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Conservation and Sustainable Management of Trees

Report of the Second Regional Workshop

held at
CATIE, Turrialba, Costa Rica

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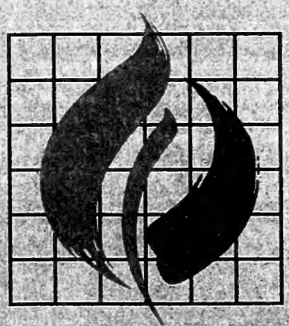

WORLD CONSERVATION
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Contents

Introduction

This Workshop was convened by the World Conservation Monitoring Centre (WCMC) as part of the joint WCMC and IUCN Species Survival Commission (SSC) project entitled the *Conservation and Sustainable Management of Trees*, funded by the Government of the Netherlands.

The Workshop had three objectives:

- to review existing information on the conservation status of Neotropical tree species and to coordinate the collection of additional information on species of conservation concern;
- to advise on the development of a *Tree Conservation Information Service* appropriate for national, regional and international needs;
- to discuss SSC activities in relation to trees of the Neotropics.

The Workshop Agenda is given in Annex 1 to this report and the participants list is provided in Annex 2.

The Workshop was chaired by **Sara Oldfield** who welcomed participants on behalf of WCMC and SSC and thanked them for information already provided as a contribution to the project. She expressed thanks to the Government of the Netherlands for their generous funding of the Workshop and thanked CATIE for their hospitality and help with the organisation of the meeting. Particular thanks were given to **Javier Zamora, Bryan Finnegan, Elizabeth Mora** and **Tania Ammour**.

Dr Markku Kanninen, Director of CATIE's Research Program, welcomed participants on behalf of CATIE and outlined the work of the organisation in three focal areas of germplasm research, education and outreach.

Sara Oldfield thanked Dr Kanninen. She pointed out that the Workshop would be conducted in an open and informal manner and any staff from CATIE were welcome to join the discussions and share their expertise.

Sara Oldfield then gave an introduction to the *Conservation and Sustainable Management of Trees* project and presented five background documents to aid discussions during the Workshop.

Working Document 1	Tree Conservation Information Service - data management issues.
Working Document 2	Guidelines for the application of the 1994 IUCN red list categories to trees. This is designed to be read in conjunction with the *IUCN Red List Categories* booklet.
Working Document 3	Sustainable use and conservation of tree species - a summary of the consultancy report prepared by Adrian Newton.

Working Document 4	List of globally threatened tree species of the Americas - based on information contained within the WCMC Plants Database. This incorporates information provided by the Nature Conservancy, according to the Memorandum of Agreement
Working Document 5	Tree species for conservation evaluation - draft profiles of widespread heavily utilised tree species for evaluation of conservation status.

Presentations

1 Introduction to the Project - Sara Oldfield

The *Conservation and Sustainable Management of Trees* project is a three-year collaborative project. WCMC and SSC are the main partners, working with a wide range of other national, regional and international organisations. The goal of the project is to provide a reliable and up-to-date information service on the distribution, conservation status, local uses and economic values of tree species worldwide, in order to assist countries in the planning of sustainable forest management and biodiversity conservation, through appropriate international or intergovernmental processes.

This is clearly an ambitious goal but should be fully achievable given the existing strengths of WCMC and SSC. Conservation data at WCMC are gathered from a wide variety of sources, and are managed and maintained in a series of databases and made available to Governmental, Intergovernmental and Nongovernmental users worldwide. Databases maintained at WCMC include:

The *Biodiversity Map Library*, a geographical interface which allows rapid access to a wide range of mapped information on the world's biodiversity. Global coverage of tropical moist forests are, for example, maintained and the collection of data on tropical dry forests is a current priority.

The *Protected Areas Database* which has over 37,000 records and nearly 5000 individual site sheets.

The WCMC *CITES Trade Database*, maintained on behalf of the CITES Secretariat

The Animals database which is used to compile the *IUCN Red List of Threatened Animals* in collaboration with SSC.

The WCMC *Plants Database* which currently records information on the distribution and status of over 100,000 plants; 30,000 of which are globally threatened. Information stored in the WCMC Plants Database is the starting point for information collection in the *Conservation and Sustainable Management of Trees* project.

Data collection for the *Conservation and Sustainable Management of Trees* project is being undertaken in collaboration with SSC's network of experts worldwide. SSC is one of the six volunteer commissions of IUCN, the World Conservation Union. The mission of the SSC is to conserve biological diversity by developing and executing programs to save, restore and manage wisely species and their habitats. The existing SSC Groups for trees are the Temperate Broadleaved Trees Specialist Group and the Conifer Specialist Group. One of the aims of this project is to develop further SSC Tree Specialist Groups.

The Conifer Specialist Group has evaluated the conservation status of a wide range of conifers and filled in standard data collection forms as a contribution to the project. The Temperate Broadleaved Trees Group has adopted a generic approach. At a meeting earlier this year experts were identified to work on the various genera. The project has funded two

issues of the Group's newsletter and preliminary mapping of threatened species of *Magnolia* and *Betula*. Members of the International Oak Society, working through the SSC Temperate Broadleaved Trees Specialist Group are helping to assign the new IUCN threat categories to *Quercus* spp., a process which will be taken forward at this Workshop.

To ensure that the project is a success it will be necessary to continue working effectively with a wide network of experts. At an international level, collaboration has been established with FAO and IPGRI. Collaboration with IPGRI will be discussed further by Dr Abdou-Salam Ouédraogo in a presentation to the Workshop. WCMC already works closely with The Nature Conservancy, which has generously provided data on globally threatened plants of the Americas in accordance with a Memorandum of Agreement between the two organisations. Participation by TNC staff in this Workshop will enhance further collaboration. WCMC welcomes involvement from all interested individuals and organisations in this project and all input will be fully acknowledged.

The proposed outputs of the *Conservation and Sustainable Management of Trees* project by the end of 1997 are:

- A world list of threatened trees using the new IUCN threat categories (following the format presented as a draft at the Workshop)
- A report on the sustainability of tree utilisation
- A world tree database made available to users in electronic format free of charge to all collaborators and other appropriate agencies
- On-line access to tree conservation information maintained by WCMC
- Development of an SSC tree network

2 Tree Conservation Information Service - Martin Sneary

Martin Sneary presented Working document 1 *Tree Conservation Information Service*, which is provided in full as Annex 3 to this report. General principles of data management applied by WCMC and covered in the presentation include the use of standards to facilitate data compatibility and exchange; maintenance of data quality; and agreements on data custodianship and collaboration.

The three key areas of activity in developing the *Tree Conservation Information Service* are data collection, data storage, and information dissemination. The steps taken so far in the design and development of the *Tree Conservation Information Service* were described focusing on the user needs survey, consultation with key organisations and use of the standard data collection form. **Martin Sneary** explained that a prototype database had been developed based on the standard data collection form and that this was available for demonstration and review at the meeting.

3 The IPGRI forest genetic resource conservation programme - Dr Abdou-Salam Ouédraogo

Abdou-Salam Ouédraogo thanked WCMC for the invitation to attend the meeting and said that his participation expressed IPGRI's intention to collaborate with WCMC in the development of the *Tree Conservation Information Service*.

The mandate of IPGRI is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI has four main elements in its work on plant genetic resources:

- strengthening national programmes
- contributing to international collaboration
- improving strategies and technologies for conservation
- providing an international information service

IPGRI has concentrated for the past 20 years on the conservation of genetic diversity of crop species. More recently its mandate has been expanded to cover forest genetic resources. In this area IPGRI works in partnership with ICRAF and CIFOR and is developing close links with WCMC.

The key activities of the forest genetic resource conservation programme are:

- locating and assessing diversity in forest ecosystems
- in situ conservation, sustainable management and use
- ex situ conservation
- TREESOURCE - an information system on forest genetic resources

In the location and assessment of diversity in forest ecosystems, IPGRI is looking at patterns of genetic diversity and levels of genetic erosion. These will depend on the nature of the forest ecosystem and will be different in different regions. IPGRI currently has projects in Costa Rica, Indochina and West Africa. It is also important to know the impacts on genetic diversity in relation to use. Aspects of selective logging and utilisation of non-wood forest products are being studied.

In situ conservation projects are being carried out in collaboration with CIFOR in Asia and in Costa Rica in collaboration with CATIE. Flávio Bertin Gandara Mendes will describe work underway in Brazil, later in the meeting. A miombo woodland project is being developed in Southern Africa.

Ex situ work includes the development of an international network of seed research involving experts in 25 countries. The network is looking at methodologies for dealing with recalcitrant seeds.

The scope of forest conservation is clearly broad and an ecosystem approach is most appropriate. Within this broad approach, realistic targets are needed by focusing on priority

species, priority populations and the level and extent of genotypic variation. There is a need for systematic decision making and thus this Workshop is important in stimulating the collection of information which can be used for setting priorities.

Information is needed on the kinds of species; threats and levels of threat, conservation status of species; *in situ* and *ex situ* conservation activities and requirements. Economic data are also needed. IPGRI has initiated a project to develop a conceptual framework for decision making based on these types of information. The project activity links with project activities on the ground in IndoChina and Brazil.

The information system currently in use for forest genetic resources is TREESOURCE which is being developed jointly by IPGRI, ICRAF, CIFOR and FAO. A central coordinating database has been established and regional nodes are being developed. Information is stored on the conservation status of endangered species and populations, together with a wide range of additional information.

Discussion
Adrian Newton asked how IPGRI assesses threat, pointing out that the IUCN threat categories do not take into account genetic considerations, and asked about the measurement of biological diversity.

Abdou-Salam Ouédraogo replied that in assessing threat socio-economic information is needed on how forest resources are used and at what level. This needs to be integrated with biological data. In the tropics, population data for species are generally not known. Surveys are needed and studies on genetic variation. GIS can be used to help measure genetic erosion. TREESOURCE deals mainly with intraspecific diversity - there is a need to combine this level of information with WCMC data on tree species.

4 IUCN Red List Categories and Guidelines - Charlotte Jenkins

Charlotte Jenkins presented Working document 2 *Guidelines for the application of the 1994 IUCN red list categories to trees*, which is provided as Annex 4 to this report. She pointed out that the application of the threat categories is an essential part of the project. Throughout the project considerable experience has been gained in using the 1994 categories but there are still difficulties in their application to tree species. The workshop provides a good opportunity to discuss these further.

Discussion
Darién Prado commented that there is a tendency to use DD because data are generally limited for tree species of South America. He also pointed out that not all applications of the categories are clearcut, even the IUCN booklet encourages subjectivity.
Charlotte Jenkins replied that one of the advantages of the categories and criteria is that they identify the causal factor leading to species decline. She encouraged people to avoid using DD, noting that categories can be modified as more data becomes available. The category DD can be useful for species which are taxonomically dubious.

The issue of species known only from few specimens was also discussed. This information can be helpful in assigning the threat categories but it is also important to note that certain areas are poorly collected.

5 Preliminary application of the new IUCN categories of the trees of Argentina - Darién Prado

Darién Prado outlined one approach in the application of IUCN threat categories based on biogeographical information. He showed how vegetation mapping can help in determining where tree species are in danger and which should be conserved.

The Piedmont Forests of northwest Argentina and southwest Bolivia are one of the most endangered vegetation units in Argentina, heavily destroyed by clearing for agriculture, and with no fragments included in protected areas. This leads to the conclusion that 47 woody and succulent species, including 25 trees, two of which are monotypic genera, which are endemic to the area (Prado, 1995) are obviously threatened species. Although no precise information is available, the extant surface of this vegetation unit is less than 20,000 sq km, and therefore, all 25 tree species should be considered at least VU B1+2a. Careful distribution dot mapping, with a strong phytogeographical approach will provide higher precision in the application of the categories. Ecosystem conservation is the most useful focus for these species. Funding is required to quantify how much of this remnant forest type is left and to design conservation strategies.

Reference: **Prado, D.E.** (1995) Selva pedemontana: contexto regional y lista florística de un ecosistema en peligro. pp. 19-52 In: Brown, A.D. & Grau, H.R. (eds.) *Investigación, Conservación y Desarrollo en Selvas Subtropicales de Montaña* L.I.E.Y. (UNT)/Proyecto de Desarrollo Agroforestal, Tucumán.

Discussion

This presentation generated considerable discussion notably on current threats and protection needs in the area; and the relationship between floristic patterns and rainfall data. **Shirley Keel** noted that conservation activities have tended to focus on tropical lowland forest and there is a need for more attention to be given to tropical dry forests. **Luis Corrales** commented that accuracy of species mapping can generally be related to the number of collections; very often there are limited data.

Discussion then turned to more general comments on the application of the IUCN threat categories. **Eduardo Calderon Saenz** asked whether the categories relate to threat ie external pressure or vulnerability ie internal condition of the species. He gave an example of the species, *Hura crepitans*, which is "threatened" because it is cut for wood and subject to other forms of utilisation, but remains very abundant. **Adrian Newton** replied that this is a semantic problem. It is important to remember that "threatened" is an abbreviation of "threatened with extinction" and the IUCN categories relate primarily to the probability of extinction rather than the external threat.

Kevin Nixon commented on the Vulnerable category in relation to oaks. He pointed out that following the 'A' criterion, most Californian woody plants would fit in the Vulnerable

category and probably most of the woody plants of Europe. The political implications of such broad listings could undermine the use of the categories. **Charlotte Jenkins** agreed that there are problems with the wide applicability of the Vulnerable category for trees and this may need to be addressed in future revisions of the categories. She stressed the need to keep a global perspective and also to base application of the categories on expert judgement as well as literal reading of the categories and criteria. **Sara Oldfield** added that the sub-criteria are useful in indicating the reasons for Vulnerable status, for example, actual or potential levels of exploitation (which may apply to widespread species) and decline in area or quality of habitat.

Joaquina Pires-O'Brien commented that in applying the categories to Brazilian trees, she used the Vulnerable category, criterion A for widespread species such as *Bertholletia excelsa*. She was able to find historical data which showed that the rate of decline had been significant for this species although it remains widespread. **Joaquina** further commented that her general feeling is that the new categories are useful and have considerable potential. Their application for trees is a dynamic process which is open for review during the current project. Categorisations can be changed as more data becomes available.

Luis Corrales pointed out the need for information on population structure and dynamics. Field studies may reveal adult trees only with no regeneration. Such populations may be a result of events 200 years ago. **Charlotte Jenkins** replied that in applying the IUCN categories only reproductively effective individuals should be counted in estimates of population size. Where regeneration depends on stochastic events, estimating the probability of extinction becomes impossible. This kind of information can however be recorded in the database developed as part of the *Tree Conservation Information Service*.

Martin Mitré commented on his experiences with applying the new categories to Panamanian trees. He has used DD for many species. Often type specimens do not have location details and may not even reveal the province where the specimen was collected. Sometimes the name of the town is given but this may refer to various settlements in the same country. He also commented on the difficulties of applying categories when information is only available from one country. **Sara Oldfield** replied that there will be instances, like these described, where the species is genuinely DD and it will be useful to note this to stimulate further studies. She also noted that international projects like this are important in attempting to link data for various countries in evaluating the conservation status of species. The working group discussions and coordination after the Workshop should help in this process.

Adrian Newton pointed out that the new categories are designed to be equally applicable to all species. The tendency for many trees to be classified as Vulnerable clearly results from their relative longevity. If, however, tree species meet the criteria for Vulnerable we should not avoid listing them.

Nohemy Elizabeth Ventura pointed out problems with the application of the current categories which can appear to overlook the critical situation faced by tree species for example in El Salvador. If a species is considered to be Vulnerable at a global scale this

could prevent action being taken in countries where the species is more severely threatened. The categories need to be more clearly defined.

Dora de Retana said that based on the information provided by Darien Prado she would consider the species in the Piedmont area to be Endangered because of their limited distribution and current threats. **Darien Prado** replied that he would not feel confident to apply a higher category without revisiting the site.

Kevin Nixon raised the question of how to treat newly described species. It was agreed that knowledge of the area of collection and level to which this had been explored botanically would be important considerations. Generally newly described tree species would be expected to fall within the threat categories.

6 Rare and common species: use and conservation of the Atlantic rain forest - Flávio Bertin Gandara

Tropical rain forests are well know for their very high diversity of tree species, around 200 species per hectare. Among these exist a great number of different kinds of species which have different life history strategies, reproductive biology, spatial distribution, interactions with animals and successional status. The Laboratory of Reproduction and Genetics of Tree Species of the University of Sao Paulo, Brazil has been studying the genetic diversity of representative species, considering these characteristics. The main focus of these studies is in the Tropical Atlantic Rain Forest, which occurs along the eastern coast of Brazil. This ecosystem is considered a "hot spot" area due to its high diversity and endemism, associated with a very high anthropic pressure.

Genetic studies, using genetic markers (mainly isozymes), are being conducted with natural populations in primary forests and with disturbed populations in secondary forests. The genetic diversity of the natural populations are considered as reference for genetic conservation, both *in situ* and *ex situ*. The different responses of the species to anthropic disturbance including changes in the genetic structure, have been considered to give guidelines for priority interventions and restoration of degraded areas.

Rare species, or those with low population density (1 tree per ha - 1 tree per 50 ha) for example *Cedrela fissilis*, show significantly high diversity and a very wide gene flow. These species are being used as references for *in situ* conservation. Common species, for example *Euterpe edulis*, fit very well the requirements for the sustainable management, mainly due to their intense regeneration and high density, and for this reason they are being used for monitoring the effects of the management activities.

The University of Sao Paulo and the National Centre of Genetic Resources/EMBRAPA are currently implementing a research programme aiming at establishing genetic reserves with support of IPGRI and GEF/World Bank. In this programme populations of the model species are being identified, mapped and monitored. Patterns of genetic variation in these populations are studied.

The knowledge of the genetic diversity of the many species of the tropical rain forest and the understanding of processes that impact genetic diversity are also being used to elaborate restoration models involving successional ecological groups. In these models, the rare and common species are being planted in low and high densities, and the early successional species are shading the late successional ones.

Discussion

Adrian Newton suggested that care needs to be taken with the use of the term 'rare'. Tree species may be naturally rare for many reasons and rarity may not be a problem for the survival of the species. This is one of the reasons why the term was dropped by IUCN. **Flávio Bertin Gandara Mendes** replied that in the work described, the concept of rarity is used to apply to species which occur at low density.

Abdou-Salam Ouédraogo emphasised that this type of research is likely to become increasingly important especially for endangered species. In areas like the Atlantic Coastal Forest it is more and more difficult to set aside large areas for conservation and so we need to look at different approaches. Future stages of this project in Brazil will look at the impact of fragmentation and socioeconomic aspects are another important component.

7 Sustainability of uses of tree species - Adrian Newton

Adrian Newton provided various examples of the threats and management issues for trees in the Caribbean, Central and South America, focusing on tree species included in the appendices of CITES, and introduced Working document 3 *Sustainable use and conservation of tree species*.

He highlighted four main issues for discussion:

1 defining sustainability
2 problems with current approaches in assessment of sustainable forest management
3 alternative approaches
4 relationship between assessment of sustainable use and conservation status

The Brundtland Report (1987) definition of sustainable development 'meeting the requirements of present generations without compromising the ability of future generations to meet their own needs' has provided the basis for numerous development policy initiatives, despite some confusion over the what the term 'sustainability' means precisely. The most useful short definition has been provided by Upton and Bass (1995). This covers environmental, social and economic aspects of sustainability. Various international forestry initiatives are attempting to assess sustainability but not all follow the same definition.

Problems with current approaches in the assessment of sustainable forest management include:

- confusion about definitions of criteria and indicators
- emphasis on timber rather than other forest products

- focus on forest ecosystems rather than species
- focus on management rather than use
- problem of scale of management units
- will all species in sustainably managed forest be adequately conserved?

Alternative approaches may need to be developed in applying sustainability concepts to tree species. A very useful publication in this context is provided by Peters (1994) who notes that tree species have different potential for sustainable use dependent on their biological characteristics. The biological characteristics which determine the ability of a species to withstand use are those which enable the species to tolerate or to recover after harvesting. The different uses of tree species also vary in the likelihood of being sustainable.

Impact of use is also clearly relevant in assessing conservation status as is recognised explicitly in the criteria for the application of IUCN categories of threat. In the IUCN criteria relating to population reduction, 'actual or potential levels of exploitation' is listed as a possible cause of decline. Use of a tree species may also result in a decline in the area of occupancy and the number of mature individuals of the species; a decline in the extent of occurrence of the species and / or quality of its habitat; or an increase in population fragmentation.

Furthermore if the use of a species results in genetic erosion, then this will increase the threat of extinction of that species. Intra-specific genetic variation is not, however, explicitly addressed by the IUCN Red List categories which make no attempt to consider genetically distinct populations, genotypes or individual genes. It is, of course, not only the existing genetic variation that is important for long-term viability of a species, but also the processes involved in maintaining that variation (such as gene flow). These processes are also not included in the criteria explicitly, although a reduction in population size or extent of occurrence, which are included in the criteria, take account of these processes to some extent. The IUCN criteria could perhaps be amended in future to include intra-specific genetic variation, although assessing genetic erosion presents a number of technical difficulties, demonstrated by the lack of quantitative data currently available

The Convention on International Trade in Endangered Species (CITES) provides a framework for the prevention of trade in endangered species, and for regulation of trade in other species of concern. New criteria for listing species on the respective appendices were adopted in 1994 to provide a more objective basis for amending the appendices. The criteria were developed along similar lines to the revised IUCN criteria for categorising the conservation status of species. The three main biological criteria are population size, area of geographic distribution and population decline. The criteria for listing on Appendix II, includes the following: 'it is known, inferred or projected that harvesting of specimens from the wild for international trade has, or may have, a detrimental impact on the species by exceeding over an extended period the level that can be continued in perpetuity'. This is essentially a definition of sustainability. It is possible to infer that any species being harvested above sustainable levels could qualify for inclusion in Appendix II. This clearly needs more consideration.

Reference: **Peters, C.** (1994). *Sustainable harvest of non-timber plant resources in tropical moist forest: an ecological primer.* Biodiversity Support Programme, Wrold Wildlife Fund, Washington DC.

Discussion

Kevin Nixon supported the ecosystem approach in discussions of sustainability but questioned whether there are in reality any sustainably managed forests. European oak forests, for example, which have been managed for centuries, only conserve highly productive oaks. Taking out timber species in a forest has a profound effect on the composition of the other species which are not being directly used. He also commented on the specific characteristics of *Quercus* in relation to **Adrian Newton**'s considerations of species sustainability.

Joaquina Pires-O'Brien commented that the ideas on the potential for sustainable use of different tree species were based on classic ecological concepts. **Adrian Newton** agreed and pointed out that one of the problems is that the sustainability debate currently is not taking into account population biology.

Dora de Retana asked about the current status of *Fitzroya cupressoides* a species protected by CITES. **Adrian Newton** replied that his Chilean colleagues do not believe that sustainable management of Alerce is biologically possible. Conservation measures for the species are constantly changing and, of course, CITES only covers exports of the species.

Abdou-Salam Ouédraogo commented that there are links between sustainability of species and ecosystems. Sustainability can be considered in terms of the ability of a species to adapt to new ecosystem conditions. We need to look for early warning systems for situations where species can no longer adapt.

8 Conservation of the genetic resources of *Swietenia* spp. - Carlos Navarro Pereira

Carlos Navarro Pereira gave a short illustrated presentation on the conservation of the genetic resources of *Swietenia macrophylla* in the Mesoamerican region. CATIE has been carrying out a comprehensive study of genetic diversity of the species in collaboration with the Institute of Terrestrial Ecology, Royal Botanic Gardens, Kew and Royal Botanic Garden, Edinburgh. The Oxford Forestry Institute has also provided assistance. Following a review of herbarium material, a strategy for regional collection was prepared which attempted to locate different population types. Four main areas have been studied and the current status of *Swietenia* in these areas was described in the presentation.

9 The work of CATIE in sustainable forest management - Dr José Joaquim Campos

Dr José Joaquim Campos gave an overview of CATIE's work in natural forest management. In Central America two-thirds of the land has the capacity for forest use and one-third has agricultural capacity. At present only one-third is under forestry and protected areas. This has consequences with which we are all familiar. Globally tropical forests cover seven percent of the planet and harbour 50 percent of the biodiversity. A

generally stated goal is that 10 percent should be in protected areas. If that is the case how do we manage the remaining 90 percent? CATIE believes that it is possible to both conserve and utilise tropical forests and is developing a concept of diversified and sustainable forest management. In doing so it is necessary to maximise the value of natural forests and diversify production. It is also necessary to involve local people in the decision making process.

In the CATIE model for sustainable management the first phase is planning. This involves undertaking inventories to define areas for forest production and areas for conservation. Even within production forests some areas should be left untouched. Production forests are divided into areas which can be periodically harvested. All harvestable trees are located and mapped. This is now a legal requirement in Costa Rica. Other activities in the planning phase include the planning and construction of roads and the establishment of permanent plots and monitoring procedures.

The second phase is the harvesting phase. CATIE is promoting the use of a wider range of species. This is important in Costa Rica because of the high rate of deforestation. Species are being commercialised in Costa Rica which are not utilised in neighbouring countries such as Nicaragua. Harvesting involves removal of lianas and directional felling. A training manual is being developed for chain saw operators. People are generally resistant to changes in harvesting practices because they are concerned about the costs.

The third post-harvesting phase involves diagnostic sampling of the forest.

Improvements associated with the change to elements of this model for sustainable management include large increases in biological production and improvements in environmental quality such as quality of water supply. There are increased costs in the planning phase but these are recovered in later phases of forest management. Various aspects of the CATIE model are still in the research phase and we still do not fully understand what is conserved when the forests are managed in this way. CATIE now wants to see its model for natural forest management become fully operational, accepting that tropical forests still present enormous challenges.

Discussion

Luis Corrales commented that plantations and management for production inevitably lead to an irreversible loss of biodiversity. **José Joaquim Campos** replied that CATIE is working with CIFOR and others to look at the impact of timber production on fauna and to establish which forestry techniques conserve the maximum biodiversity.

10 Tropical high Andean forests in southern Peru - Dr Washington Galiano Sanchez

Dr Washington Galiano Sanchez described the high biodiversity of the Peruvian Andes and illustrated this with a discussion of the distribution and ecology of the genus *Polylepis*. He noted that in the Puno area of the Andes forests occur to an altitude of 5200m. The genus *Polylepis*, with 16 species is endemic to the Andean region. Ten

species are found in the Urubamba region which now has 35 percent forest cover. The main threat to the forests is charcoal burning.

Discussion

Abdou-Salam Ouédraogo asked about conservation measures in place. **Washington Galiano Sanchez** replied that there is currently a proposal to protect 400,000 ha of high altitude land in Urubamba which will help to conserve three *Polylepis* spp. *in situ*. It is also proposed to create a botanic garden to conserve plants in the region.

Allen Coombes asked about the availability of seed, noting that only one species of *Polylepis* is in cultivation in the UK. **Washington Galiano Sanchez** replied that it would be easier to provide seedlings for cultivation. Seeds of the genus are very small and difficult to find in the natural habitats.

Daríen Prado pointed out the generally high number of endemic species in the Andean area and the need to focus on ecosystem conservation.

11 The FFI Soundwood Programme - a brief overview - Pam Wellner

Pam Wellner thanked WCMC for the workshop invitation and pointed out the value of the information being discussed to the FFI Soundwood Programme. This focuses on the conservation and sustainable use of tree species used in the manufacture of musical instruments.

The Soundwood Programme began in the UK in 1993 and was launched in the US in June 1996. Soundwood has the following objectives: assessment and monitoring of species used by the music industry; promoting awareness of the status of species; facilitating sustainable utilisation and developing forest management strategies with local people. Replacement with substitute materials and trade bans are not advocated except in extreme cases.

The Soundwood Programme encourages the use of timber certified by the Forest Stewardship Council (FSC). FSC has established principles and criteria for sustainable forest management and acts as an umbrella organisation for independent certifiers. Soundwood's species work involves three steps: research, to identify species under threat; workshops to enhance local involvement in species conservation planning and implementation of conservation initiatives.

The first international workshop of the Programme was held in Maputo, Mozambique in November 1995. This workshop was called to discuss *Dalbergia melanoxylon* and resulted in an agreed regional conservation strategy for the species. It is planned to hold the next workshop in Brazil in collaboration with the Rio de Janeiro Botanic Garden. This workshop will focus on *Caesalpinia echinata*. In 1997 research efforts will also concentrate on *Dalbergia latifolia*, *Dalbergia stevensonii* and *Dalbergia retusa*.

Discussion

Eduardo Calderon Saenz asked if there was a list of the species used by the musical instrument industry in various countries. **Pam Wellner** replied that this was being developed and information was being collected on woods used for traditional musical instruments. Alternative woods not currently in wide usage are also being identified.

Nina Marshall asked if industry had provided support for conservation of *Dalbergia melanoxylon* as a result of the Maputo workshop. **Pam Wellner** replied that feedback from the industry had been diverse. A broad range of potential supporters is being considered.

12 Networking and development of SSC - Nina Marshall

Nina Marshall introduced the work of the Species Survival Commission (SSC), one of six commissions or voluntary networks of IUCN, the umbrella organisation for the world's conservation agencies and NGOs. The SSC is the largest network in the world of professionals dedicated to the cause of conserving species and biological diversity. Membership in the SSC is voluntary. It offers an opportunity for individuals to work with others to contribute to species conservation and be part of a well-respected and effective body of conservation experts.

The SSC Secretariat is based at the Headquarters of IUCN in Switzerland. Activities of the various Specialist Groups are coordinated by the Secretariat. There are currently over 100 Specialist Groups with a combined membership of around 7000. Activities of the Groups include preparation and implementation of Action Plans, networking through newsletters, meetings and workshops, provision of advice to governments and inter-governmental organisations and helping to implement international conventions. The Action Plan process increases the availability of information on species within a particular group, makes this information available to further conservation, produces comprehensive recommendations and guides future activities of the Specialist Group.

There are currently a range of plant Specialist Groups, various of which are already closely involved with the *Conservation and Sustainable Management of Trees* project. There are also regional plant groups such as South American Temperate Plant Specialist Group and the Brazil Plant Specialist Group. At the first regional workshop for the *Conservation and Sustainable Management of Trees* project participants agreed to form an African Tree Specialist Group, and **Dr Abdou-Salam Ouédraogo** has agreed to chair this new Group.

It will be very useful to consider at this Workshop whether an American Tree Specialist Group should be formed.

Discussion

Dora E. Mora de Retana, a member of the SSC Orchid Specialist Group pointed out the advantages of forming a regional tree Specialist Group and encouraged the meeting to support this idea. Following further discussion of the value of forming a Group and the benefits of institutional support it was agreed to pursue the idea further after the close of the Workshop. It was also recommended that information on existing plant groups would be circulated with the Workshop report.

Working Group Reports

The Working Groups were asked to discuss their experiences in the use of the IUCN categories and criteria; review Working Document 4 - List of globally threatened tree species of the Americas, and suggest any further species for addition; and to evaluate selected species from Working Document 5 - Tree species for conservation evaluation. Working Group 1 focused on a more specific agenda concentrating on the conservation evaluation of a range of oak species. Each Working Group set its own agenda and priorities for discussion within the broad remit given and reported back to the meeting as a whole.

Working Group 1 - Oaks

Participants: Maricela Rodriguez Acosta, Kevin Nixon, Allen Coombes, William Hess

Kevin Nixon reported on the discussions of the Group which had worked on a list of approximately 125 American *Quercus* species provided by WCMC. The list included both trees and shrubs. There is no recent monograph which can be followed and from the list provided 61 names are considered to be synonyms. Of the remaining species, 11 were categorised by the Group as Not Threatened, [LR:lc]. Fifteen species were originally categorised as DD, but some of these were later changed to VU. Now that the Group has a better understanding of the categorisation process, it may be possible to research these species, by working up maps and other data and to provide conservation assessments.

In total 30 of the oak species were considered to be VU, generally based on restricted range criteria. Observations of Mexican species in dry forest areas indicate that decline is nearly always related to grazing giving rise to regeneration problems. For Central American species, deforestation is the main threat. A number of widespread species in lowlands were considered to be threatened due to 20 percent loss over three generations where for example forests have been cut for coffee plantations. Seven species were categorised as EN and two as CR. One species on the list may be Extinct in the Wild (EW) but more research is needed. This species is no longer found at its original type locality, and only seven collections of the species have been made.

The Group also noted a lack of knowledge of official threatened plant listings at national or state level. There will need to be communication with appropriate authorities. The importance of sound taxonomy was also stressed. Information is reasonably good for *Quercus* but there will be difficulties, for example in Southeast Asia where there is no good taxonomic treatment for the genus.

A summary of the evaluations by Working Group 1 is given in Annex 6.

Discussion

Pam Wellner asked about the status of oaks in North America. **Kevin Nixon** replied that the Group had considered various species to be threatened in West Texas, Alabama and Arkansas. The importance of communicating with local conservation agencies was agreed.

Working Group 2 - Central America

Participants: Nina Marshall, Dora E Mora de Retana, Nelson Zamora, Nohemy Elizabeth Ventura Centeno, Cirilo Nelson Sutherland, Adrian Newton, Pamela Wellner, Luis Corrales, Martin Mítre

Dora de Retana reported on the work of the Group which had considered in detail the species in Working Document 5 which occur from Mexico to Panama. Thirteen species were evaluated.

The Group used several general criteria in their evaluations:

- high exploitation (for example, logging and medicinal use)
- regeneration power of species
- abundance of species in range (Mexico to Panama)

The Group thought that some information was missing from the draft species profiles, especially for species found in South America. If information is not available for the entire range, it makes application of the categories difficult. The only way to assign categories is through consultation with all countries where the species occurs. However, it was not too hard to apply categories for species where the Group had access to full information.

Discussion
Adrian Newton asked how information on regeneration had been used in application of the categories. **Dora de Retana** replied that field experience of the Group with regard to observations on regeneration was especially valuable.

Working Group 3 - South America

Participants: Eduardo Calderón Saenz, Eduardo Dalcin, Flávio Bertin Gandara Mendes, Jan de Koning, Silvia Llamozas, Ximena Buitrón, Daríen E Prado, Joaquina Pires O'Brien, Washington Galiano Sanchez, Shirley Keel, Ana-Maria Giulietti

Joaquina Pires-O'Brien reported on the discussions of the Group which had worked on 21 South American species for which summary information was provided in Working Document 5. Generally, the group found the evaluations of the widespread species difficult, noting that threats and status vary from country to country, and they were not totally happy with their results. For most species, they used the A criterion. The Group also filled in data collection forms for several species.

The Group emphasised the need for more information on which to base evaluations. Information is not necessarily available from published sources but may for example be found in University theses.

Discussion

Shirley Keel considered that the list of species for evaluation was rather short and many other species could be added to it. **Joaquina Pires-O'Brien** added that corrections had been made to the information presented and that this had been useful in improving the preliminary information provided by WCMC. **Sara Oldfield** welcomed the improvements and agreed that it would be difficult to compile comprehensive information for South America because of the huge diversity of species and resources needed for good coordination. She pointed out that the draft species profiles for a small selection of species had been put together rapidly for the workshop, based on very limited information. She welcomed advice on other experts to consult.

Luis Corrales asked about difficulties encountered with the application of the categories. **Joaquina Pires-O'Brien** emphasised the need to develop consistency in the application of the categories and criteria. This should become easier as more evaluations are carried out. **Darién Prado** said that one of the greatest difficulties results from the uneven development of taxonomy in different parts of Latin America. He finds the categories very useful and not too difficult to apply but problems result from differing views on the same species based on different experiences in different countries.

Sara Oldfield replied that the IUCN categories are currently for global listing. We need to note problems in their application, for example, to widespread species and provide input into the development of national categories.

Martin Mitré asked about the mechanism WCMC will use when there are different evaluations from different countries. **Sara Oldfield** replied that clearly there needs to be discussion and sharing of information. It is possible to infer the global category from information in part of the range of a species but it is obviously preferable to examine the different category assessments, share findings and reach consensus.

General discussion on the Working Group reports

Ana-Maria Giulietti commented that *Virola surinamensis* had been classified differently by the two Groups; VU in Central America and EN in South America. Various other discrepancies were also noted.

Sara Oldfield pointed out that there was a certain amount of conformity between groups. Both considered the species to be "threatened" in the broad sense. Wherever possible, WCMC would act as mediator, contact all involved, and try and reach consensus.

Dora de Retana suggested that it should be possible to reach consensus during the meeting if information was shared between the Groups on the basis for evaluations.

Abdou-Salam Ouédraogo commented that regarding the assessment for *Virola*, it would be expected that some species will have different status at national/regional levels because of different levels and types of threat. For global assessments we clearly need to

harmonise these, but it is important not to lose track of national situations because this is where conservation solutions are developed and applied.

Adrian Newton asked whether it is true to say that where a species occurs in Central and South America generally the species is more abundant in South America? If so, South American assessments are more important. *Swietenia* is a good example.

Kevin Nixon replied that for species of *Quercus*, they are more abundant in South America.

Nelson Zamora commented that a key requirement is to consult appropriate people. Contact with experts is very important.

Luis Corrales noted that IUCN categories have a considerable reputation in Latin American countries, both positive and negative. If a global category is assigned indicating lower threat "globally" than nationally, this could lead to increased threats in certain populations. Political aspects can be important to consider. **Dora de Retana** agreed with this very important point and the potential for misuse of data.

Bill Hess asked about the development of threatened species lists at a national level. **Luis Corrales** replied that often local authorities do not have enough data because of lack of resources and technical capacity, so IUCN categories are used. Frequently national data are not being updated but the situation varies from country to country.

Ana-Maria Giulietti added that analysis across the whole range of a species could distort the national view. Analysis at country level is important.

Sara Oldfield pointed out that the intention of the *Tree Conservation Information Service* is to back up the categories and criteria with supporting information. In the summaries published in the World List of Threatened Trees we can specify where the conservation situation is more critical than is apparent from the global assessment. WCMC's main role is to compile information at the global level and it is more appropriate for detailed information to be maintained by national agencies.

Following further discussion between the Working Groups for Central and South America, a threat category was agreed for most of the species where evaluations initially differed. The results of the evaluations for these widespread species are given in Annex 5.

Closing Remarks

Sara Oldfield thanked all participants for their contributions to a very productive Workshop, for generating the many positive ideas to emerge from the meeting and for the provision of information in support of the *Conservation and Sustainable Management of Trees* project. She summed up key points of agreement to emerge from discussions noting that:

- Botanists are in a good position to contribute to the international debates on forest conservation. Although forest conservation initiatives are often taken at the ecosystem level, species information should also be taken into account and increasingly genetic resource information. Good species information depends on the work of plant taxonomists and the *Tree Conservation Information Service* will be reliant on their expertise.

- Botanical information is continuously being updated at WCMC and is available on request. The results of this Workshop will be widely circulated to stimulate further data collection and exchange. Data presented at the Workshop will be incorporated into the new database for the project and sent to participants for review. The conservation evaluation of tree species is a dynamic process reliant on wide consultation and review.

Workshop Agenda

18 November

Morning (9.30am-1pm)
Registration

* Welcome to CATIE - **Dr Markku Kanninen**

* Introduction to the project - **Sara Oldfield**
  the work of WCMC and SSC
  project aims, activities and progress

* Development of *Tree Conservation Information Service* - data management issues - **Martin Sneary**

* Discussion and database demonstration

LUNCH
Afternoon (2pm-5pm)

* The IPGRI forest genetic resource conservation programme - **Abdou Salam Ouédraogo**

* Introduction to the new IUCN categories of threat and overview of their use for trees - **Charlotte Jenkins**

* Preliminary application of the new IUCN categories to the trees of Argentina - **Darién Prado**

* Discussion on application of new threat categories to trees species

19 November

Morning (9am-11am)

* Genetic conservation and management of trees in the Atlantic Forest, Brazil -**Flávio Bertin Gandara**

* Sustainability of uses of tree species - **Adrian Newton**

* Conservation of the genetic resources of *Swietenia* spp. - **Carlos Navarro Pereira**

* Discussion

11 am - 1pm
Working Groups

Group 1 Evaluating the conservation status of American oaks

Group 2 Application of the IUCN threat categories to Meso American and Caribbean tree species

Group 3 Application of the IUCN threat categories to South American tree species

LUNCH

Afternoon (2pm-4pm)

* Working Group discussions continued
* The work of CATIE in sustainable forest management - Dr José Joaquim Campos

20 November

Morning (9am-12am)

* The FFI Soundwood Programme - a brief overview
* Tropical high Andean forests in southern Peru - Dr Washington Galiano Sanchez
* Reports from Working Groups
* Networking and SSC tree conservation activities
* Integration with regional conservation initiatives

Afternoon (2pm-4pm)

* Discussion and conclusions

Participants list

Allen J. Coombes
The Sir Harold Hillier Gardens & Arboretum
Jermyns Lane, Ampfield
Romsey
Hampshire SO51 0QA
email 101736.1173@compuserve.com

Eduardo Dalcin
Centro de Informacoes e Servicos
Programa Mata Atlantica
Jardim Botanico de Rio de Janeiro
Rua Pacheco Leao 915
Rio de Janeiro-RJ
email pmajb92@ax.ibase.org.br
biosys@ax.apc.org

Washington Galiano Sanchez
Herbarium Vargas
Universidad Nacional de San Antonio
Cusco, Peru

Ana-Maria Giulietti
Coordenadora da Comissao Flora do Brasil
da SBB
Departamento de Biologia
Universidade Estadual de Feira de Santana
Km 03 BR116
Campus Universitário
CEP 44031-460
Feira de Santana
Brazil
Tel: 55-75-224 80 21
Fax 55-75-224 22 84

William Hess
The Morton Arboretum
Rt. 53
Lisle, Illinois 60532
USA
email whess@mortonarb.org

Shirley Keel
The Nature Conservancy
1815 N Lynn Street
Arlington, VA 22209
USA
email skeel@tnc.org

Luis Corrales
The Nature Conservancy
1815 N Lynn Street
Arlington, VA 22209
USA
email lcorrales@tnc.org

Jan de Koning
Hortus Botanicus/Rijksherbarium
PO Box 9516
2300 RA Leiden
Netherlands
email koning@rulrhb.ledienuniron1

Martin Mitre
Smithsonian Tropical Research Institute
Apdo. 2072
Balboa, Panama
Fax (507) 232 44 06

Cyril H. Nelson Sutherland
Director
Departamento de Biologiá (Herbario)
Universidad Nacional Autonoma de
Honduras
Tegucigalpa
Honduras
email cnelson@ns.unah.hondunet.net

Adrian Newton
Institute of Ecology and Resource
Management
University of Edinburgh
Darwin Building, Kings Buildings
Mayfield Road, Edinburgh, EH9 3JU
Tel +44 (0) 131 650 5419
Fax +44 (0) 131 662 0478
email a.newton@ed.ac.uk

Kevin Nixon
Associate Professor
L.H. Bailey Hortorium
462 Mann Library
Cornell University
Ithaca
New York 148-4301
USA
email kcn2@cornell.edu

Maricela Rodriguez
Africam Safari
Of. Puebla
11 Ote. 2407 C.P. 72000
Mexico
email macosta@siu.cen.buap.mx
Tel 52 (22) 358 607

Nina Marshall
IUCN EARO
PO Box 68200
Mukoma Road, Langata
Nairobi
Kenya
email nim@earo.iucn.ch
Tel/Fax (254) 2 890471

Marianne Syrylak Sandison
The Herbarium
Royal Botanic Gardens, Kew
Richmond, Surrey TW9 3AE
UK
Tel +44 (0) 181 332 5723
Fax +44 (0) 181 332 5757
email m.sandison@rbgkew.org.uk

Nohemy Elizabeth Ventura Centeno
Herbario de la Universidad de El Salvador
Escuela de Biologia
Universidad de El Salvador
Facultad de Ciencias Naturales y Matematica
San Salvador
El Salvador
Tel (503) 226 2072 (Of)
Fax (503) 226 1948

Daríen Prado
Catedra de Botanica
Facultad de Ciencias Agrarias, UNR
PO Box No 14
2123 Zavalla, Santa Fe prov.
ARGENTINA
Tel 54 41 970080/0085/0199
Fax 55 41 257164

Joaquina Pires-O'Brien
Independent Consultant
"Camelot", Mill Road
Mutfor, Beccles
Suffolk NR34 7UR
UK
Tel/Fax +44 (0) 1502 476351

Flávio Bertin Gandara Mendes
Avenida Padua Dias, 11
Caixa Postal, 530
CEP 13 400-970 Piracicaba, SP Brasil
Tel 55 (0194) 33 6155
Fax 55 (0194) 33 6081
email fbmendes@floresta.dsalq.usp.br

Pamela Wellner
SoundWood US
1009 De Haro Street
San Francisco, CA 94107
USA
Tel/Fax 1 (415) 695 1956
email pwellner@igc.apc

Abdou-Salam Ouédraogo
Forest Genetic Resources
IPGRI
Via dele sette Chiese 142
00145 Rome
Italy

Ximena Buitron
c/o TRAFFIC/UICN-SUR
Av. Atahualpa 935 y Republica
Edifico Digicom 4to. piso
PO Box 17-17-626
Quito
Ecuador
Tel (593-2) 466622/23
Fax (593-2) 466624
email ximena@vicn.ecx.ec

Dora E. Mora de Retana
Universidad de Costa Rica
Escuela de Biologia
Universidad de Costa Rica
San Jose 1000, Costa Rica
Tel/Fax (506) 552 3151

Nelson Zamora
Coordinator
Departamento de Botanica
Instituto Nacional de Biodiversidad
Apdo. 22-3100
Santo Domingo, Heredia
Costa Rica
email nzamora@randia.indio.ac.cr

Eduardo Calderon
Av. 3cn 62N-77, Casa 43
Villas de San Martin
Cali, Colombia
Tel/Fax 57 2 6658168

Silvia Llamozas
Fundacion Instituto botanico de Venezuela
Herbario Nacional de Venezuela
Jardin Botanico de Caracas
Av Salvador Allende
Plaza Venezuela
Apartado 2156
Caracas, Venezuela
Tel 58 2 6930143
Fax 58 2 6629081
email sllamoza@strix.ciens.ucv.ve

CATIE STAFF

Markku Kanninen
CATIE
Turrialba
Costa Rica

Carlos Navarra Pereira
CATIE
Turrialba
Costa Rica

Jose Joaquim Campos
CATIE
Turrialba
Costa Rica

Tania Ammour
CATIE
Turrialba
Costa Rica

WCMC STAFF

Sara Oldfield
World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
UK
Tel +44 (0) 1223 277314
Fax +44 (0) 1223 277136
email sara.oldfield@wcmc.org.uk

Charlotte Jenkins
World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
UK
Tel +44 (0) 1223 277314
Fax +44 (0) 1223 277136
email charlotte.jenkins@wcmc.org.uk

Martin Sneary
World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
UK
Tel +44 (0) 1223 277314
Fax +44 (0) 1223 277136
email martin.sneary@wcmc.org.uk

Working Document 1

Tree Conservation Information Service
Data management issues
November 1996

This paper outlines the development of the ***Tree Conservation Information Service***, which will, through the collaborative efforts of a wide range of individuals and organisations, provide access to high quality information relating to tree species. The service will aim to harmonise and enhance the value of the data collected and maintained by the expanding Species Survival Commission (SSC) Trees Network by facilitating its application to the conservation and management of trees at the local, national and international level.

The service will be of value to individuals and to key organisations whose decisions rely on access to accurate information. Access to high quality data and information will enhance capacity at all levels to make informed and well reasoned decisions. Whether determining the best use of local land or negotiating the obligations of an international treaty, authoritative data and information on tree species will inform the process and increase the likelihood that sustainable practices are employed and negative environmental consequences are minimised.

Background

The World Conservation Union (IUCN) has long recognised the importance of information management, integration and distribution. The Union created the Conservation Monitoring Centre in 1979 (later the World Conservation Monitoring Centre (WCMC) in 1988) to help manage and disseminate the wealth of data deriving from the activities of the IUCN Commissions. The importance of sound information management is now being expressed in the development of the Biodiversity Conservation Information System (BCIS). BCIS is a collaborative effort of IUCN commissions, programs and partners, including the IUCN SSC, and WCMC, with the broad objective of *supporting decision making and management practices that affect biodiversity and natural resources through the provision of data and information*. A process is now underway to plan the BCIS in detail, and partner reviews were undertaken during May and June 1996 and presented in a report titled *Partner needs and capability assessment*. The development of the SSC Trees Network and the formation of the Tree Conservation Information Service are complimentary to this ambitious project, and collectively they aim to enhance the conservation of biodiversity through the provision of accurate data and information.

Goal

To provide a reliable and up-to-date information service on the distribution, conservation status, local uses and economic values of tree species worldwide, in order to assist countries in the planning of sustainable forest management and biodiversity conservation, through appropriate international or intergovernmental processes.

Data harmonisation and data quality management

Data are widely distributed amongst individual experts, national, and international organisations. For these data to realise their full value, they need to be harmonised and presented in an integrated form. Indeed, whether presenting information for an action plan, a national survey, or to develop legislation, the supporting data will have greater impact if it is consistent. For example, when evaluating the status of a species, either regionally, nationally or internationally, it is essential to ensure that all potential sources have been identified, and that all the material being considered refers to the same taxonomic species.

The process of harmonising data can be reduced if data are collected along similar guidelines, and considerations also need to be given to the use of existing data standards. The application of appropriate standards facilitates **consolidation** and **communication** (exchange of data) and helps to ensure **consistency** within and between datasets.

The following will benefit considerably from standards:

- Taxonomy
- Geographic areas (eg Biological recording units - BRUs)
- Habitat or vegetation classifications
- Other standards (eg IUCN threat categories)

Although the service will aim to encourage the use of standards, the adoption of existing standards will depend on individuals, who will need to assess their suitability for use.

In addition to suggesting collection guidelines and identifying existing standards, the service will aim to promote and maintain excellent **data quality management**. Quality management refers to the overall process which governs the quality of a product from beginning to end. In the case of information the process begins with data collection and ends with user application. Quality control checks and quality assurance methods should be applied through all stages of the process.

There can be no absolute measure of the quality of a dataset. What may be "high quality" data for regional planning may be "low quality" for local decision making because of factors such as scale, detail, and error. Datasets may not be "100%" accurate, as the data are often based on subjective observation (such as deciding a boundary of a habitat), incomplete sampling (eg. field observations), or indirect measurement (eg remote sensing). Even if it were theoretically possible to collect complete and accurate data, time and cost considerations often make this extremely difficult from a practical standpoint. Therefore, datasets will generally contain an element of error and uncertainty. "Quality" must be considered a measure of "fitness for use" and is therefore relative to the proposed or intended use. This is a very important consideration when data are being integrated and used for applications beyond the original purpose of data collection.

Quality management requires attention to quality assurance, integrity protection, and to the complete documentation of the dataset in terms of its quality, uncertainty, limitations, origin and intended purposes. Such descriptions will form part of the data maintained through the service.

Data custodianship

A key to good management of biodiversity data is to ensure that data are always maintained by the organisation best placed to ensure quality. "Custodianship" provides a framework under which responsibility for a dataset can be assigned and accepted by the most appropriate agency. It provides a mechanism to ensure that each information holding is established, maintained and made available

by the agency best able to do so. The responsibilities of custodianship encompass data acquisition, management, and documentation, as well as determining under what conditions a dataset may be accessed and used.

As the Tree Conservation Information Service evolves, and more data are collected throughout the networks of custodians, accuracy will be maintained by relying on the individuals best qualified to comment on and maintain data doing so at the appropriate level. Indeed, custodianship should be recognised as being at the core of efficient and effective information management, and essentially provides a mechanism to ensure that each dataset is established, maintained and made available by the organisation best able to do so.

Licensing Agreements

Custodians may be responsible for management of the various licensing agreements, which can become very complex. Where appropriate, every effort should be made to develop relatively simple generic licences for data access and use within each jurisdiction. "Memorandum of Understanding" and similar high-level mechanisms that would allow the unrestricted flow of information between agencies may need to be negotiated. Successful biodiversity management requires ready access to many datasets from a wide variety of institutions. There should be an absolute minimum of administrative, cost and other impediments to the flow of information, consistent with the protection of copyright, intellectual property and other legitimate custodian rights. Any obstacles to the free flow of information will inevitably inhibit responsible decision making and sound biodiversity management.

The concept of custodianship can be very useful when attempting to build cooperative networks of information systems, whether linkages between the partners are electronic or informal. An important principle of the scheme is that all datasets are, in theory, accessible by all the partners. Designated custodians, however, have responsibility for collection and maintenance of the data and the sole right to update it and perform corrections. Varying conditions may be attached to data on the network. For example, data may be used for government decision making, public information or research purposes, but not for any commercial purposes, at least without specific permission.

Collaboration

Linking with other organisations is an important aspect of the information service, and will ensure that information collected through the project is compatible with other data gathering initiatives. Two important areas of collaboration have been developed: between WCMC and IPGRI and between WCMC and FAO. These relate to the following projects:

- **REFORGEN** database system, developed by the Forest Resources Division of FAO, is a global database system designed to house information related to the world's forest genetic resources.
- **TREESOURCE**, a global information system on forest genetic resources, represents a collaborative effort between FAO, CIFOR, ICRAF and IPGRI, and has been designed to provide readily, reliable and accessible information on forest genetic resources.

These collaborative links will also minimise replication of effort and promote exchange of data. Furthermore, wherever possible, the information service will adapt to support other initiatives for which the data may have a use.

Capacity Building

The service will not aim to maintain all the information potentially available on tree species. Central to the success of the service will be the development of regional capacity and in the development of the Tree Conservation Information Service, we are discussing with various national agencies their data management capacity and development needs. We would welcome your views on local needs during the course of the workshop, particularly as there is no single way to achieve improvements in the environment through the use of information. In all cases the approach has to be tailored to local conditions. Practically, WCMC can offer advise to agencies and individuals implementing their own priorities for information management. Topics covered, in a broad sense, include information systems development, database development, the role of quality management and its implications, techniques for information production and the role of information for decision support.

WCMC has been very active in supporting the development of in-country information management and is the hub of a network of organisations preparing guidelines and materials for capacity building. Documents developed for the UNEP-supported project *Development of Supporting Materials for Biodiversity Data Management and Exchange* are instructive in providing guidance on the conceptual processes, techniques and tools involved in the management of biodiversity information, and will provide valuable experience for the project.

- ***Guidelines for a National Institutional Survey*** (in the context of the Convention on Biological Diversity) - provides guidance to countries in the conduct of a survey and assessment of the capacity of existing national institutions to support biodiversity information management

- ***Framework for Information Management*** - guidelines meant to facilitate the development of capacity for information management and exchange as required by the ***Convention on Biological Diversity***

- ***Electronic Resource Inventory*** - represents a compilation of reference directories, guidelines, and standards relating to biodiversity information management

Characteristics of the information service

The Tree Conservation Information Service will be designed to be more than a simple catalogue of data, and will aim to provide benefits to individuals and institutions, at all levels. To serve the needs of this wide audience, the information service will have many different features, and central to its success will be the ability to provide practical solutions to **data collection**, **data storage** and **information dissemination**.

Data collection will benefit from standards. Data storage will require an **operational database**, providing standard database functions such as add, edit and delete, coupled with comprehensive reporting. The use of appropriate look-up tables and standards will ensure good data integrity. Dissemination of information will rely upon **presentation** functionality, with a strong emphasis on providing information on a selected topic in a range of forms. The media for this will vary, and will certainly take advantage of technologies such as the World Wide Web as well as a desk-top based presentation solution for those without Internet access.

The development of the information management system component of the information service will involve a number of distinct phases:

- User needs analysis
- Functional specification and prototyping
- System design and development
- Implementation
- Operation

The benefit of following a recognised path from concept to an operational system, often referred to as the **Structured Development Life Cycle** will ensure that the final product has been developed with appropriate consultation between prospective users and developers, and will therefore provide the necessary information management infrastructure to support the information service and its future maintenance and expansion.

User Needs Analysis

When building an information service, it is essential to identify clearly the requirements of the people who will be using the system, and to identify clearly the information products they require. These will provide clear direction for later phases in the development of the service itself, and ensure that the information service fulfils the objective of those involved.

To assist with establishing user needs, a tree and timber database questionnaire was prepared and mailed (July, 1995) to over 500 organisations in the following categories:

- National governmental forestry and conservation departments
- Bilateral and multilateral development agencies
- National and international NGOs
- Research organisations
- Forest product trade organisations
- Individuals

The questionnaire survey had two main aims:
- To collect information on existing databases
- To determine priority user needs for the *Tree Conservation Information Service*

Information on over 50 existing tree and timber databases has been received and is collated into a **meta-database**, which may itself become part of the information service. Where the appropriate consent has been given, details of the individual databases will be added to a larger database network, such as CIESIN (Consortium for International Earth Science Information Network) or UNEP GRID (United Nations Environment Programme Global Resource Information Database) meta-database. Information on priority information requirements has been provided by over 80 potential user organisations and individuals and these are summarised in table 1.

Table 1: Priority information requirements

Information Category	Response rate
Species scientific name	86%
Local uses	86%
Species distribution	85%
Commercial uses	83%
Conservation status *global*	77%
Level of exploitation	76%
Habitat type	74%
General ecology	73%
Management practice	73%
Maps	73%
Conservation status *national*	72%
Protected areas	72%
Indication of species abundance	70%
Conservation information *in situ*	69%
Vernacular name	66%
Growth & regeneration	64%
Species description	64%
National legislation	55%
Conservation information *ex situ*	52%
Species identification	50%
Certified timber sources	50%
Wood properties	43%

The range of information categories being considered lead to a number of possible questions which the information service could assist with:

- Is the species of conservation concern?
- Has the species been evaluated for the new IUCN threat categories?
  If so, what is the category and criteria by which it was assigned?
  What information is available to support the threat category?
- What is the distribution of the species?
- What are the uses of the species?
- Is the use of a species sustainable?

- What are the current levels of trade of the species?
- What are the types, levels and values of use that are being made of a species?
- Is the species legally protected - regionally, nationally, internationally?
- What are the administrative and legislative structures pertaining to the conservation/sustainable use/management of tree species in any particular context?
- What are the implications of specified human actions and/or natural phenomena?
- What current actions are being taken to manage tree species, and how effective are they in achieving their objectives?
- Which individual or organisation holds, has access to, or can generate the data or information relevant to a specific issue?

In addition to identifying key questions, the objectives of collecting the data must also be explored. Information may be required for a range of purposes, such as:

- To support policy development
- To support strategic decisions
- To develop effective legislation (for example, CITES)
- To be able to implement legislation
- To evaluate, compare and thus help determine priorities
- To identify what natural resources currently exist and where
- To identify where resources exist together (especially where in conflict; eg minerals and high biodiversity)
- To build scenarios of possible consequences of management actions
- To identify what changes are taking place, why and how fast
- To identify what actions will slow or reverse adverse changes
- To implement conservation measures
- To comply with international obligations

From the range of information categories, and the associated questions, certain data will be required and the following broad categories of data have been considered:

- Taxonomic (scientific names, authority, synonyms, common names)
- Distribution (point records, polygons, inferred)
- Conservation status (criteria and supporting references)
- Local Use
- Economic (trade figures, commercial use, level of exploitation)
- Ecology
- Habitat type
- Threats
- Legal structures
- Management practices
- Source of knowledge and expertise
- Links to other systems (Protected areas, legislation (ELC), land use

Through the views expressed in the questionnaire, discussion at the workshop in December 1995 and follow-up meetings with a number of organisations, including FAO and IPGRI, and

the two SSC specialist Groups, Conifers and Temperate and Broadleaved Trees, a **data collection form** (appendix A) was designed.

The data requested in the form can be summarised as follows:

Section 1: **Nomenclature and occurrence**
Section 2: **Conservation status**, including revised global IUCN threat category and criteria, threats and conservation measures
Section 3: **Uses and Ecology**, including habitat type

This form has been designed to collect species information from regional and taxonomic experts. Existing details of species name and distribution are provided from the WCMC Plants Database, and the partially completed forms are distributed to experts who are asked to assign the new IUCN red list categories and complete the form with details of species conservation status, uses, habitat and ecology. By providing a framework for data collection it is hoped that these forms will greatly assist the collection of information to be made available through the information service.

Over a thousand of these forms have already been completed by members of the SSC Specialist Groups for Conifers and Temperate Broadleaved Trees and by regional experts in Africa. Data for Asian and American tree species will be collected in the coming months.

The data collection form currently provides a framework for a number of data categories. These will be refined and extended to cover the other information categories as the project progresses, and importantly, ongoing consultation and collaboration with other organisations will be maintained and developed. One example of collaboration is illustrated by the Medicinal Plants Specialist Group, who have made some very useful comments on the data collection form and, in particular, how to make the data more relevant to sustainable use issues. It is hoped that this type of liaison will continue throughout the project.

Functional specification and prototyping

On the basis of the questionnaire results, and ongoing discussions with other organisations and SSC specialist groups, a functional specification of the desired information system can be drafted. In addition to this document, the development of a prototype promotes an interactive approach to development, and ensures that the proposed functioning system correctly addresses the requirements of the users. The development of a small version of the system, built quickly and inexpensively, allows discussion of the potential capabilities, and identifies, at an early stage, areas requiring refinement.

The prototype database provides the first draft operational database, and is focused on providing standard database functionality for the information being collected through the data collection form. It has been developed using Microsoft® Foxpro® 2.6 for Windows™. The decision for using this relational database management system to develop the prototype was based upon the ease and speed of development offered by the product, and does not preclude

the use of a different product for the final version. The prototype will provide the basis for review and comment from interested parties, and will be refined as part of the ongoing development.

During this phase, the following will be documented and produced:

- Precise information needs of intended users
- Conceptual and logical data models
- Process and data flow diagrams
- Description of all desired information products
- Inventory of key data holdings and information systems; this will involve the completion of the meta-database
- Functioning prototype

System Design and Development

In the system design phase, the functional requirements resulting from the previous phase will be translated into system specifications. The descriptions of data and processes will become the basis for database structures where computer databases are required, and the definition of procedures and programs. The inter-relationships of the modules and the transfer of data between them will be specified. It is at this phase that final decisions are taken on the overall system architecture, the hardware and software to be used. The prototype database developed in the earlier phase will provide invaluable guidance for this phase, and may be used as a starting point for the development of the functioning system. During design, although the major effort comes from the developers, continued user involvement and input is essential to ensure that the evolving system reflects correctly their needs.

The design specification defines the development tasks to be undertaken during the development phase. In this phase, again the major effort is from the developers, with essential input and guidance from users. The output of this phase is a functioning system which has been tested during development and should meet the requirements identified by the users.

Implementation and Operation

During these phases, the system is tested in an operational environment to ensure that it provides the expected functionality. Essentially, the functionality of the system is checked against the original user requirements as documented in the functional specification. Once approved, the system moves into an operational phase, which will continue for its lifetime. This will involve continual maintenance of the system, which may involve refinement and minor modification to adapt to changing requirements.

Summary

The information management component of the Tree Conservation Information Service will provide practical solutions to **data collection**, **data maintenance** and **information dissemination**. The development of a data collection form and the use of appropriate standards will promote consistency and guide the collection of data. Data storage will be served by an operational database, providing standard database functionality together with a comprehensive set of reporting tools. A prototype database has been developed, and will serve as a focal point for discussion, and will also guide the development phase. Information presentation will involve a number of media, and will certainly involve establishing a World Wide Web site for the project. Web pages will initially give project information, the list of temperate threatened tree species, and links to other related web sites. To serve those without Internet connection, other forms of presentation will be considered. In addition the Tree Conservation Information Service will aim to make available information on the following:

- Comprehensive information on species of conservation concern (including maps)
- Material on sustainable use
- Details of legislation
- Management Practices
- Collection methodologies
- Information management guidelines
- Application of the new threat categories

To make a significant contribution to the conservation and sustainable use of tree species, the information service will aim to address the following key points:

- Make information available to individuals and organisations at all levels
- Protect custodians' legitimate interests
- Ensure information is available in a timely manner
- Provide information in a form that is readily understood and easily communicated
- Ensure information is accompanied by an auditable trail so all underlying data and intermediate products can be scrutinised and independently reviewed
- Aid the development of regional capacity for information management
- Promote data exchange
- Develop collaborative links with other organisations
- Be responsive and flexible

Appendix A - Data Collection Form (reduced in size)

Section 1 - Nomenclature and Occurrence

Scientific name	
Other scientific name(s) in current use	
Family	
Common names	
Distribution at BRU* level (*Basic Recording Unit)	
Global IUCN threat category	
Uses	
Is the taxonomy above correct?	
Is the distribution complete? If not, in which additional countries or states can the species be found?	
If the species distribution is confined to a particular area? (e.g. a mountain range) Please give the details	

Section 2 - Conservation Status

Is this species of conservation concern in any part of its range? Please specify where	◻ Yes ◻ No
Revised global IUCN threat category (1994)	◻ EX ◻ EW ◻ CR ◻ EN ◻ VU ◻ LR:cd ◻ LR:nt ◻ LR:lc ◻ DD ◻ NE
Criteria (e.g A.1.(d) etc.)	
Comment Please use this space to sum up the status of the species. Please include any information about the **population size or decline, restricted range, ecological or taxonomic uniqueness, characteristics of regeneration or reproductive strategy**, and any indications of the fragility of the state of the species, especially where data are **insufficient to assign a threat category**	
Threats If multiple threats please indicate order of concern - use 1 for the most serious threat(s)	[ ] Felling [ ] Grazing [ ] Exploitation of plant parts [ ] Fire [ ] Natural Disaster [ ] Pollution [ ] Pests & Diseases [ ] Invasive species [ ] Lack of dispersal/pollination agents [ ] Seed Predation [ ] Poor regeneration for unknown reasons [ ] Mining [ ] Tourism [ ] Industrial development [ ] Agriculture [ ] Forestry [ ] Expansion of human habitation [ ] Decline in soil water content [ ] Other major threat:
Conservation measures Please give the details of any on-going conservation activities, including **legal measures, presence in protected areas, management practices and *ex situ* conservation**, especially where the species is categorised as LR:cd	

Section 3 - Uses and Ecology

Brief species description						
****Uses**	**Use**	**Part**	**Level**	**Use**	**Part**	**Level**
Please enter in the columns provided the appropriate letter and number corresponding to the part used and the level exploitation respectively Unspecified, Entire plant, SeeDling, Gall, STem, Bark, Leaf, Inflorescence, Fruit, Seed, EXudate, Root 1 Major International trade 2 Minor International trade (LKS) 3 National or Local trade 4 Local use only	**EXAMPLE** Medicine Timber Fuel Food Food additive Animal food Invertebrate food Bee plant Vertebrate poison	**T,B**	**2,2**	Non-vertebrate pois on Gum, resin, oil etc Fibre Gene source Social use Environmental use Ornamental Other (please specify)		

*****Habitat Type** Please tick whichever boxes describe the species natural habitat most appropriately.	☐ Closed forest ☐ Open forest ☐ Scrub ☐ Herbaceous vegetation ☐ Sparsely vegetated	☐ Lowland ☐ Submontane ☐ Montane ☐ Alpine	☐ Broadleaved ☐ Coniferous ☐ Mixed	☐ Cloud forest ☐ Mangrove ☐ Swamp forest ☐ Wetland ☐ Sclerophyllous ☐ Anthropic landscape
	☐ Temperate ☐ Tropical	☐ Seasonal ☐ Non-seasonal	☐ Moist ☐ Dry	

Please define habitat type further if necessary	
Species associations	
Regeneration guild	☐ Early pioneer ☐ Late secondary ☐ Primary
Spatial distribution	☐ Abundant ☐ Scattered ☐ Clumped
Obligative species dependencies	
Dispersal/pollination agents	
Altitudinal range in metres	Min Max
Status of the species in cultivation	☐ Plantation grown ☐ Widely cultivated ☐ Small scale ☐ None
Relevant references Please cite any references used to complete this form	

Please indicate the uses of species only when relevant to human use e.g. only those plants eaten by invertebrates such as silkworms, lac insects etc. should be indicated as **invertebrate food. Bee plants are those which are used for honey production. **Animal food** refers to those plants eaten by domesticated animals. **Environmental use** refers to shade trees, windbreaks and trees used in erosion control etc. Examples of plants of **social use** are narcotics, contraceptives, plants of ritual significance etc.

***Closed forest** consists of trees with interlocking crowns. **Open forest** (woodland) contains trees with crowns not interlocking. **Herbaceous vegetation** is dominated by non-woody plants with scattered trees.

Your name	Date

Draft
Working Document 2

Guidelines for the application of the 1994 IUCN Red List Categories to trees

These guidelines are for use in conjunction with the red pamphlet *IUCN Red List Categories (1994)*. They are intended to provide practical advice and examples of the application of the categories specifically to tree species. IUCN categories of threat have been in use for over thirty years. The 1994 revision represents the first step to make the categories more quantitative, objective and equable over all taxa (except for microorganisms). As from now, a category can only be assigned to a species if one or more of a choice of five criteria apply.
The revised IUCN categories are being applied to tree species as part of the *Conservation and Sustainable Management of Trees* project being carried out by the World Conservation Monitoring Centre in collaboration with the IUCN Species Survival Commission. Over 2500 tree species have already been evaluated by various experts using different methods and sources, some of which are outlined below. It is the aim of the project that all tree species of concern will be evaluated by the end of 1997 and it is envisaged that these evaluations will be added to and updated as more information becomes available.

As part of the project, William Hawthorne was contracted to assign the categories to Ghanaian tree species and report on the process in comparison to the "Star system" which he developed for national use in Ghana. His report illustrates how the criteria can be interpreted in different ways and how the general paucity of data affects the application process. These guidelines have been developed from the recommendations made by William Hawthorne and from other comments made by botanists in their attempt to use the categories. It is hoped that they will help to standardise the work of different assessors, especially those working in isolation.

Information sources for evaluating tree species

In order to qualify for a category of threat, evidence is needed to demonstrate that a species is experiencing, to various degrees, one of the following:

Criterion A. Population is seriously declining or is expected to decline
Criterion B. Population is localised, fragmented and declining at an unspecified rate
Criterion C. Population is small and declining, and either fragmented or localised if declines are less than 10%
Criterion D. Population is very small

Information on species conservation status and threats, although more commonly available than in the past, remains scarce and patchy for many countries. Taxonomists, or their published floras and taxonomic revisions, provide essential baseline data on taxonomy, nomenclature, species distribution, habitat type and sometimes additional information. In many cases this is the sole source of information on rare and restricted-range species.

It is possible, by examining the geographical and altitudinal ranges, the location and habitat of species, to make preliminary evaluations of their status. The numbers of collections in herbaria and the date they were made can help to indicate the rarity and the likelihood of still finding specimens in the wild. Species which are known from less than five specified locations can automatically qualify

for a threat category, **VU D2**. The same species can qualify for more serious threat categories, **EN C2b, EN B1 & 2c** etc if they are confined to an area or habitat which is declining. Frequently, species which are rarely collected are overlooked or from areas or habitats that are rarely visited. It is up to the assessor to judge whether this is likely to be the case. It is important to record these poorly known species even though they may, eventually, be removed to lower risk categories. Supporting comments are being collected as part of the evaluation process in the *Conservation and Sustainable Management of Trees* project. It will be stated where threat categories are given because species are only known from a few collections.

Relevant data may also be obtained from transects and sample plots in the field. These give evidence of vegetation changes, species ecology and guild, population densities and structure. Rarely do restricted-range and uncommon species appear in these datasets but these data, along with evidence from forest cover changes, can identify less rare species which may have experienced 20% or more habitat loss. An excerpt from Will Hawthorne's report in annex 2 gives an example of a typical evaluation.

GIS (Geographical Information System) is a powerful tool to store and analyse species distribution information in a standard way. Where species point localities can be stored in a GIS, data can be very successfully manipulated to assess whether their **AOO** (Area of Occupancy) or **EOO** (Extent of Occurrence) are within the limits set by the B criterion and also by the criterion for **VU D2**. David DuPuy and Jonathan Hughes have evaluated a subset of Madagascan Legumes in this way.

It is important, initially, to note:

- The categories only apply at a global level to the entire species range.
- The categories can be applied to any taxonomic level, including infra-specific taxa and microspecies.
- It is not expected that all the criteria will be appropriate for any one species. Different criteria apply to different species according to the biology and habit of the taxon.
- Exact population figures or areas of occupancy are not essential in order to apply categories. It is possible to infer or project into the future the effects of current and potential threats. The situation known in part of range may also be sensibly extrapolated to assess the overall status of the species if it is unknown elsewhere. Population declines can also be estimated from habitat loss or levels of trade.
- It is essential that the criterion and subcriterion applied are recorded with the category of threat (e.g. VU A1c,d). Lower risk species should be recorded as LR:cd, LR:nt or Lrlc.
- The B criterion should only be used when two of the subcriteria are fulfilled.
- The category "Rare" from the previous version of the IUCN categories of threat no longer exists. Species which are naturally rare can only be assigned a category of threat by having less than 5 localities (**VU D2**) or by showing signs of some population decline or loss of habitat.
- The most serious category applicable should be assigned to the taxon.

The definitions interpreted for tree species

1. **Mature individuals** ("number of individuals known, estimated or inferred to be capable of reproduction"). The capability of reproduction in tree species varies widely and vaguely according to age/size class of individuals (e.g. *Bailonella toxisperma* first flowers at 50-70 years and doesn't fruit until roughly twenty years later, conversely *Sequoiadendron giganteum* may produce seed at less than 20 years of age and continue to do so for 3000 years). We suggest 80% of individuals in any age/class should be capable of fruiting in order to call them "mature". If little is known about age at fruiting, mature individuals should be counted as those of a typical size; e.g. canopy species should be canopy height etc. In addition, individuals should be reproductively effective. Individuals which are unable to regenerate or those hampered by their isolation or by inbalanced sex ratios may be discounted from population estimates. Clones of apomictic species and self-fertilizing species qualify as individuals.

2. **Generation time** ("average age of parents in the population"). We suggest that the age of species at maturity (see above) should be used as an estimate of their generation time. Where there is no information we suggest the following estimations: 50 years for most tree species, 5-10 for pioneer species or small trees, 100 years or more for slow-growing trees.

3. **Population** ("the total number of mature individuals"). These estimates should include only **mature individuals**. For most non-pioneer species population estimates should be a fraction of the total population number.

4. **Extreme fluctuations** ("in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude"). Tree species are unlikely to experience extreme fluctuations. Therefore in order to qualify a species as threatened according to the B criterion the population must be fragmented or in ten or fewer locations and also declining or likely to decline.

5. **Extent of occurrence (EOO)** ("the area contained within the shortest continuous imaginary boundary which...encompasses all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy"). In tropical regions, if the total population or the sum of disjunct subpopulations takes up the equivalent of approximately 2 degree square then this may qualify the species as having an **EOO** less than 20,000km². In more temperate latitudes around 2.5 degree squares can be occupied. **Endangered** and **Critically endangered** species should be assessed at a finer scale, perhaps on a 1:1,000,000 map using grid squares of 50km x 50km.

6. **Area of occupancy (AOO)** ("smallest area essential at any stage to the survival of existing populations"). This is intended to be a more accurate figure for the area to which species are confined. The estimate should take into account the habitat requirements of the species, whether these are specific pollinators, canopy height or climatic conditions. **AOO** should be measured on a scale roughly ten times finer than that used to measure **EOO**. For more endangered species grids of 5 X 5 km and maps of 1:100,000 would be useful.

7. **Subpopulation** ("distinct groups in the population between which there is little exchange...one successful migrant..per year"). In the case of tree species we may define a subpopulation as an isolated population which experiences insignificant seed or pollen migration from other populations within a generation time.

8. **Extinct in the wild** ("exhaustive surveys in known and/or expected habitat...throughout its historic range have failed to record an individual..over a time frame appropriate to the taxon's life cycle and life form"). There is no suitable time frame in which to judge a tree species to be extinct, especially where few exhaustive surveys have been carried out to recover it. We suggest if its habitat has disappeared or the site has been visited by trained botanists then the species can be considered as **Extinct**. If the site is restricted then a threat category should be assigned, **CR C2b, EN C2b**. If the area is less restricted then at least **VU D2** is appropriate. Where the species is taxonomically poorly determined then the species should be considered **Data Deficient**.

The criteria applied to tree species

Criterion A

This criterion is useful in applying the categories to species which are **not localised but whose habitat or population has been heavily exploited or degraded** or which are **regenerating poorly** and also for species which are **sparsely distributed and declining.** Other criteria (B, C or D) are more useful to assign categories to species which are low in numbers or highly localised. Some suggestions are made below as to how to use this criterion.

How to make estimates of population decline in the last 100+ years. Three generations of a tree species may span a millennium. Where data are unavailable on species ranges and population dynamics over a long period of time it is wholly appropriate to assume the situation from population declines and ranges that are currently known. It is fair to say that rates of decline are rarely known and more commonly assumed.

Should species which are widespread but have experienced a general decline of 20% because of habitat destruction be Vulnerable? Many tropical forest species have experienced a 20% decline in their natural habitat over the past 3 generations. Some of these species, however, do have a wide ecological tolerance. The most likely candidates for this criterion are those which are strictly confined to declining habitat types and not able to regenerate outside of them, or species which are specifically and heavily exploited.

Where species are regenerating poorly. If regeneration is known to be poor then the A criterion could be applied by using projected decline. Will individuals replace themselves in the next three generations? If the species is long living or its regeneration depends on stochastic events it will be hard to project a decline. Criteria C or D may apply.

Where species are sparsely distributed. Where species population density is low or populations do not occur in easily-recognisable clumps, from which **AOO** can be estimated, the only way to denote the species as threatened is through estimated or projected declines in population (criterion A) or in population numbers (criterion D).

Where species have experienced a genetic decline. In many cases for tree species there has been a tremendous genetic decline or loss of fitness in the population where the larger and fitter individuals have been harvested. If this is a significant proportion (20% or more) of the **mature population** then the taxon can be registered as threatened under criterion A.

Criterion B

This criterion is useful in order to assign categories to threatened species which are **regionally endemic** or **confined to a particular habitat**. Much of the necessary discussion concerning these criteria can be found under the definitions for **AOO** and **EOO** and also under **Extreme fluctuations**. Incidentally, it is expected that many threatened tropical tree species will be assigned under this criterion.

Criteria C & D

These criteria can only be used where **population numbers or locations, from which the species is known, are small or highly restricted**. It is also possible to assign these criteria to **species which are not regenerating.**

Where a species is known from less than five locations. A species can be assigned a category of **Vulnerable D2** on this information alone. If there are doubts as to whether the population still exists a more serious threat category should be assigned by assuming a decline and that the extent of occurrence is small, **EN B1+2c, CR B1+2c**, or the population size is less than 10,000 mature individuals, **EN C1, C2a or b or CR C1, C2a or b**. The assessor may also choose to assume the species is more widespread than evidence suggests and assign a category of **Lower Risk**.

Where the species is not regenerating. This is also discussed above under criterion A. It is embedded in the definition of "mature individuals" that individuals should be effective at reproducing. Individuals which produce offspring which are not viable should not be counted in the population estimate. Therefore population estimates may be made by taking the proportion of the population which are reproducing effectively, the population density and the area of occupancy.

Criterion E

Few population viability assessments (PVA) have been carried out for tree species. We would be pleased to hear of any.

Category Lower Risk, conservation dependent (LR:cd)

When should presence in protected areas be used as a means for applying LR:cd? In some cases, if protected area boundaries were to be taken away the tree species inside would rapidly be wiped out and, where the ensuing declines in species population are significant, the species would register as threatened. If the current status of the species does not qualify as threatened, **LR:cd** is the appropriate category to use in these cases. The effectiveness of protected areas in preventing declines in species populations is sometimes questionable or unknown. In these cases, species should be allocated a category of **LR:nt** if not qualifying as threatened.

Category Lower Risk, near threatened (LR:nt)

This category should contain species which narrowly miss the criteria for threatened species. It is also useful for species which appear not to suffer from serious threats but would quickly qualify as threatened if new pests, further exploitation or development of agriculture, forestry or human

settlements were to occur. Category changes can often occur in rapid or large steps. A **LR:nt** species may become **EN** in one step.

Category Lower Risk, least concern (LR:lc)

This is the appropriate categorisation of "not threatened" species.

Category Data Deficient (DD)

This category is useful to apply to species which are taxonomically dubious. As long as the name is published, however, a threat category can be applied. It must be emphasized that data are largely deficient for a truly accurate evaluation of the status of most tree species. However, this should not deter the assigning of threat categories. **DD** should be used as a last measure.

Case Studies

The examples of species evaluations below are provided by regional and taxonomical experts. They illustrate how assessments for tree species may be based on less precise data or little information at all. The supporting comments will be stored, along with the IUCN category, in the *Tree Conservation Information Service*.

Species for which there is limited information

Rollinia pickelii - **VU B1+2c** is restricted to a fairly small area (probably less than 20,000km²) in the highly threatened *restinga* vegetation on the coast of Paraíba and Pernambuco states in Brazil.

Cynometra filifera - **CR A2, B1 & 2(a-e)** is locally dominant in a patch of Tanzanian forest of about 0.25ha. It is only known elsewhere from a forest, 40km away, which has not been visited for 40 years and is believed no longer to exist.

Nectandra herrerae - **EN B1+2c** was discovered near the train station of Aguas Calientes in Machu Picchu Historical Sanctuary in Peru. The area is heavily visited by tourists on foot and by train. The town is rapidly expanding and there is frequent burning of the forests in surrounding areas.

Cariniana pauciramosa - **EN B1 + 2c** has only ever been found along the Manaus to Itacoatiana road in the Brazilian Amazon.

Mollinedia lamprophylla - **CR C2a, D1** was formerly known to occur along streams. Extensive searches for this understorey species have only located two female specimens, which are restricted to Brazilian Atlantic forest in Corcovado. One specimen has, however, set seed. It is included in the official list of threatened species of Brazil compiled by IBAMA.

Extinct species

Thuja sutchuenensis - **EX** was collected from a site, where it was possibly planted, near a temple in Sichuan in 1892. No-one has collected a wild specimen since, despite botanical visits to Sichuan.

Chrysophyllum januariense - **EX** was once collected in Rio de Janeiro in the Laranjeiras forest, which no longer exists.

A species displaying poor regeneration

Heritiera longipetiolata - **VU C1** consists of about 1000 trees on Guam, several hundred on Tinian and less than 100 on Saipan. Lack of regeneration on Guam is the major problem there. This may be caused by seed or seedling predation by ungulates or crabs. Habitat loss is a minor problem currently and the species status is not especially fragile. If the lack of regeneration is found to be a significant problem this species could easily qualify for a category of **EN.**

Mountain top or isolated species

Gustavia erythrocarpa - **Vu D2** appears to be restricted to non-flooded forest between 1250 and 1300m in Amazonian Brazil and adjacent parts of Venezuela.

Araucaria schmidii - **VU D2** is known from one location on escarpments near the summit of Mt. Panié in New Caledonia. It is possible that individuals could be found on neighbouring mountains but this is a remote area and botanically less well known.

Widespread timber species

Amburana acreana - **VU A1d+2d** formerly abundant in terra firme forest, this species has been heavily exploited for its wood which is used for making luxury furniture. In Rondônia the number of sawmills, which process principally *A.acreana*, has increased 8 fold between 1975 and 1982. The species is now on the official list of threatened species of Brazil compiled by IBAMA.

Fitzroya cupressoides - **EN A1cd & A2cd** has been logged since the 1500's, particularly in the mid nineteenth century when Europeans eliminated all populations in poorly drained lowlands in Chile and Argentina. In the Andes clear-cutting and human-made fires have caused the loss of *Fitzroya* forests. Illegal logging and export of the timber continues despite national and international legislation banning it. The species' very slow growth and maturation (200 years) makes the prospects for sustainable management of the species highly unlikely.

Lower Risk but near threatened species

Agathis vitiensis - **LR:nt** is a timber species endemic to Fiji. It is found in low densities but is relatively unthreatened. If logging activities intensify in the area then the status of this species will become a concern.

Manilkara rufula - **LR:nt** occurs in numerous subpopulations in submontane forest in central and eastern states of Brazil. Recent collections have suggested a decline in the number of individuals

Micropholis gnaphaloclados - **LR:nt** is a tree of submontane cerrado, caatinga and rocky outcrops. It ranges from Pernambuco to Mato Grosso in Brazil but the populations appear to be highly fragmented.

Lower Risk least concern taxa

Dacrycarpus expansus - **LR:lc** is locally common or in pure or co-dominant stands in disturbed areas and on the edge of tree fern grassland in Irian Jaya and Papua New Guinea.

Cordia sebestena **var.** ***caymanensis*** - **LR:lc** occurs in all three Cayman islands. There is potential for hybridisation with nominate subspecies imported for landscaping. Restrictions on plant imports and increasing interest in local propagation may reduce this threat. Widespread habitat destruction is reducing the population size but the species is well represented in protected areas and often retained in landscaping.

A Conservation dependent taxon

Cupressus arizonica **var.** ***nevadensis*** - **LR:cd** a variety known from four localities in nine groves in the Piute Mountains of California. Some risk occurs from fires. Several occurrences are within protected areas.

Data Deficient species

Monodora junodii var macrantha - **DD** is endemic to northern Mozambique, where war and its aftermath has prevented any kind of field work. The taxonomy, extent of the species range and current status needs to be confirmed.

Key to the application of red list categories to tree species

1

Can the species population or habitat be said to experience declines to any degree, in the past, present or future?	**Go to 2**
Is the species population and habitat in a completely stable state?	**Go to 6**

2

Has or will the global population experience declines of 20% or more because of poor regeneration, exploitation, habitat degradation or loss, or any other reason?[1] (N.B.Geographically confined or small populations may also qualify for other criteria, continue to 3.)	
20% habitat/species declines	**Assign VU A1 or 2(a-e)**
50% habitat/species declines	**EN A1 or 2(a-e)**
80% habitat/species declines	**CR A1 or 2(a-e)**
Is the global population decline unqualified or less than 20%?	**Go to 3**

3

Is the global population known or likely to contain less than 10,000 mature individuals? (N.B. Geographically confined species may also qualify the B criterion, continue to 5.)	**Go to 4**
Is the global population unknown or likely to contain more than 10,000 mature individuals?	**Go to 5**

[1] It is assumed that three generations is greater than 10 years and is at least 100 years

4

Is the global population experiencing declines of 10% or more and does it contain no more than 10,000 mature individuals?	**Assign VU C1**
or 2500 mature individuals + 20% decline?	**EN C1**
or 250 mature individuals + 25% decline?	**CR C1**
Is the global population fragmented and containing no more than 10,000 mature individuals + subpopulations of less than 1000 mature individuals?	**Assign VU C2a**
or 2500 mature individuals + subpopulations of less than 250 mature individuals?	**EN C2a**
or 250 mature individuals + subpopulations of less than 50 mature individuals?	**CR C2a**
Is the species only known from one population containing no more than 10,000 mature individuals?	**Assign VU C2b**
or 2500 mature individuals?	**EN C2b**
or 250 mature individuals?	**CR C2b**
Is the species none of the above?	**Go to 5**

5

Does the species exend over a range less than 20,000km² and can it be assumed that the species is known from less than ten locations or it is fragmented?[2]	
Extent of Occurrence 20,000km²	**Assign VU B1&2(a-e)**
Extent of Occurrence 5000km²	**EN B1&2(a-e)**
Extent of Occurrence 100km²	**CR B1&2(a-e)**
Does the species extend over a range greater than 20,000km² or can the assumptions above not be made?	**Go to 7**

[2] If an accurate measure of the actual species **Area of Occupancy** (AOO) can be made refer to the IUCN red list categories booklet.

6

Is the global population known or likely to contain less than 1000 mature individuals in the wild?	
Less than 1000 mature individuals	**Assign VU D1**
Less than 250 mature individuals	**EN D1**
Less than 50 mature individuals	**CR D1**
Is the global population unknown or likely to be more than 1000 mature indivduals in the wild?	**Go to 7**

7

Is the species only known from less than five localities or from an area less than 100km²?	**Go to 8**
Is the species known from more than five localities?	**Go to 9**

8

Technically it is correct for these species to be assigned a threat category. It is sometimes likely that individuals of the species are overlooked in the field and should be found to be more widespread. The decision whether to take this to be the case or not is up to the assessor.	**Assign VU D2**
It may be worthwhile to reconsider whether species can be presumed to be declining and either confined to less than 20,000km² or to less than 10,000 mature individuals.	**Return to 1**

9

Does the species narrowly miss qualifying one of the above criteria or will it become threatened should circumstances worsen or change for the worse?	**Go to 10**
Is the species unlikely to qualify as threatened unless under very unusual circumstances?	**Assign LR:lc**

10

Is a significant proportion of the population contained within a protected area so that, in the future, the species will be cushioned from fulfilling a category of threat?	**Assign LR:cd**
Does the species occur outside protected areas?	**Assign LR:nt**

An excerpt from "Conservation priorities amongst Ghana's forest trees. An assessment of the IUCN red-list guidelines, and a comparison with Ghana's own star-rating

Population numbers are next to impossible to estimate for continental tree species in the tropics. Ghana has carried out one of the most extensive surveys of its forests in Africa and yet it is impossible to collect sufficient details about rare species to validate a population estimate. The approach taken by William Hawthorne in assessing the status of tree species in Ghana involves estimating the likely **EOO** from the distribution of the species habitat and assuming its rate of destruction in the last few decades from published figures. The following is an extract from the working document prepared by William Hawthorne for the project's technical conference in Wageningen in November 1995.

Forest Types are those defined by Hall and Swaine (1981):
WE Wet Evergreen, **ME** Moist Evergreen

Wet forest species: General trends
[In Ghana] the decline in forest quality and quantity has been less dramatic here [in wet forests] than in drier forests, yet the statistics are rarely presented in a way which allows this to be quantified.

The greatest number of globally rare species in Ghana are wetter evergreen forest species, apparently restricted to these forests by a wetter climate/base-poor soil there, although there is also much speculation about their status as 'refugees' in or near Pleistocene refugia there (see summary discussion and references in Hawthorne, 1995). A sketch of enclaves of Wetter (evergreen) Guinean forest is shown in Parren and de Graaf, 1995. A species restricted to this vegetation in Ghana has a maximum EOO of about 2000 km², but the internal variation is substantial and no rare species are found throughout. Many such species favour swamps or riverside forest, for instance. Much of this vegetation type in Ivory Coast is deforested. The total area in the Ghana and Ivory Coast Block is probably < 3000 km². A species restricted to this area would qualify as at least endangered (B1,B2), without further consideration. Most species occur outside this block, however, either in the Liberian block of WE forest or in the ME zone in Ghana and elsewhere. In Liberia and Sierra Leone, the remnant WE type zone is larger, possibly about 15000-20000 km² (from maps in Parren and de Graaf, 1995).

Some species are restricted to the WE zone, others extend various degrees into the drier ME zone. In Ghana the area of ME zone forest is about 2.5 times the WE area, but is more widely disturbed. Assuming the same trend for the Liberian block, we can estimate an effective ME area of the order of perhaps 30,000 km². Combined with the WE area, this sets a maximum area on Upper Guinean wetter-forest species.

White (1983) includes both WE and ME type forest in his mapping unit 1a ("hygrophilous coastal evergreen Guineo-Congolian rain forest"). The extent of this mapping unit in Lower Guinea is about twice the extent of that of Upper Guinea. Most Guinea-wide species (i.e. species in both Upper and Lower Guinea) have been filtered out from consideration; those that remain for consideration here are those like *Afrostyrax lepidophyllus* which seem restricted within these zones, so these total areas of Guinean Wet forest are much broader than the EOO (esp.AOO) of these species[3]

[3] Note that attempts to model AOO using known distribution and the environmental associations of such species would in most cases lead to a gross overestimate of AOO.

Although the area of this type of forest is limited, it seems that forest loss has not been as bad in such areas (especially the WE type) as in drier areas, because of negligible loss due to fire, lower densities of timber than in semideciduous forests and rather infertile (heavily leached) soils, although mining in the ME belt of Ghana has accounted for significant losses e.g. around Tarkwa. Cocoa farming has not been as great a factor in the WE zone as it as in the ME zone. Mining is a potential threat for deforestation in Ghana, with recent quarrying in Neung and Cape Three Points, and there has been significant forest loss on unreserved land in the WE zone (and in Western Region generally) since Ahn's (1959) summary of land-use patterns. Deforestation of Subri Forest Reserve and elsewhere due to industrial plantation is, being moderately optimistic, unlikely to expand much further.

Wet Forest species: Specific cases

It is hard to place with confidence any WE species as critically endangered, in spite of the limited range of many of them. Some potential contenders, like *Trichoscypha chevalieri* (found only a few times ever, in a limited total range) come very close, but our picture of this species' situation is a little too hazy to commit it to this alarming status. Instead, I propose to put the majority of such (locally and globally) rare, systematically declining WE species in the Endangered category, preferably with a hair-trigger, set to upgrade their status to critical if any more negative factors arise. Alternatively, any future records e.g. in Lower Guinea are liable to render the species merely Vulnerable. For species with a wider distribution, only *Monocyclanthus vignei* (from two main areas) attains endangered status. The others must therefore be defined as Vulnerable.

Wet forest species: tentative conclusions:

VULNERABLE (VU-B1&2c & A1c)

Tapura ivorensis
Drypetes afzelii (EN?)
Sapium aubrevillei
Cassipourea hiotou
Cola umbratilis
Placodiscus bancoensis
(P. bracteosus?)
Spathandra barteri
Trichilia ornithothera
Xylopia elliotii
Croton aubrevillei
Desmostachys vogelii
Amanoa bracteosa
Anthonotha vignei
Berlinia occidentalis
Cryptosepalum tetraphyllum
Dactyladenia dinklagei
Deinbollia molliuscula
Didelotia idae
Gilbertiodendron bilineatum
Gilbertiodendron splendidum
Isolona deightonii
Neostenanthera hamata
Ouratea amplectens
Pausinystalia lane-poolei
Pavetta mollissima
Phyllanthus profusus
Piptostigma fugax
Placodiscus oblongifolius
Rhaptopetalum beguei
Schumanniophytum

VULNERABLE CONTINUED

Synsepalum aubrevillei
Trichoscypha albiflora
T. beguei
T. cavalliensis
Afrostyrax lepidophyllus
Allexis cauliflora
Dasylepis assinesis
Amanoa strobilacea
Citropsis gabunensis
Crotonogyne manniana
Didelotia unifoliolata
Gluema ivorensis
Oricia suaveolens
Pellegriniodendron diphyllum
Piptostigma fugax
Pseudagrostistachys africana
Trichoscypha atropurpurea
Warneckea memecyloides

ENDANGERED (B1&2c)

Chrysophyllum azaguieanum
Dactyladenia hirsuta
Hemadradenia chevalieri
Hymenostegia gracilipes
Sericanthe toupetou
Trichoscypha chevalieri
Monocyclanthus vignei
Neolemonierra clitandrifolia This large tree probably a very long generation time. Its habit extends to Upland evergreen forest, which has declined more than the lowland variants.

(The following species are perhaps of less concern than the above; LR:cd "Conservation dependent" (in Forest reserves), might be more appropriate.

Crudia gabonensis Probably well-buffered in lower Guinea.
T. oba
Raphia Palma-pinus Guinea-wide Swamp species often outside forest..
Uapaca paludosa
Xylopia rubescens
Magnistipula zenkeri
Anisophyllea meniaudii
Dichaetanthera africana Although rare in Ghana a pioneer of wet forest
Ehretia trachyphylla. Pioneer-ish, and well into ME zone
Ficus tesselata
(Homalium dewevrei & longistylum) Complicated taxonomy/variation pattern and distribution area. These appear to be widespread. ?Data deficient.

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Conservation evaluations for selected widespread tree species

Amburana cearensis

Distribution: Argentina, Bolivia, Brazil, Paraguay and Peru
Conservation status: EN (A1a, 2a,c,d). Evaluated by Working Group 3.

Aniba rosaeodora

Distribution: Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Surinam and Venezuela
Conservation status: CR (A1a, 2a,c,d). Evaluated by Working Group 3.

Araucaria angustifolia

Distribution: Argentina, Brazil and Paraguay
Conservation status: CR (A1a, 2a,c,d) Evaluated by Working Group 3. Note - previously evaluated as VU by SSC Specialist Group - need to refer back for further consideration.

Aspidosperma polyneuron

Distribution: Argentina, Brazil, Colombia, Paraguay and Peru
Conservation status: EN (A1a, 2a,c,d). Evaluated by Working Group 3, noting that in Colombia the species is more severely threatened.

Balfourodendron riedelianum

Distribution: Argentina, Brazil and Paraguay
Conservation status: EN (A1a, 2a,c,d). Evaluated by Working Group 3, noting that the genus is under revision.

Bertholletia excelsa

Distribution: Bolivia, Brazil, Colombia, the Guianas, Peru and Venezuela
Conservation status: VU (A1a,c 2a,c,d). Evaluated by Working Group 3.

Caesalpinia paraguariensis

Distribution: Argentina, Bolivia and Brazil
Conservation status: VU (A1a,c). Evaluated by Working Group 3.

Cariniana legalis

Distribution: Brazil
Conservation status: VU (A1a,c). Evaluated by Working Group 3.

Caryocar costaricense

Distribution: Costa Rica, Colombia?, Panama and Venezuela
Conservation status: VU. Evaluated by Working Group 2 on the basis of: high exploitation, restricted distribution, weak regeneration - well known by the group. Criteria needed.

Cedrela fissilis

Distribution: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Panama, Paraguay, Peru and Venezuela
Conservation status: EN. Evaluated by Working Groups 2 and 3. Criteria needed.

Cedrela odorata

Distribution: Antigua & Barbuda, Argentina, Barbados, Belize, Bolivia, Brazil, Cayman Is., Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Guadeloupe, Montserrat, St.Kitts, Mexico, Nicaragua, Panama, Peru, St.Lucia, Surinam and Venezuela
Conservation status: Working Group 2 considered this to be LR:lc based on high levels of exploitation but also high regeneration capacity, however differences between countries - in Panama relatively abundant in areas that have some conservation, in El Salvador good regeneration, but trees are cut when very young and grazing is a problem. Working Group 3 considered this to be EN based on high levels of exploitation and regeneration problems due to a commonly occuring disease in apical buds of seedlings. On the basis of information from countries in significant part of range it would seem that this species does fall within the threatened categories - information from more countries will be sought.

Chlorocardium rodiei

Distribution: Brazil, Guyana, French Guiana, Surinam and Venezuela
Conservation status: VU (A1a,d). Evaluated by Working Group 3.

Dalbergia retusa

Distribution: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama
Conservation status: VU. Evaluated by Working Group 2. Criteria needed.

Guaiacum officinale

Distribution: Anguilla, Bahamas, Antigua & Barbuda, Barbados, British Virgin Is., Colombia, Cuba, Dominica, Dominican Republic, Haiti, Jamaica, Grenada, Guadeloupe, Martinique, Montserrat, Netherland Antilles, Puerto Rico, St. Martin & St Bartholomew, St. Vincent, Turks & Caicos Is., US Virgin Is. and Venezuela

Conservation status: EN (C2a). Evaluated by Working Group 2.

Guaiacum sanctum

Distribution: Aruba, Bahamas, Bonaire, Costa Rica, Cuba, Curacao, Florida, Guatemala, Hispaniola, Honduras, Mexico, Nicaragua and Puerto Rico

Conservation status: EN (C2a). Evaluated by Working Group 2.

Juglans neotropica

Distribution: Colombia, Ecuador, Peru and Venezuela

Conservation status: EN (A1a, 2a,c,d). Evaluated by Working Group 3.

Liquidambar styraciflua

Distribution: Belize, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and USA

Conservation status: LR:lc. Evaluated by Working Group 2.

Mezilaurus itauba

Distribution: Bolivia, Brazil, Ecuador, French Guiana, Peru and Surinam

Conservation status: VU (A1a,). Evaluated by Working Group 3.

Minquartia guianensis

Distribution: Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guyana, Panama, Peru, Surinam and Venezuela

Conservation status: Working Group 2 considered this to be LR:lc; Working Group 3 considered this to be VU based on observations in Brazil - where although relatively abundant it is intensely used by local people for construction. People are having to go further into forest to find. More information is needed on the situation in other countries.

Ocotea porosa

Distribution: Argentina?, Brazil and Paraguay?

Conservation status: CR (A1a,c,d). Evaluated by Working Group 3.

Oreomunnea pterocarpa

Distribution: Costa Rica, Mexico? and Panama?
Conservation status: EN (C2a). Evaluated by Working Group 2.

Pilgerodendron uviferum

Distribution: Argentina and Chile
Conservation status: CR. Evaluated by Working Group 3. Note - previously evaluated as VU by SSC Specialist Group - need to refer back for further consideration. Criteria needed.

Platymiscium pleiostachyum

Distribution: Costa Rica, El Salvador, Honduras and Nicaragua
Conservation status: EN (C1). Evaluated by Working Group 2.

Podocarpus parlatori

Distribution: Argentina, Bolivia and Peru
Conservation status: CR (A1). Evaluated by Working Group 3, noting the very restricted and scattered subpopulations.

Schinopsis balansae

Distribution: Argentina, Bolivia, Brazil and Paraguay
Conservation status: LR:lc. Evaluated by Working Group 3.

Swietenia mahagoni

Distribution: Anguilla, Antigua & Barbuda, Bahamas, Barbados, Cayman Is., Colombia, Cuba, Dominica, Dominican Republic, Florida Keys, Grenada, Haiti, Jamaica, Guadeloupe, Martinique, Montserrat, St.Kitts & Nevis, St.Martin & St.Barthelemy, St. Vincent, Peru, St.Lucia, Trinidad & Tobago, Turks & Caicos Is. and Venezuela
Conservation status: EN (C1). Evaluated by Working Group 2.

Virola surinamensis

Distribution: Brazil, Costa Rica, Ecuador, French Guiana, Guyana, Panama, Peru, Surinam and Venezuela
Conservation status: EN (A1d 2a,c,d). Evaluated by Working Groups 2 and 3 - widely used for plywood manufacture.

Conservation and Sustainable Management of Trees

Draft Species Summaries

uercus acerifolia

agaceae EN B1+2c, C2b

nited States (Arkansas)

ree localities of this species are known, occurring in open glades and rubland, including new localities which were reported in the past five ars. The range is not expanding but populations may be stable. Data cumulated by Stoynoff and Hess support the contention that the taxon is pecies and not a subspecies of Q.shumardii.

ercus albocinta

gaceae LR lc

xico (Chihuahua, Sinaloa, Sonora)

ercus arkansana

gaceae VU D2

ited States (Alabama, Arkansas, Florida, Georgia, Louisiana, ssissippi, Texas)

s than five localities of this woodland species are known to exist. pulations are thought to be declining because of habitat destruction sed by grazing and conversion to farmland.

ercus x basaseachicensis

gaceae EN D1

xico (Chihuahua, Durango)

ybrid of Q.rugosa and Q.depressipes known from 4 sites in Chihuahua 1 in Durango in submontane woodland or scrub. The populations are ated and none are believed to be large.

rcus benthamii

gaceae VU A1c

temala, Mexico (Chiapas, Oaxaca)

il the taxonomy of Central American specimens is confirmed the exact e of this species cannot be consolidated but could extend to southern s of Central America. The rate of destruction of the moist forest tat in the last few decades qualifies the species as threatened.

rcus boytonii

aceae DD

status of this species is not well consolidated. It appears to have me extinct in the areas from which it was known. There is, however, ssibility that it occurs in Mississippi and Lousiana.

rcus brandegeei

aceae EN B1+2c

ico (Baja California)

species occurs in low density in a xeric habitat in the foothills of the a Lazaro. The area is accessible and subject to grazing pressure. neration has not been observed in recent years.

cus brenesii

aceae DD

Rica

onomically doubtful species apparently endemic to the department of ela.

Quercus bumelioides

Fagaceae VU A1c

Costa Rica, Guatemala, Honduras, Nicaragua, Panama

The montane moist forest habitat of this species has suffered serious declines in past decades. The tree can grow to large proportions and has obvious value as a timber tree.

Quercus cedrosensis

Fagaceae VU D2

Mexico (Baja California)

A species restricted to a specialised sclerophyllous habitat at lowland to montane altitudes. Cedros Island suffers from overgrazing by goats. More information on the regeneration of this species may qualify it for a status of endangered.

Quercus coahuilensis

Fagaceae DD

Mexico (Coahuila)

It is suspected the species will prove to be threatened when the area of occupancy is calculated taking into account the altitudinal range of the species.

Quercus convallata

Fagaceae DD

Mexico (Jalisco, Nayarit)

The taxonomic status of this species is dubious.

Quercus conzattii

Fagaceae LR lc

Mexico (Durango, Jalisco, Oaxaca, Zacatecas)

Quercus costaricensis

Fagaceae VU B1+2e

Costa Rica

Occurring in the montane forest of Volcan Irazu and Cerro Chirripó, the species is restricted to an area of occupancy of less than 2000km². Although deforestation has been extensive in the past, these areas are now given some degree of protection.

Quercus deliquescens

Fagaceae VU D2

Mexico (Chihuahua)

A species of dry montane scrub, known only from one population system in the valley of Río Concho and north along Río Grande.

Quercus depressa

Fagaceae LR lc

Mexico (Hidalgo, Mexico Distrito Federal, Oaxaca, Puebla, Veracruz)

Quercus devia

Fagaceae VU D2

Mexico (Baja California)

Two or three populations occur in dry montane forest, where grazing

World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge CB3 ODL, U.K.
Tel: +44 (0) 1223 277314 Fax: +44 (0) 1223 277136 Email: info@wcmc.org.uk

pressure is high. The mainland Mexican species, Q.viminea, may be synonymous, in which case the species would qualify for a status of lower risk.

Quercus dumosa

Fagaceae EN A1c+2c

Mexico (Baja California), United States (California)
A number of populations (e.g. Santa Barbara, Hollywood and Griffith Park) have disappeared. The lowland scrub habitat of the remaining populations is under threat from pollution and expansion of urban and industrial areas.

Quercus engelmannii

Fagaceae VU A1c

Mexico (Baja California), United States (California)
Extensive declines of the sclerophyllous habitat of the species have been observed over the past 50 years. Regeneration of the species is poor and the remaining habitat is under threat from urban, agricultural and industrial developments.

Quercus excelsa

Fagaceae DD

Mexico (Jalisco, Veracruz)

Quercus flagellifera

Fagaceae VU A1c

Guatemala
Confined to the moist montane forests of east and central Guatemala, the species will have experienced declines in its habitat in the last 50 years. There are a number of estimated rates of deforestation, all exceed an annual rate of 1%.

Quercus fulva

Fagaceae LR lc

Mexico (Chihuahua, Durango, Sinaloa)

Quercus galeanensis

Fagaceae VU D2

Mexico (Nuevo Leon, Tamaulipas)
A scarce species, characterised by the leaves being vertically appressed to the twigs, occurring in submontane to montane chaparral. It is restricted to 2 populations occupying a narrow band (150km x 10-20km) from Galeana, Nuevo Leone to the Miquihrana region in Tamaulipas.

Quercus georgiana

Fagaceae EN B1+2ce

United States (Alabama, Georgia, South Carolina)
Small isolated populations are restricted to granite outcrops, occupying an area less than 500km². The impact of tourism is considerable on Stone Mt. Drought, poor regeneration, soil erosion and compaction are all weakening the status of the species.

Quercus germana

Fagaceae VU A1c

Mexico
A species of submontane seasonal dry forest, which has experienced dramatic declines over the last few decades. Forest has been converted fo agricultural use, especially coffee plantations. The trees are often decked with an array of densely packed epiphytes.

Quercus graciliformis

Fagaceae CR C2b

United States (Texas)
One small isolated population exists in riparian oak woodland in the Chisos Mts. The locality is threatened by the activities of tourists from a nearby camping ground and by occasional drought. Previous records fro Mexico are erroneous.

Quercus gravesii

Fagaceae LR lc

Mexico (Coahuila), United States (Texas)

Quercus gulielmi-treleasei

Fagaceae DD

Costa Rica, Panama
The taxonomic status of the species is uncertain. It is confined to Chiriq in Costa Rica and Cartago in Panama in wet montane forests.

Quercus hintonii

Fagaceae CR B1+2ac

Mexico (Mexico State)
A submontane to montane dry forest species which is confined to a sma area (less than 10 X 10km) along a road. Much of the area is in the process of conversion into avocado plantations and human settlements.

Quercus hypoxantha

Fagaceae DD

Mexico (Coahuila, Nuevo Leon)
It is suspected that this species will prove to be threatened when the are of occupancy is calculated taking into account the altitudinal range of t species.

Quercus invaginata

Fagaceae DD

Mexico (Coahuila)
It is suspected that the species will prove to be threatened when the area occupancy is calculated taking into account the altitudinal range of the species.

Quercus liebmannii

Fagaceae LR lc

Mexico (Oaxaca)

uercus x macdonaldii

agaceae VU D2

nited States (California)

ie species is restricted to a few scrubby localities in Santa Rosa, Santa atalina and Santa Cruz Islands. Control of grazing and the removal of eep has helped oak regeneration on Santa Cruz Island.

ercus macdougallii

agaceae VU D2

exico (Oaxaca)

distinctive species known only from the type locality in the dry montane ests of Oaxaca. It has not been recently collected and it is biologically orly known.

ercus martinezii

gaceae LR lc

xico (Jalisco, Michoacan)

ercus miquihuanensis

gaceae EN B1+2e

xico (Nuevo Leon, Tamaulipas)

endemic of Peña Nevada and Miquihuana, locally common in montane e-Oak forest and also chaparral, covering an area less than 500km². gging activities and overgrazing threaten the habitat.

ercus oglethorpensis

gaceae EN B1+2ce

ted States (Georgia, Mississippi, South Carolina)

s species is known from two isolated populations, consisting, in total, pproximately 1000 individuals, with an extent of occurrence of 0km² or less than 150km² area of occupancy. Habitat loss, poor seed ility and chestnut blight are contributing to the species decline.

rcus parvula var. parvula

aceae EN B1+2ce

ed States (California)

small populations on Santa Cruz Island and 5-6 populations in Santa ara County are known. Occurring in maritime chaparral and pine ts, no population extends more than 10km². Habitat degradation and ing are threats on Santa Cruz Island.

rcus peninsularis

aceae DD

ico (Baja California)

ntane species. The number of localities and population status are own.

cus perpallida

aceae DD

co (Baja California Sur, Chihuahua, Sinaloa, Sonora)

Quercus planipocula

Fagaceae LR lc

Mexico (Guerrero, Michoacan, Nayarit, Sinaloa)

Quercus praeco

Fagaceae LR lc

Mexico (Jalisco, Nayarit)

Quercus praineana

Fagaceae DD

Mexico (Jalisco, Sinaloa)

Quercus purulhana

Fagaceae VU A1c

Belize, Guatemala, Honduras, Nicaragua

A moist montane forest species, abundant in areas, but which has been subject to the general declines in forest habitats in Central America.

Quercus rapurahuensis

Fagaceae VU A1c

Costa Rica, Panama

A moist forest species which has been subject to the general forest declines in this area. Further investigation may show that the species is more seriously threatened.

Quercus rysophylla

Fagaceae DD

Mexico (Nuevo Leon, San Luis Potosi, Tamaulipas)

The known populations are small but their extent is not known.

Quercus skinneri

Fagaceae VU A1c

El Salvador, Guatemala, Honduras, Mexico (Chiapas)

The species is widespread and often occurs in abundance in moist montane forests. It is also frequently planted. General rates of deforestation in the past decades qualifies the species as vulnerable.

Quercus skutchii

Fagaceae DD

Guatemala, Mexico (Chiapas)

Quercus subspathulata

Fagaceae VU A1c

Mexico (Durango, Jalisco, Nayarit, Sinaloa)

A forest species which has suffered extensive destruction of its habitat.

Quercus x tardifolia

Fagaceae CR D1

United States (Texas)

A maximum of 5 trees are thought to occur in dry montane woodlands in Chisos Mts. The hybrid is a product of Q.hypoxantha and Q.gravesii. One of the parents no longer occurs in the area.

World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge CB3 ODL, U.K.
Tel: +44 (0) 1223 277314 Fax: +44 (0) 1223 277136 Email: info@wcmc.org.uk

Quercus tomentella

Fagaceae — VU B1+2ce

Mexico (Guadalupe I), United States (California)

The regeneration of the species is hampered because of overgrazing in the dry forest areas to which it is restricted on the channel islands of California and Guadelupe Island of Mexico.

Quercus tonduzii

Fagaceae — DD

Costa Rica

A species of uncertain taxonomic status, found in the mountains of central Costa Rica in Alajuela. One collection from 1896 is cited from Volcan Poas.

Quercus toumeyi

Fagaceae — LR lc

Mexico (Chihuahua, Sonora), United States (Arizona, New Mexico)

A species scarcely distributed in shrub-thornland and limestone hillsides between 1300 and 1600m altitude.

Quercus undata

Fagaceae — DD

Mexico (Durango)

Quercus uxoris

Fagaceae — VU A1c

Mexico (Colima, Guerrero, Jalisco)

The extent of population declines is not documented but the species occurrence, in an area which has experienced dramatic forest destruction, qualifies it as, at least, vulnerable.

Quercus vicentensis

Fagaceae — VU A1c

El Salvador, Guatemala, Mexico

Declines in population numbers have not been recorded but the species occurrence in an area of extensive forest destruction qualifies it as vulnerable.

WORLD CONSERVATION
MONITORING CENTRE

World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge CB3 0DL
United Kingdom

Telephone: +44 1223 277314
Fax: +44 1223 277136
e-mail: info@wcmc.org.uk

IUCN The World Conservation Union

UNEP

WWF

The World Conservation Monitoring Centre is a joint-venture between the three partners who developed the *World Conservation Strategy* and its successor *Caring for the Earth:* IUCN-The World Conservation Union, UNEP-United Nations Environment Programme, and WWF-World Wide Fund for Nature.