0.25		2013	cifor
SW	Fako	Mt Cameroon	ACS Transects	73 128.31	CIFOR - Encodev	FAO project	2008	Y meeting Aug 08		11.4	1.66		271	0.37		0.37		2013	cifor
total										83.25	57.33					0.6	509		

NDF Workshop
WG 1 - Trees
CASE STUDY 9 SUMMARY
Prunus Africana
Country - **Cameroon**
Original Language - English

NON-DETRIMENT FINDINGS REPORT ON *PRUNUS AFRICANA* (*ROSACEAE*) IN CAMEROON

AUTHOR:
Dr Jean Lagarde BETTI

Prunus africana is a species of the Rosaceae family, known under its trade/pilot name as pygeum or African chery. It is a montane tree species of the tropical Africa including the Côte d'Ivoire, Bioko, Sao Tome, Ethiopia, Kenya, Uganda, South Africa, Madagascar, Congo, the Democratic Republic of Congo, and Cameroon.

Prunus africana is classified by the World Alliance for Nature (IUCN) as a vulnerable plant species in Cameroon. This led to its listing in the Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). The annual quota of export volume used in Cameroon is 2000 tons.

Prunus grows well in the sub-montane and montane forests at an altitude of 1500 – 3000 m. In Cameroon, the plant can be found in some 64 sites, distributed in 23 divisions and 6 provinces. North west (27 sites), west (15), South west (8) and Adamaoua (7) are in this order, the most important provinces in terms of number of sites of occurrence. In its distribution area the natural range of *P. africana* is discontinued. Pygium forests appear fragmented in several isolated sub-stands distributed in afromontane forests.

Natural populations of *Prunus africana* are continuously declining in Cameroon due to over-harvesting and inadequate techniques practised. Several reports confirmed the fact that the natural population has suffered major damage from both legal and illegal exploitation, reducing the population from all previous inventory estimates by up to 50% in a short period.

As one of management measure, *Prunus* has been recognized as a "special product with particular interest". To promote its conservation, some initiatives have assisted local people in the process of community forests. The problem is that, the harvesting campaigns were not monitored in good manner. Many of those community forests were totally debarked, before their simple management plans have been approved by the forest administration.

A prediction of the sustainable yield of *Prunus* bark is often made from estimates of the natural population, the average yield per tree and the length of time between successive debarkings required to allow total recovery of the bark. Results tend to show that, the exploitation of *Prunus* has never been conducted in sustainable manner in Cameroon, in spite of the effort made by the forest administration.

Since 2007, the forest administration took some important measures to alleviate poaching in the exploitation of *Prunus* including: the restoration of the field book for the harvesters, the instauration of specific way bills for the circulation of Special products, the erection of an important part of the Mount Cameroon in national park, and the reduction of quotas granted for *Prunus*. But many problems still remain in the monitoring of the exploitation and exportation of *Prunus* in Cameroon. Problems are observed at all levels of the control, from the forest till the points of exports, and from the central administration to the external services.

Data discussed in this report tend to confirm that *Prunus* is a threatened plant species in Cameroon, which explained the ban pronounced by the European Commission on Cameroon's products. We can even consider that *Prunus africana* is at least an endangered plant species in Cameroon according to the IUCN check list for NDFs, and due to the level of exploitation and the monitoring measures currently used by the forest administration.

The elaboration and implementation of simple development plans for the sustainable harvesting and trade of *Prunus* and other special products remains the gap and the challenge for the Cameroon Government.

4TH MEETING OF THE MAHOGANY WORKING GROUP

PROCEDURES FOR MAKING NON-DETRIMENT FINDINGS FOR MAHOGANY

Cancún, Quintana Roo, November 2008

PATRICIA D. DÁVILA ARANDA
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International Workshop of Experts on Non-Detriment Findings for Bigleaf Mahogany (*Swietenia macrophylla*)

- **México, as President of the Working Group on Mahogany, organized Workshop in Cancún, Quintana Roo (April 10-13, 2007)**
- **Based on Decision 13.58 & on recommendations from the 16th Plant Committee meeting in Lima, Perú (PC 16)**

PARTICIPANTS

- 46 participants from 12 countries within the area of distribution (Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, México, Nicaragua, Panamá & Perú), including an expert panel & specialists
- European Union, in its capacity as importer (Belgium & Spain)
- President of the Plants Committee
- Representative of the CITES Secretariat
- Representative of ITTO
- Representatives of 2 NGOs
- Representative of the International Importers Association

Non-Detriment Findings

- represent methodologies and procedures that allow evaluation of species population status, with the objective of determining extraction levels or optimal exploitation rates that will ensure the survival of those populations

BASIC ELEMENTS FOR FORMULATING NDF

- Estimation of mahogany range area
- Population parameters
- Management principles, methods & indicators
- Tools for monitoring & verifying harvests, processing & conservation

I. ESTIMATING DISTRIBUTION AREA

National (potential) =

- **Forest cover maps**
- **Forest production area maps**
- **National forest inventories**
- **Available satelite images (Landsat)**

I. ESTIMATING DISTRIBUTION AREA

Sub-national (regions, states, watersheds) =

- **GIS results from national analyses**
- **National databases (including management units)**
- **Sub-national forest inventories**
- **Sub-national mapping from various sources**
- **Available satellite imagery**

I. ESTIMATING DISTRIBUTION AREA

Local (management unit) =

- **Forest management unit**
- **Statistical samples (for forest management plans)**
- **High or medium resolution satellite images of harvest areas**
- **GIS representation of harvest areas**
- **100%-area commercial censuses (based on georeferenced data)**

II. Population parameters

A. **Periodic measurements**
B. **Indicators of sustainable management**
C. **Local reference values**

A. Parameters for periodic measurements

1. Characterization of population structures
2. Estimation of seed production
3. Estimation of standing volume & future harvests

Characterization of population structures

1. **Direct measures**

- **Diameter (DBH >10 cm, based on sampling methods accounting for irregular distribution patterns)**
- **Height (total, commercial) = optional**
- **Ecological situation (climate, geomorphology, topography, hydrology, soil, etc)**

2. **Derived measures**

- **Density (trees/ha by diameter size class)**
- **Volume (m^3)**
- **Basal area (optional & in addition to density)**

ESTIMATING SEED PRODUCTION

- Sample annual seed production from a statistically significant number of trees in different size classes, before & after harvest
- Evaluate periodicity of seed production & change over time (e.g., as a function of tree size, or inter-annual variation)

ESTIMATING CURRENT & FUTURE HARVEST VOLUMES

- **Obtain data about current trees that will provide future harvests (reserved / retained commercial trees + sub-commerical trees) = trees that must be accounted for during current commercial harvests**

B. INDICATORS OF SUSTAINABLE MANAGEMENT

Permit determination of necessary silvicultural practices based on:

- **Estimation of number of seed producing trees (potential)**
- **Regeneration / recruitment rates (natural or artificial / enrichment)**
- **Turnover rates in number of individuals per size class category**
- **Number of trees available for future harvests**

C. LOCAL REFERENCE VALUES

Permit monitoring of population parameters over the long term, for the purpose of adjusting future harvests based on:

- **Compliance with forest management plans & annual harvest plans = local reference allowing verification of harvested trees with georeferenced positions**
- **Growth rate derived from permanent sample plots or from periodic measurements of individual trees (preferably annual)**

III. MANAGEMENT PRINCIPLES, METHODS & INDICATORS

Principles:

1. <u>Sufficient ecological & silvicultural information</u> about mahogany exists to proceed with outlining general management guidelines. We still lack detailed information about reproductive aspects & some silvicultural parameters (e.g., growth, seed tree selection criteria, minimum diameter cutting limit (MDC)).
2. Available data suggests that the species exhibits more or less homogeneous growth & development patterns across its range. Therefore, taking relevant precautions, <u>it is possible to establish common reference values</u> for silvicultural practices across its natural range.

III. MANAGEMENT PRINCIPLES, METHODS & INDICATORS

Principles:

3. Adaptive management for mahogany is essential = derived from current understanding but modified according to results from regeneration & growth studies within management areas

III. MANAGEMENT PRINCIPLES, METHODS & INDICATORS

Principles:

4. **Management plans should consider <u>biological & silvicultural experience</u> establishing:**

- **Tree age at first seed production**
- **Tree age at maximum seed production**
- **Annual diameter increment rates**
- **Timber quality**

III. MANAGEMENT PRINCIPLES, METHODS & INDICATORS

Principles:

5. **Silvicultural practices for mahogany should <u>include secondary timber species</u>. This increases harvest profitability & encourages improved silvicultural practices (e.g. natural regeneration in secondary vegetation).**
6. **Although harvesting multiple species incurs additional costs, it contributes to economic sustainability of harvest operations and to comprehensive & sustainable forest management.**

III. MANAGEMENT PRINCIPLES, METHODS & INDICATORS

Principles:

7. **Management occurs at different intensities (intensive in plantations, semi-intensive in secondary forests, extensive in primary forests with low densities of mahogany). In all cases it is possible to consider basic principles & minimum guidelines for management.**

SUSTAINABILITY

Methods that guarantee the sustainability of populations:

1. Planned harvest operations
2. Harvest systems
3. Regeneration
4. Conservation
5. Commercial plantations

1. Planned Harvest Operations

a. **Define harvest operations in accordance with landscape conditions.**

b. **Define silvicultural practices in accordance with harvest system. This implies consideration of initial <u>size class frequency distribution</u> & intended future (second cutting cycle) size class frequency distributions.**

2. Harvest systems

Depending on forest conditions & populations to be harvested, different harvest systems can be implemented:

- **Thinning / selection-cutting methods**
- **Uniform shelterwood / protective cuttings**
- **Clearcut in 1 or 2 stages**
- **Thinning / clearing**

3. Regeneration

Considering the low levels of natural regeneration of mahogany, the following are necessary:

- **Protect future (2nd harvest) commercial trees, based on inventory information & silvicultural practices**
- **Open clearings (ideally >2000 m^2, but determined for each management area)**
- **Enrichment plantings in clearings using artificial regeneration**

3. Regeneration

- **Select & protect seed trees, considering that trees >75 cm DBH with broad crowns are the most productive**
- **Establish a maximum distance between seed trees, accounting for maximum distances to which successful pollination can occur**

4. Conservation

To conserve populations the following steps need to be taken:

- Protect different populations throughout the natural range to conserve phenotypic & genetic diversity
- Establish reserve areas (intact populations, possibly those with low density or unique diameter distributions)
- Select seeds adequately for enrichment plantings

4. Conservation

- **Sowing selected seeds or planting nursery-grown seedlings according to local ecological & productive conditions**
- **Coordination of national & regional seed collection for conservation of different populations & regions**
- **Protection of individual trees & groups of seed trees**
- **Creating seed orchards**

5. Commercial Plantations

- Establishment of pure & mixed plantations & agroforestry systems as medium-term alternative to production from natural forests

IV. LOGGING & PROCESSING

Non-detrimental harvesting & production requires:

1. **Determination of annual production quotas**
2. **Optimization of timber use & processing**
3. **Monitoring & verification**

1. Determination of quotas

- **This implies accurate quantitative knowledge of populations. Without this knowledge, that is, based only on commercial & pre-commercial “stocks”, it is not possible to anticipate impacts of harvests on natural populations.**
- **Quotas should be determined at the level of forest management units because population characteristics can vary between forests & across regions.**

1. Determination of quotas

Determining quotas requires the following activities:

1. **Implementation of minimum viable population models, to supplement information regarding maximum volume production levels.**
2. **Quotas should be determined one year before production to ensure verification capacity.**

1. Determination of quotas

3. **<u>Analysis of extraction / export quotas</u>, based on available roundwood-to-sawnwood yield studies. This allows quotas to account for losses from bark thickness, stem quality & defect rates, inefficiency or waste during log processing, percentage of high quality timber yield for export, etc. <u>If these factors aren't taken into account, it is probable that export cuotas will overestimate production capacity</u>.**

2. Optimizing timber use & processing

- Ongoing training & capacity building should be available for field personnel involved in harvest operations.
- Georeferenced maps of commercial & sub-commercial trees should be available during harvests to allow planned extraction routes reducing collateral stand damages, especially of future crop trees.

3. Monitoring & Verification

- **To the extent possible, it is important to establish permanent plots for detailed & long-term studies of harvest impacts on mahogany populations & the forest.**
- **Strengthen the chain-of-custody from harvest to export.**
- **Strengthen forest certification & transparency to improve control of trade in legal & illegal timber.**

3. Monitoring & Verification

- **Establish a verification system linking forest inventories to remote sensing systems.**
- **Field verification of harvest areas based on sampling intensity sufficient to ensure compliance with harvest regulations including authorized extraction levels, assisted by high-resolution satellite imagery, is essential.**
- **Establish a control system linked to sufficiently punitive sanctions in case of non-compliance.**

PERSPECTIVES

- **It is urgent that the mahogany trade be brought under control.**
- **This will require precise technical & scientific information allowing determination of export quotas that do not place populations at risk (NDF).**
- **Sufficient information & tools already exist to confirm that NDF are possible for mahogany.**

PERSPECTIVES

- **Other types of information & activities that are lacking or only particially available should be developed as soon as possible.**
- **The Parties have a mandate from CITES to demonstrate that all producer nations have export quotas based on NDF.**
- **Each producer nation should develop its own approach & strategies for making NDF.**

EXPERTS

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- Dr. Roberto Kometter Mogrovejo (Perú)
- Dr. Carlos Navarro Pereira (Costa Rica)
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