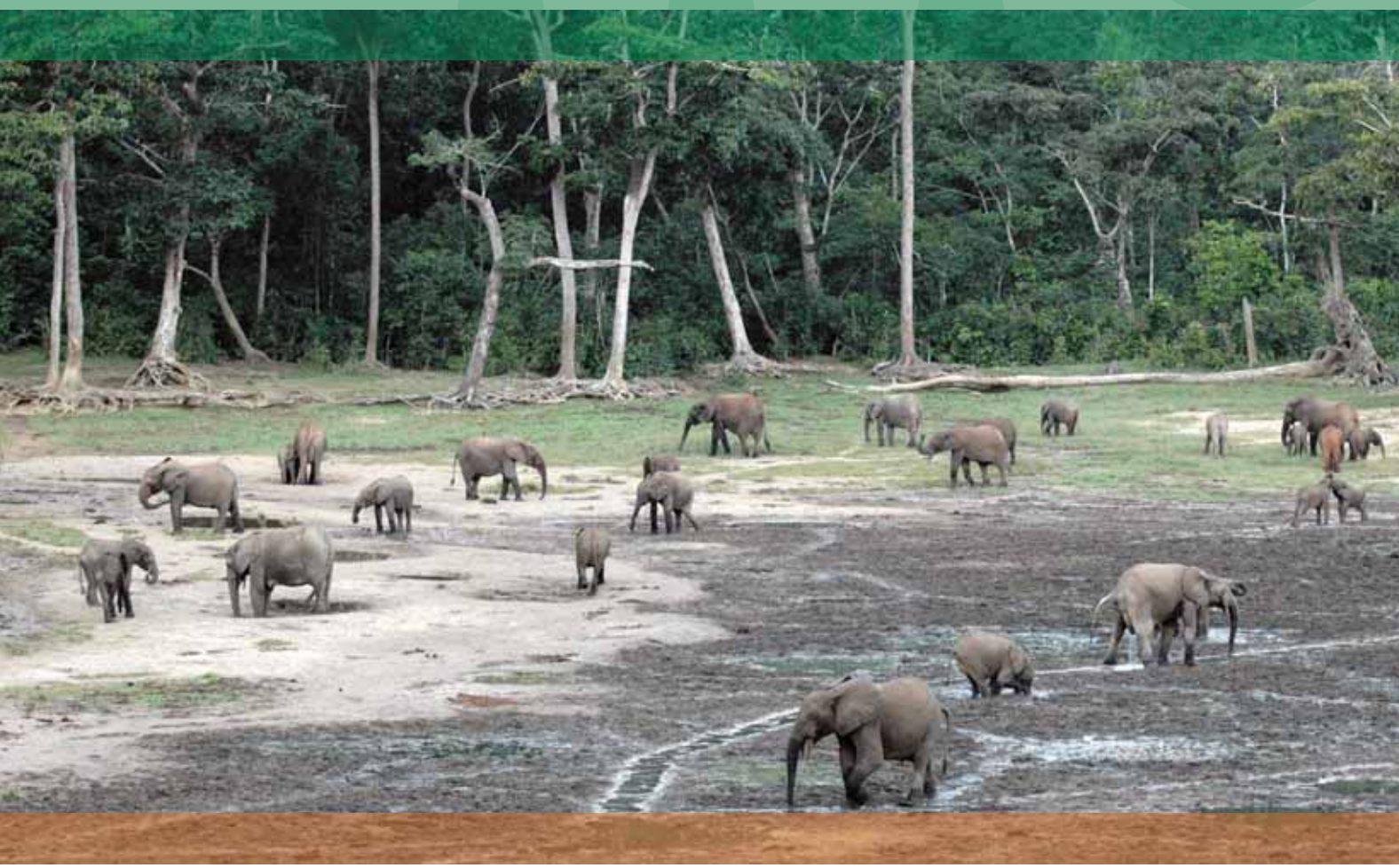
POLICY DEVELOPMENT

17

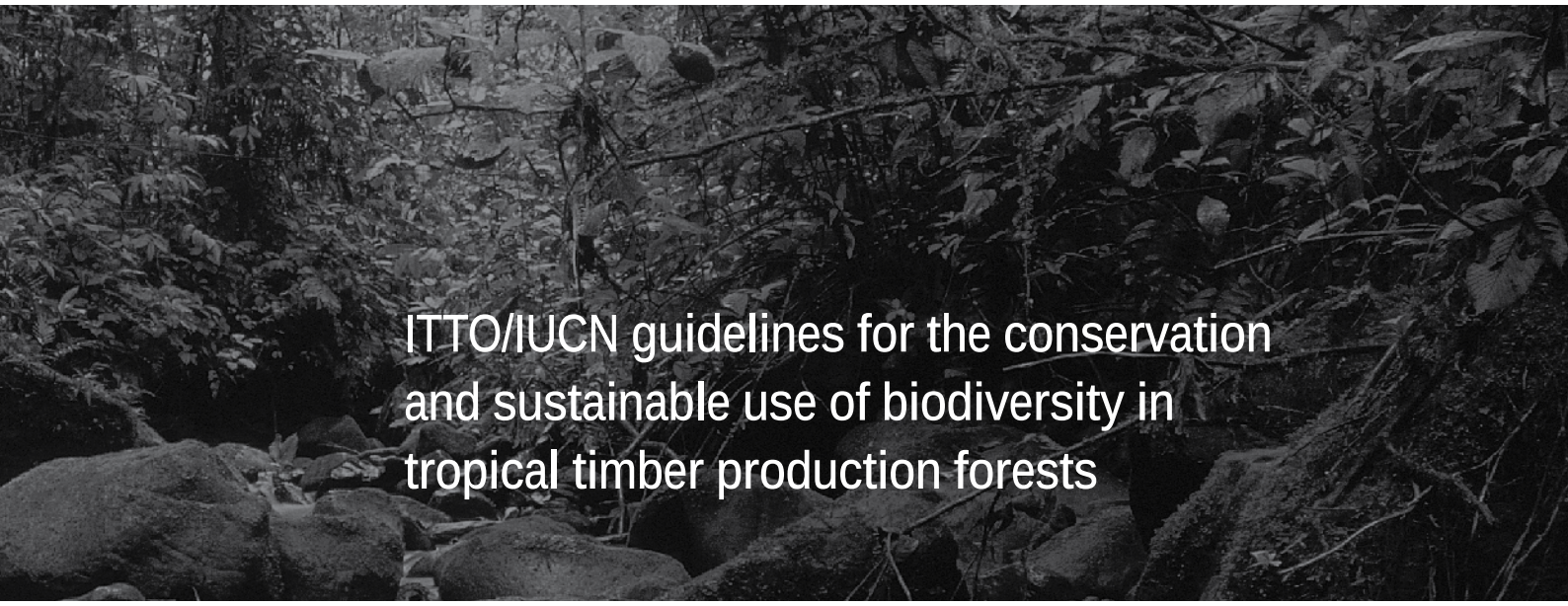
ITTO/IUCN Guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests



A joint publication of the International Tropical Timber Organization and the International Union for the Conservation of Nature

ITTO Policy Development Series No 17

ITTO



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The International Tropical Timber Organization (ITTO) is an intergovernmental organization promoting the conservation and sustainable management, use and trade of tropical forest resources. Its 60 members represent about 80% of the world's tropical forests and 90% of the global tropical timber trade. ITTO develops internationally agreed policy documents to promote sustainable forest management and forest conservation and assists tropical member countries to adapt such policies to local circumstances and to implement them in the field through projects. In addition, ITTO collects, analyses and disseminates data on the production and trade of tropical timber and funds projects and other actions aimed at developing industries at both community and industrial scales. All projects are funded by voluntary contributions, mostly from consumer member countries. Since it became operational in 1987, ITTO has funded more than 750 projects, pre-projects and activities valued at more than US$300 million. The major donors are the governments of Japan, Switzerland and the United States.

The International Union for the Conservation of Nature (IUCN) helps the world find pragmatic solutions to its most pressing environment and development challenges. IUCN supports scientific research, manages field projects all over the world, and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. IUCN is the world's oldest and largest global conservation network. It is a democratic membership union with more than 1,000 government and NGO member organizations and some 10,000 volunteer scientists in more than 160 countries. IUCN's work is supported by 1,100 professional staff in 62 offices and hundreds of partners in public, NGO and private sectors around the world.

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Foreword

Some scientists estimate that 80% or more of the world's terrestrial species are inhabitants of natural tropical forests. Whatever the exact figure, these forests are enormously important for the conservation of biodiversity. Many species will be maintained in effectively managed protected areas, but these cover less than 10% of the global tropical forest estate and, alone, are inadequate for meeting the challenge of conserving the full range of forest species.

What will happen to the remaining 90% of tropical forests? Much of it is likely to be lost as the agricultural frontier advances, but a significant proportion will be used for the cyclical extraction of timber and other products. Logging in tropical forests is often cited as a major threat to biodiversity, but there is plenty of evidence to suggest that, well managed, forests used for timber production can constitute a major resource for biodiversity conservation. Indeed, it is crucial that they do.

The International Tropical Timber Council first adopted *Guidelines on the Conservation of Biological Diversity in Tropical Production Forests* in 1993, at a time of intense international debate on tropical forest conservation and use. Much has happened since – in international policy and dialogue, in public awareness, and in the forest. In 2005 the Council decided that the guidelines needed updating to take into account new developments in conservation and sustainable forest management. This publication, which has been produced jointly by ITTO and IUCN, replaces those 1993 guidelines.

The body of knowledge about biodiversity is always growing. Similarly, society's expectations of both forest management and biodiversity conservation are evolving, often with extraordinary speed. Nor does the physical environment stay the same: climate change, for example, is likely to have enormous impacts on tropical forests and their biodiversity. In the future, forest management will need to be highly adaptive, which will require good information about what is happening in the forest. One of the most important messages in these guidelines is that forest managers must be capable of monitoring changes in both biodiversity and society's requirements for biodiversity and of adapting their management accordingly.

We thank the many people involved in the production of these guidelines for their dedication and hard work. A strong spirit of cooperation among the many stakeholders with interests in tropical forests is essential for good biodiversity conservation; the consultative process by which these guidelines were produced shows the way. We are especially pleased with the strong partnership between ITTO and the IUCN Forest Conservation Programme, which for some years now has been playing an important role in assisting countries, timber companies and local communities to better manage their forests.

This publication sets out the specific actions that policymakers, forest managers and other stakeholders should take to improve biodiversity conservation in tropical production forests. In this way, it aims to help in the conservation of arguably the planet's most valuable resource – its diversity of life.

Emmanuel Ze Meka
Executive Director
ITTO

Julia Marton-Lefèvre
Director General
IUCN

Preface

Much has changed since ITTO published its original guidelines for the conservation of biodiversity in tropical production forests in 1993. The science of conservation biology has matured and become influential; it tells us much about the responses of natural systems to various forms of disturbance. Large-scale, landscape approaches to conservation have become common. The greater availability of remote sensing technologies and geographic information systems has greatly improved our knowledge of change in forest systems and far more information is now available on species distribution and ecology.

There have also been significant developments in international policies related to biodiversity conservation. The most important of these is the adoption, also in 1993, of the Convention for the Conservation of Biological Diversity (CBD), which has devoted considerable effort to questions related to forest biodiversity. The parties to the Convention are now committed to an Expanded Programme of Work on Forest Biological Diversity, which sets goals and objectives for conservation and includes a number of measures particularly addressed at forests subject to logging. In 2000 the CBD also adopted twelve principles of an ecosystem approach, which set biodiversity conservation in the context of local developmental needs and stress the importance of maintaining ecosystem functions, achieving sustainable economic benefits, making use of local and traditional knowledge, and looking at landscape-scale issues in managing natural systems. Most recently, the CBD adopted the Addis Ababa Principles and *Guidelines for the Sustainable Use of Biodiversity*, which address a number of issues relating to biodiversity in managed systems. These principles and guidelines are consistent with all of the above and especially with the principles of sustainable forest management as defined by the United Nations Forum on Forests, ITTO and the various regional and global sets of criteria and indicators for sustainable forest management. In preparing these guidelines we have tried to reflect the spirit of the CBD's work on forest biodiversity; the application of these guidelines would be an important step for countries in implementing their obligations under the CBD.

Members of the biodiversity guidelines team evaluate the draft guidelines in the field in a Cameroon logging concession.

Since 1991 ITTO has adopted several set of guidelines for forest managers and policymakers, including on natural production forests, planted forests, the restoration, management and rehabilitation of degraded and secondary tropical forests, and fire management. All contain provisions for the maintenance of biodiversity and all have helped reinforce the importance of biodiversity conservation in tropical production forests.

The emergence and ongoing debate on forest certification has also become a significant force for biodiversity conservation in production forests. Several global, regional and national certification initiatives now exist, including the Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification, the Indonesian Ecolabelling Institute, the Malaysian Timber Certification Council, and Programa Brasileiro de Certificação Florestal; the standards of all these give attention to the need to conserve biodiversity. Principle 6, Criterion 2 of the FSC, for example, states that:

> Safeguards shall exist which protect rare, threatened and endangered species and their habitats (eg nesting and feeding areas). Conservation zones and protection areas shall be established appropriate to the scale and intensity of forest management and the uniqueness of the affected resources. Inappropriate hunting, trapping and collecting shall be controlled.[1]

A number of other forest-related initiatives have addressed biodiversity issues. Notable among these are the Food and Agriculture Organization of the United Nations (FAO)'s *Code of Practice for Forest Management*, published in 1993, and *Guidelines for Reduced Impact Logging*, which were published jointly by FAO and the Center for International Forestry Research. The listing of a number of timber trees in the appendices of the Convention on International Trade in Endangered Species (CITES) also provided impetus to reduce the impacts of production forestry on biodiversity. FAO's forest resource assessments now report on forest biodiversity, and ITTO's *Revised Criteria and Indicators on the Sustainable Management of Tropical Forests*, published in 2005, include a criterion on biodiversity and procedures for the conservation of biodiversity in tropical timber production forests.

Other changes since 1993 have had an impact on biodiversity in tropical production forests. Tropical forests continued to be cleared, mainly for agriculture. Fires have destroyed or degraded large areas of tropical forests. Infrastructure development has intensified throughout the tropics; many areas that, in the early 1990s, were remote and inaccessible are now penetrated by roads and railways. In some countries, forest management has been decentralized to local communities, with both negative and positive impacts on biodiversity.

The right of local populations to benefit from the biodiversity on their traditional lands has been the subject of international debate in the CBD and other international forums. Local rights have also been the focus of programs to exploit the economic value of wild species. The idea of paying local communities and individuals for the ecosystem services – including biodiversity conservation – provided by forests has been widely canvassed (but, to date, little practised). There have been moves to recognize the intellectual property associated with local and Indigenous knowledge about biodiversity, although mechanisms to formalize such recognition have proved elusive.

Many countries have revised their forestry laws in the past decade; in most cases, the new laws give greater attention to biodiversity conservation. In many countries, forest management plans now routinely address biodiversity conservation, an indication that the policy work of ITTO and other organizations and the pressure exerted by civil-society organizations and certification are having an effect.

Various other forms of global change are affecting forest biodiversity. Economic integration and the reduction of trade barriers are driving processes of increased economic efficiency; as a result, a far higher proportion of the world's timber now originates from planted forests. Planted forests might help

[1] FSC (1996).

reduce logging pressure in natural forests but can also do a great deal of damage if they replace natural forests. Some people are concerned that the commercial use of genetically modified organisms will lead to unanticipated environmental hazards – such as the aggressive invasion of natural systems by such organisms, or the contamination of natural gene pools.

Climate change could have major impacts on the distribution and abundance of forest-dwelling species, the nature of pests and diseases, the frequency of storms and other extreme climatic events, and the risks posed by invasive species and fire. The uncertainty associated with climate change underlines the need to conserve biodiversity in order to maintain resilience and to give forest systems the best possible chance of adapting to changing conditions.

All these developments increase, rather than decrease, the importance of clear, up-to-date advice on how to best conserve biodiversity in tropical production forests. Recognizing this, in 2003 the International Tropical Timber Council decided that ITTO's guidelines on biodiversity conservation in tropical production forests should be revised. An initial meeting of a small group of stakeholders assisted the redrafting of the guidelines by a core team of biodiversity specialists in 2004. The redraft was then evaluated in the field among timber companies, forest agencies and local communities in four producer countries. An expert panel met in 2007 to further revise the guidelines in light of the field evaluation.

This long and exhaustive process has, we believed, greatly improved the value of the guidelines. We hope and expect them to provide forest policymakers, owners and managers with excellent guidance on how to best conserve biodiversity in tropical timber production forests.

Musa Abu-Juam, Claudia Azevedo Ramos, Petrus Gunarso, William Hawthorne, Stewart Maginnis, Jeff Sayer, Sandeep Sengupta and Emmanuel Ze Meka

Core drafting team

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Acronyms

CBD	United Nations Convention on Biological Diversity
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GEF	Global Environmental Facility
ITTO	International Tropical Timber Organization
IUCN	International Union for the Conservation of Nature
NGO	Non-governmental organization
NTFP	Non-timber forest product
SFM	Sustainable forest management
WWF	Worldwide Fund for Nature

Acknowledgements

The core team guiding the revision and testing of the guidelines consisted of Claudia Azevedo Ramos (Brazil), Musa Abu-Juam (Ghana), Petrus Gunarso (Indonesia), Emmanuel Ze Meka (ITTO), Jeff Sayer, Sandeep Sengupta and Stewart Maginnis (IUCN), and William Hawthorne (United Kingdom). The following people joined members of the core team in the first meeting held to develop the guidelines: Bernie Agaloos (Philippines), Peter Arcese (Canada), Miguel Clusener-Godt (United Nations Environmental, Scientific and Cultural Organization), Parfait Mimbimi Esono (Cameroon), Ana Euler (Brazil), Jorge Malleux (Peru), N. Manokaran (Malaysia), Schadrack Ondoua Ekotto (Cameroon), Pierre Sigaud (FAO), Robert Stuebing (Malaysia), Suparna Taslim (Indonesia), Gijs van Tol (Netherlands) and Johan Zweede (Brazil). Robert Nasi and Douglas Sheil (Center for International Forestry Research – CIFOR) made major contributions at different stages of the process to develop the guidelines, and research by CIFOR provided valuable information.

The following people commented on various versions of the draft or contributed in other ways to the process: Alicia Grimes and Patrick Smith (both with the United States Agency for International Development), Dennis Dykstra (US Forest Service), Mike Fullerton and Sylvie Gauthier (Canadian Forest Service), Kathy MacKinnon (World Bank), Charlotte Cudby (Ministry of Agriculture and Forestry, New Zealand), Richard Malonga (Wildlife Conservation Society, Congo), Gustavo Campos Pinho (Brazil) and Manuel Guariguata (CBD). John Parrotta (US Forest Service), Jeff Sayer, Hideaki Takai (Forestry Agency of Japan) and Eduardo Mansur (ITTO) took a lead role in the final drafting of the principles, guidelines and actions. Alastair Sarre (ITTO) edited the document and Intu Boedhihartono (IUCN), Steve Johnson and Ken Sato (both with ITTO) helped prepare it for publication.

National studies on the practical application of the guidelines were led by Claudia Azevedo Ramos, Ana Euler and Marcelo Arquelles in Brazil, David Singh and his colleagues from the Iwokrama International Centre for Rainforest Conservation and Development in Guyana, Zacharie N'Zooh and Parfait Mimbimi in Cameroon, and Petrus Gunarso and Chairul Saleh in Indonesia. Romain Pirard conducted a cross-cutting study on economic issues.

An expert panel that met in Bangkok in September 2007 provided in-depth comments and contributed to the final revision of these guidelines. The panel comprised several members of the original technical panel together with: Aulia Aruan (Indonesia), Yati Bun (Papua New Guinea), Jaime Cavelier (Global Environment Facility Secretariat), Efransjah (Indonesia), Kimiko Okabe (Japan), Siti Syaliza Mustapha (Malaysia), John Parrotta, James Singh (Guyana), Oudara Souvannavong (FAO) and Raphael Yeboah (Ghana).

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Many other people took part in national meetings held during the preparation of the guidelines, commented on drafts, and took part in field evaluation. Space does not allow that they are all named here, but their contributions are hereby acknowledged and greatly appreciated.

Local transport on the Dzangha River, Republic of the Congo.

Part I Tropical production forests and the conservation and sustainable use of biodiversity

Natural tropical forests are enormously important for the conservation of the world's biological diversity. They contain, for example, a very large proportion of the world's species of mammal, birds and amphibians (Figure 1 and Figure 2), and are equally – if not more – important for plants and invertebrates. Some of this diversity will be maintained in effectively managed protected areas, but these cover less than 10% of the global tropical forest estate.

What will happen to the remaining 90%? Much of it is likely to be lost as the agricultural frontier advances. A significant proportion, however, will stay as forest that will be harvested for timber and other forest products. Timber extraction in tropical forests is often cited as a major threat to biodiversity.[2] Under good management, however, tropical timber production forests (referred to hereinafter as tropical production forests) can be a major resource for biodiversity conservation.[3] They can complement national parks and other reserves and greatly extend the area of near-natural habitats in the tropics.

These guidelines are designed to assist policymakers and forest managers by bringing together in one place the specific actions that are needed to improve biodiversity conservation in tropical production forests. In this way they aim to help in the conservation of arguably the planet's most valuable resource – its diversity of life.

Tropical forests contain a huge variety of invertebrates, such as this cicada in Kalimantan, Indonesia.

[2] e.g. Baillie et al. (2004).
[3] See, for example, Meijaard et al. (2005).

1 What is biological diversity, and why conserve it?

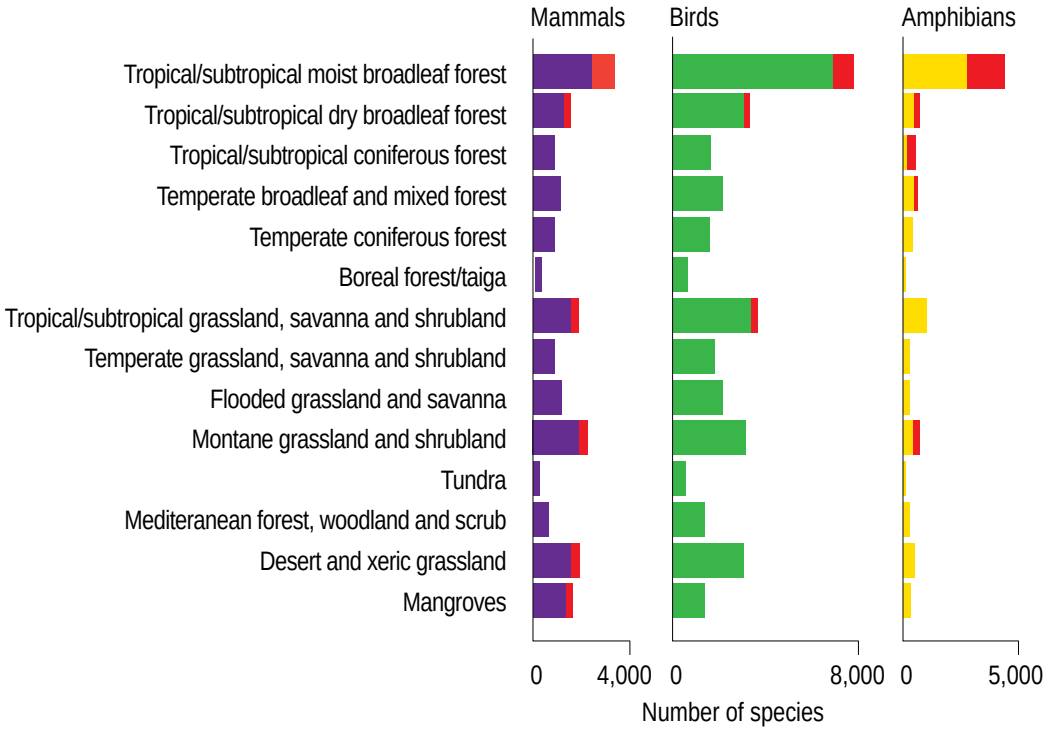
Biological diversity, or biodiversity, is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems.

Some species, like gorillas, have won our hearts and minds simply for their grace and beauty. Countless less-charismatic species – many too tiny to see – provide services we need for our well-being. Collectively, biodiversity stabilizes our atmosphere and climate, protects water catchments, and renews the soil. It also helps keep ecosystems adaptable, should environmental conditions change abruptly.

The diversity of nature is the foundation of the world's material wealth. From biodiversity we develop food crops and derive the raw inputs and genetic materials for industry, agriculture and medicine. These benefits are worth many billions of dollars each year, and people spend further billions to appreciate nature and its diversity through tourism and recreation.

Despite their importance, little is known about many species, particularly invertebrates, their roles in ecology, and the impacts of human activities on them. Learning, experimentation, the dissemination of information and the transfer of appropriate technology are, therefore, all critically important for the conservation and sustainable use of biodiversity in tropical production forests.

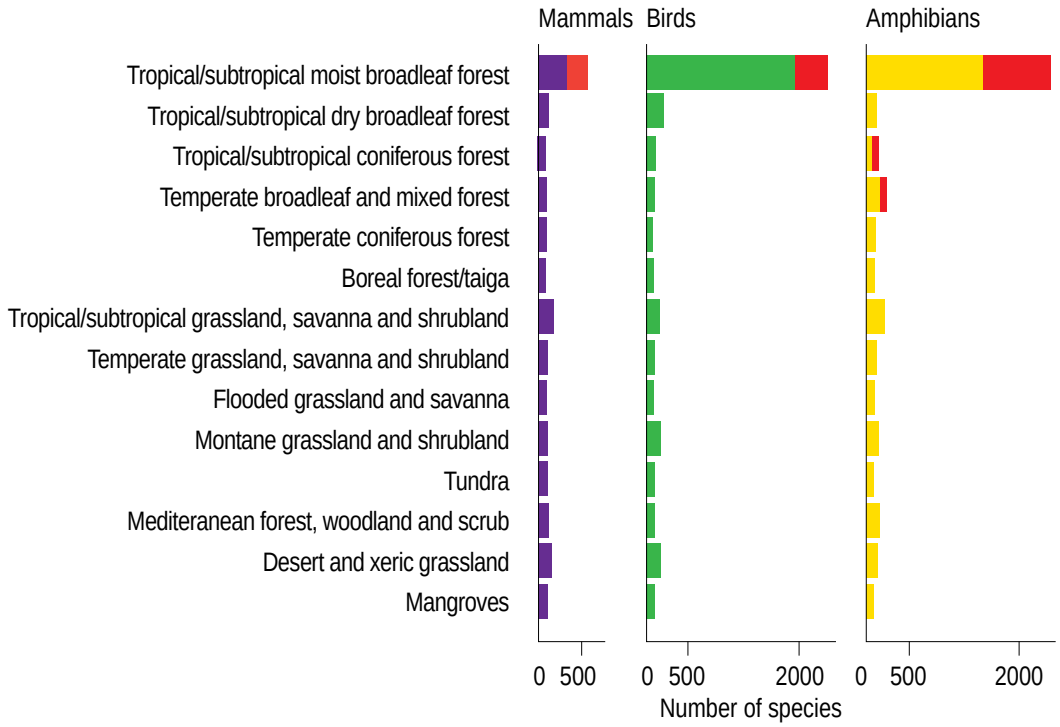
Figure 1. Numbers of mammals, birds and amphibians occurring in each biome



Note: The proportion of threatened species is indicated in red.

Source: Baillie et al. (2004).

Figure 2. Numbers of mammals, birds and amphibians endemic to each biome



Note: The proportion of threatened species is indicated in red.

Source: Baillie et al. (2004).

Scope

This publication updates and replaces the original version of the *ITTO Guidelines for the Conservation of Biological Diversity in Tropical Production Forests*, which were published in 1993, and complements other ITTO-published guidelines covering various aspects of tropical forest management (Box 2). The full series of ITTO guidelines contains much that is favourable for biodiversity. Indeed, it has often been noted that what is good for forest management and sustainability tends to be good for biodiversity. This publication, however, contains additional measures to favour biodiversity that are generally not covered in other publications in the series, or are dispersed within it.

2 ITTO policy documents with implications for biodiversity conservation and sustainable use

ITTO (1992). *ITTO Guidelines for the Sustainable Management of Natural Tropical Forests.* ITTO Policy Series No 1, Yokohama, Japan.

ITTO (1993). *ITTO Guidelines for the Establishment and Sustainable Management of Planted Tropical Forests.* ITTO Policy Development series No 4. Yokohama, Japan.

ITTO (1993). *ITTO Guidelines for the Conservation of Biological Diversity in Tropical Production Forests.* ITTO Policy Development Series No 5. Yokohama, Japan.

ITTO (1997). *ITTO Guidelines for Fire Management in Tropical Forests*. ITTO Policy Development Series No 6. Yokohama, Japan.

ITTO (1998). *Criteria and Indicators for Sustainable Management of Natural Tropical Forests.* ITTO Technical Series No 7, Yokohama, Japan.

ITTO (1999). *Manual for the Application of Criteria and Indicators for Sustainable Management of Natural Tropical Forests.* ITTO Policy Development Series No 9. Yokohama, Japan.

ITTO (2002). *ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests*. ITTO Policy Development Series No 13. Yokohama, Japan.

African Timber Organization/ITTO (2003). *ATO/ITTO Principles, Criteria and Indicators for the Sustainable Management of African Natural Tropical Forests.* ITTO Policy Development Series 14. Yokohama, Japan.

ITTO (2005). *Revised ITTO Criteria and Indicators for the Sustainable Management of Tropical Forests including Reporting Format.* ITTO Policy Development Series No 15. Yokohama, Japan.

When the preparatory work for the original ITTO biodiversity guidelines was under way in 1990–1992, the international policy environment was quite different from today. There was no Convention on Biological Diversity (CBD), no Global Environment Facility (GEF), and no forest certification. Many conservationists, too, still believed that logging in tropical forests was the main threat to tropical biodiversity.

In the intervening years, much has been learnt about the role, and potential role, of tropical production forests in biodiversity conservation. Many studies have been conducted, published in the scientific literature and summarized in reviews (Box 3), and attempts have been made to change forest management in ways that promote biodiversity conservation. Much of this new work was influenced by the original ITTO guidelines and the debates that surrounded their publication. This new publication captures this new scientific knowledge and practical experience.

3 Major sources of information on biodiversity in tropical production forests published since 1992

Blockhus, J., Dillenbeck, M., Sayer, J. and Wegge, P. (1992). *Conserving Biodiversity in Managed Tropical Forests*. IUCN, Gland, Switzerland. This publication reviews the measures that were being taken up until 1992 in ITTO producer member countries and presents the background to the 1993 ITTO guidelines. Its introductory chapter includes a draft set of technical guidelines that were prepared for the consideration of ITTO in 1991. This draft was considered too prescriptive and detailed when it was examined by the ITTO expert panel and was simplified before being published in 1993. The national case studies show that, in general, there were few targeted measures addressing the needs of biodiversity conservation in tropical production forests at that time, although many of the measures to support SFM provided biodiversity benefits.

Johns, A. (1997). *Timber Production and Biodiversity Conservation in Tropical Rainforests*. Cambridge University Press, Cambridge, United Kingdom. This is a comprehensive review of the literature and also draws heavily on the author's own field work. Among other things it shows that, in many situations, the impact of logging on biodiversity has been less severe than was widely believed at that time. It also highlights the special threats that logging poses for certain categories of biodiversity.

Fimbel, R., Grajal, A. and Robinson, J. (2001). *The Cutting Edge: Conserving Wildlife in Logged Tropical Forest*. Colombia University Press, New York, United States. This multi-authored edited volume includes many papers on the impact of logging on tropical wildlife. It is a rich source of information on both negative and positive outcomes of logging. It covers all three tropical regions.

Erik Meijaard, E., Sheil, D., Nasi, R., Augeri, D., Rosenbaum, B., Iskandar, D., Setyawati, T., Lammertink, M., Rachmatika, I., Wong, A., Soehartono, T., Stanley, S. and O'Brien. T. (2005). *Life after Logging: Reconciling Wildlife Conservation and Production Forestry in Indonesian Borneo*. CIFOR, Bogor, Indonesia. Although this book focuses on a single region – Borneo – it includes a comprehensive review of the literature for the entire humid tropics. It is also based upon the in-depth work that CIFOR scientists have carried out in this important area over the past decade. It is a valuable source of information on the state of the science underlying these guidelines.

Since 1993 it has become more widely accepted that there is no single best way to manage forests and that management should be adapted to suit local conditions. Principle 1 of Principles of the Ecosystem Approach, one of twelve such principles adopted by the CBD in 2000, states that the objectives of management of land, water and living resources are a matter of societal choice; Principle 2 declares that management should be decentralized to the lowest appropriate level, and Principle 11 states that all forms of relevant information, including scientific and Indigenous and local knowledge, innovations and practices, should be considered.

These guidelines, therefore, distinguish two levels of intervention. At one level, they set out those general approaches to forest management that will have wide application in ensuring that biodiversity values are maintained and should be adopted universally. At the other level, they review practical experience and provide advice that managers and decision-makers might draw on in designing locally applicable guidelines, codes of practice, regulations and silvicultural practices.

Objectives

These guidelines aim to promote the conservation and sustainable use of native animal and plant species in tropical production forests. Specifically, they aim to promote:

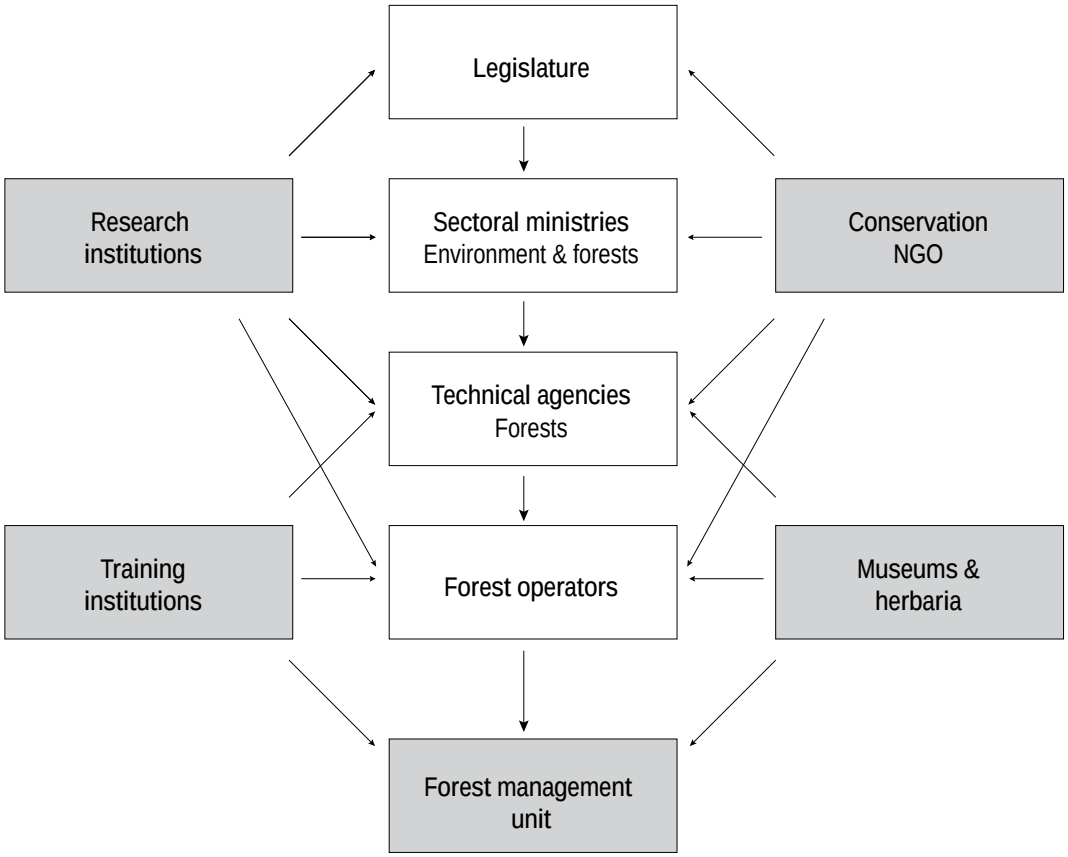
- an enhanced role for tropical production forests as components of landscapes that contribute to biodiversity conservation at different spatial scales;
- the equitable sharing of the costs and benefits of biodiversity conservation and sustainable use in tropical production forests;
- an improved understanding of the impacts of forest management on biodiversity;
- the adaptation of forest management practices at all spatial scales to favour the conservation and sustainable use of biodiversity;
- improved ecological processes in tropical production forests provided by the presence of locally adapted biodiversity; and
- improved practical forest management at all spatial scales aimed at conserving and sustainably using biodiversity.

Who should use these guidelines

The conservation and sustainable use of biodiversity in tropical production forests is not just a technical task for forest managers. It requires that biodiversity concerns be addressed in national-level planning and policymaking, at the stage of allocating forests to conservation, production and conversion, and during management planning and field implementation.

These guidelines are designed to provide information and guidance to stakeholders at all these levels, including national, provincial and local policymakers, company and community decision-makers, and those people managing forests at the local level. The successful conservation and sustainable use of biodiversity in tropical production forests requires the coordinated actions of many different stakeholders, who, ideally, work together towards mutually agreed biodiversity conservation goals. Figure 3 illustrates the linkages between interest groups whose actions might impact on biodiversity in tropical production forests. These guidelines refer to stakeholders in a number of generic groups, including: governments, relevant government agencies, forest agencies, timber companies, civil society, forest managers, other relevant stakeholders, and ITTO members. Given the huge diversity of situations throughout the world's tropical forests, identifying stakeholders to a greater level of specificity would be counterproductive; the groupings given here are provided for guidance only. In most cases the designations should be self-explanatory, but some groups are also defined in the glossary.

Figure 3. Responsibilities for biodiversity conservation and sustainable use in tropical production forests



Forest in southeastern Cameroon.

How to use these guidelines

This publication comprises three parts. Part I introduces the guidelines and provides background information on important biodiversity-related concepts such as sustainable forest management (SFM), landscape management, adaptive management, and monitoring. Part II comprises the set of eleven principles, 46 guidelines and numerous priority actions that, together, constitute the main advice of this publication on how to maximize the conservation of biodiversity in tropical production forests. Principles 1–8 deal with issues that, in many cases, must be addressed by national and sub-national policymakers, decision-makers and land-use planners. Principle 9 contains specific advice for forest managers at the forest management unit level. Principle 10 contains both general and specific information on the conservation of biodiversity in planted forests, and Principle 11 addresses the role that biodiversity plays in maintaining forest functions.

Part III of the guidelines describes the lessons learned during the field evaluation of the guidelines and outlines some of the key enabling conditions that will help their implementation. Annex I is adapted from recently published IUCN guidelines for reducing the impact of commercial harvesting on great apes in western equatorial Africa. Annexes II–VIII contain positive examples from across the tropics of efforts to conserve biodiversity in production forests and demonstrate the power of well-considered management interventions. Annex IX contains the IUCN categories for rare and endangered species. Annex X is a summary table showing the principles, guidelines and actions by relevant stakeholder group(s).

These guidelines are designed to assist forest stakeholders in reducing their impacts on biodiversity in tropical production forests. They are not obligatory; rather, they provide guidance on developing an approach to biodiversity conservation and sustainable use and signal the key issues of which all stakeholders should be aware.

Background

How much, and what, biodiversity to conserve?

Most tropical forests contain so much biodiversity that it is impossible to explicitly monitor and manage it all; choices are necessary. Some people believe that all biodiversity should be maintained, others that some loss is tolerable as long as forests continue to provide the required goods and services. ITTO's definition of SFM, for example, involves avoiding an 'undue reduction' in the inherent values of a forest:

> [SFM is] the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment.

Global conservation interests emphasize threatened species, charismatic species and that component of the biodiversity with actual or potential value to humans (such as wild crop relatives). Many local people, particularly the poor, depend on forests for a significant proportion of their needs; for them, biodiversity is about eating, staying healthy and finding shelter. Depleting or making inaccessible the resources on which they depend can add to their hardship. Priority-setting must recognize and engage with the views and needs of all these people but particularly of the marginalized poor and vulnerable.

Ultimately, the question of what to conserve, at what cost, is a decision for societies. Different societies with differing cultural values and at differing stages of economic and social development will inevitably make different choices on their biodiversity conservation and sustainable use strategies and priorities.

Timber harvesting – logging – inevitably leads to changes in biodiversity; ideally these changes will be recognized and accepted before harvesting commences. Tradeoffs between economic costs and benefits on the one hand and biodiversity gains and losses on the other should be acknowledged explicitly and the selection of alternative strategies and scenarios negotiated between stakeholders. Planning and negotiation should seek achievable conservation outcomes with acceptable costs.

Efforts to implement SFM need to consider numerous ecological interactions such as the pollination, seed dispersal and symbiotic relationships on which the productive forest depends. Knowledge is often limited, however; there is continuing uncertainty, for example, about the species responsible for pollinating many timber trees.

Just because a species is still present after timber extraction does not guarantee its long-term viability. Trees might live for many centuries, for example, despite being unable to regenerate.

Research in all tropical regions has suggested various ways in which the biodiversity impacts of forest management might be mitigated. Measures to reduce the damage done to the forest by harvesting, road-building and other forest practices are likely to be beneficial. Many such measures are already incorporated in SFM under the umbrella of reduced impact logging, but more can often be done. It should be possible, for example, to protect important habitat structures – such as large trees, hollow trees, dead stems and fruiting species. Special habitats such as pools, wallows, salt-licks, edible clays, caves, and lekking and nesting sites could also be protected. Reducing timber extraction rates and lengthening recovery periods will also reduce the impact of logging on the forest and its biodiversity. While some options are costly, others can save money.

Important benefits for biodiversity can arise when managers are able to anticipate, confront and address threats such as hunting, fire, invasive species and mineral extraction.

Logging inevitably leads to changes in biodiversity. Tradeoffs between economic costs and benefits and biodiversity gains and losses should be acknowledged explicitly and the selection of alternative strategies and scenarios negotiated between stakeholders.

Landscape-level considerations

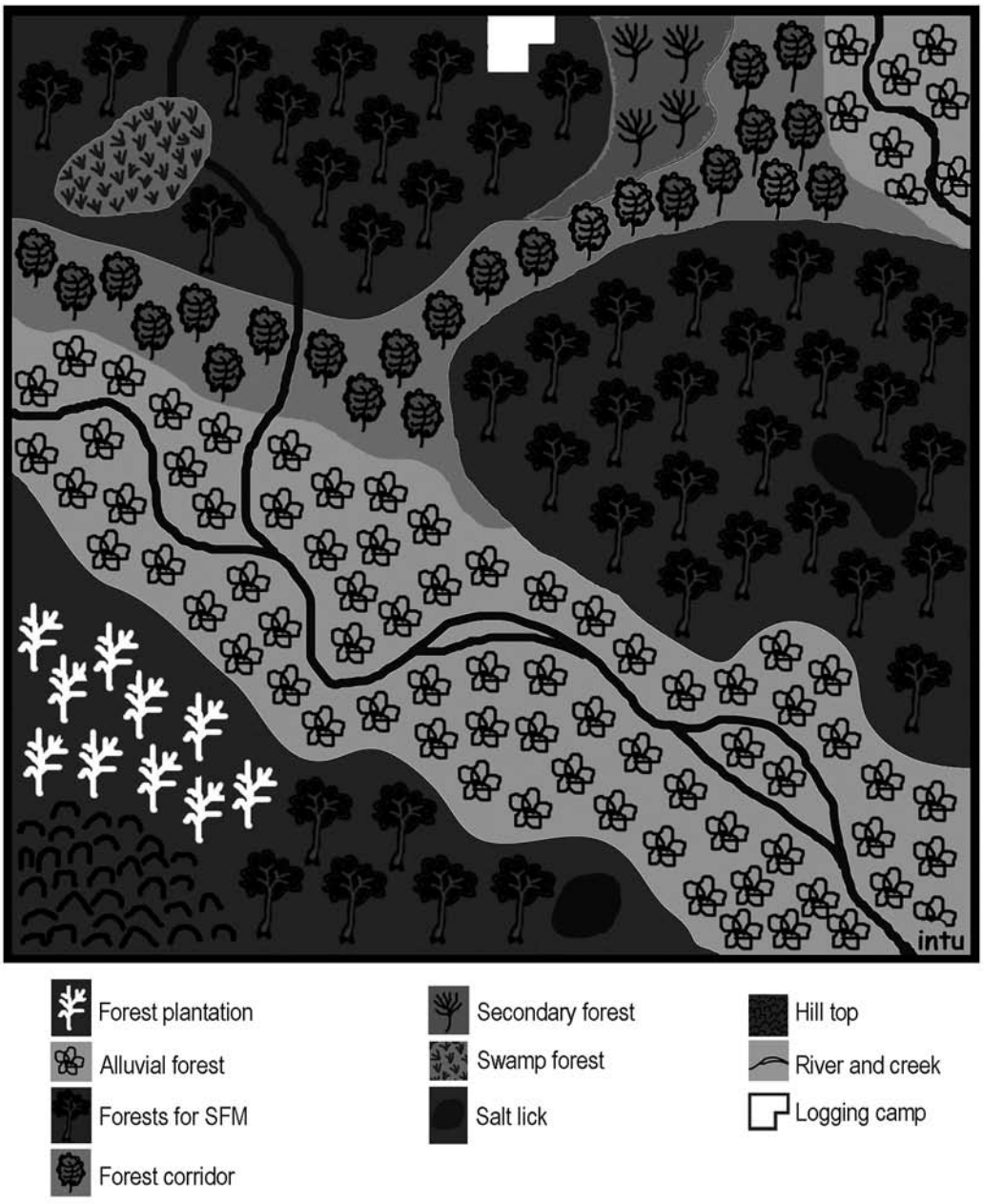
A landscape can be defined as a cluster of interacting ecosystem types (Figure 4), and also as a mosaic of land-cover types and their institutional and cultural context. Landscape ecology is the science of understanding the ecological consequences of management at landscape scales; it can provide guidance on the implications for biodiversity conservation of different landscape-scale management options.

Maintaining tropical production forests around and between strictly protected areas increases the biodiversity value of the landscape and contributes to conservation. Biodiversity conservation and sustainable use strategies, therefore, should consider the whole forest landscape.

Areas of tropical production forests often contain, border on or influence other non-production areas and non-forest habitats of conservation significance (such as water bodies and high mountain habitats). Maintaining the biodiversity values and features of these areas should be considered explicitly as part of the overall management of the landscape. Many species move in and out of forest ecosystems and depend for their survival on the maintenance of multiple habitats. Some such species are of high conservation significance or play important roles in the ecology of the forest. In Central American forests, for example, some key forest pollinators are themselves dependent on non-forest habitat outside gazetted reserves. Box 4 contains some additional landscape-level considerations for biodiversity conservation.

L'Hoest's monkey in the Nyungwe National Park, Rwanda.

Figure 4. Schematic depiction of a forest landscape



4 Landscape ecology and tropical forest management

Figure 5 shows several landscape-level arrangements of protected and production areas that can benefit biodiversity.

Maintaining viable landscapes for wide-ranging species: many animal species range over large areas and occur at low densities. Protected area networks are often too small and fragmented for such species, especially those averse to non-forest habitats, and special efforts need to be made to secure their habitats at the landscape scale. Migratory species often have especially large ranges. The main factor that determines wide-ranging behaviour is often food availability (eg fruit resources that occur in different places in different seasons), but other factors, such as the availability of nesting or lekking sites can be relevant. Such key sites and features should be conserved so that these species can persist.

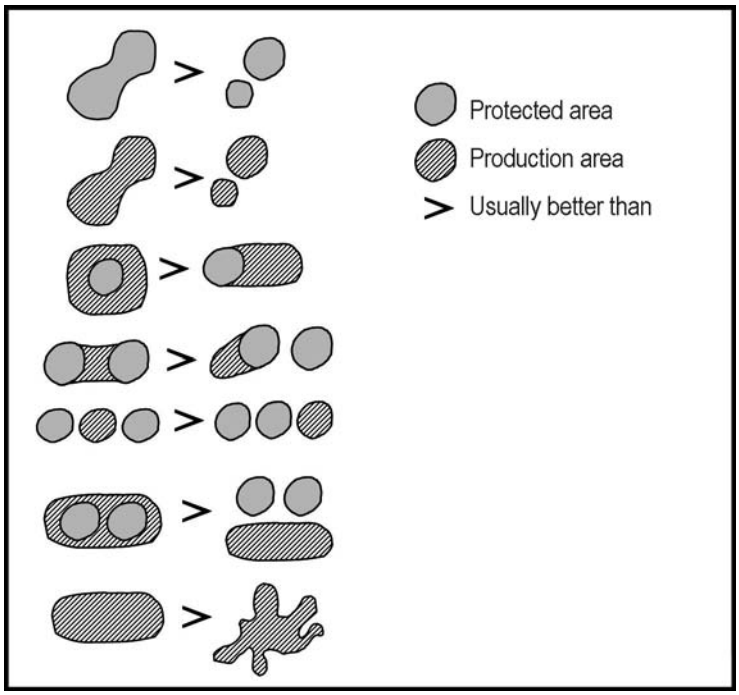
Enhancing the effective size of populations within patches: large populations of a species will have a high level of genetic variation compared to smaller populations and therefore a lower risk of extinction. The inflow of individuals and genes from surrounding areas can help to reduce local extinctions in forest patches. The vulnerability of species in forest fragments is strongly influenced by their ability to use the surrounding landscape mosaic: unsurprisingly, those that can move and feed in other habitats are less sensitive to fragmentation. Forest patches act as a source of species that can colonize adjacent fallow land; fallow patches near forest reserves are usually richer in forest species than those further away.

Reducing fragmentation: in most cases, a collection of small, isolated forest patches will be able to maintain fewer species than a single intact forest of the same total area. Small, isolated populations are at a high risk of local extinction. Forest fragments are also especially vulnerable to fire, the invasion of weedy species, and other processes of habitat erosion. Some forest species are highly vulnerable to fragmentation because they cannot survive in a non-forest environment or even at the edges of forests. The 'edge effect' can include changes in radiation, temperature and humidity, and also increased wind-throw of edge trees. Interactions between organisms can also be affected; for example, predation often increases in edge zones. The effects of fragmentation can be reduced if the distance between forest patches is low. Research has also highlighted the importance of maintaining forest or forest-like habitats in the intervening landscape. Biodiversity will benefit from efforts to maintain forest connectivity, minimize road width, and reduce canopy openings and edge creation.

Buffering against climate change: conservation planning at the landscape level can assist the adaptation of forests to climate change by facilitating the migration of species in the face of changes in total rainfall, seasonality, and other climatic effects.

Regulating movement: corridors (or stepping stones) of suitable forest habitat can assist species to disperse across landscapes.

Figure 5. Configurations of protected and production forest that favour biodiversity



Adaptive management and monitoring

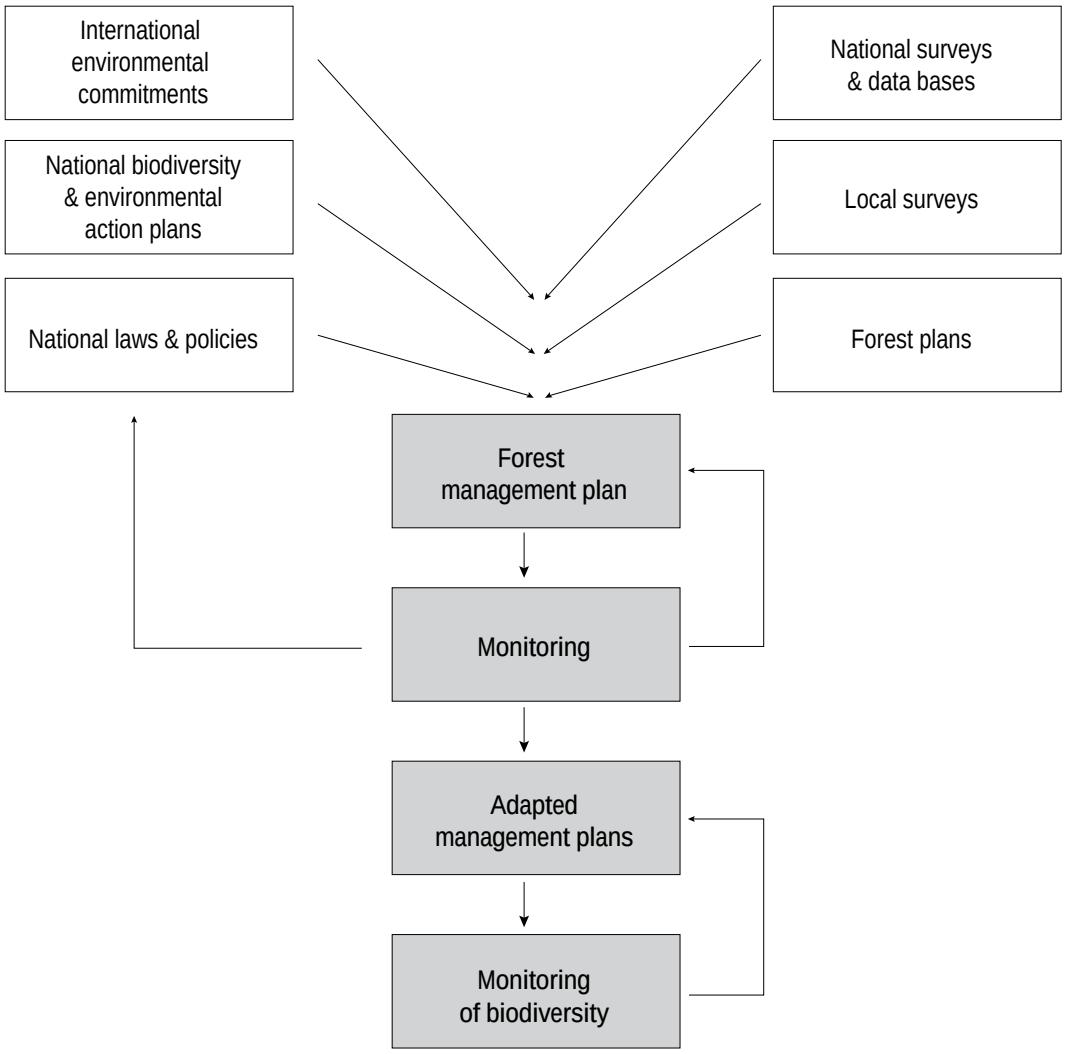
The ability to predict the outcomes of management interventions for biodiversity remains limited. Forests change constantly, with or without human intervention. Good forest managers are constantly anticipating and observing changes and threats in and around their forests, and adapting their activities as required. This adaptive management process, illustrated in Figure 6, is especially important for biodiversity conservation.

Essential for adaptive management is monitoring, of which four types can be distinguished:

1. identifying and assessing threats and problems: general patrolling (site tours) to identify encroachment, fire risk, invasive species, illegal activities and other problems;
2. implementation monitoring: supervising and checking whether planned biodiversity-friendly activities have been implemented as prescribed;
3. effectiveness monitoring: checking that prescribed activities and interventions have had the desired effects, and that threats have been dealt with adequately; and
4. inventories and monitoring of selected aspects of biodiversity: conducting research and studies and monitoring key trends in forest biodiversity.

Properly collected and analysed, data from surveys conducted during and after management interventions provide vital information on the impacts of management and the need or otherwise for modifications to the management regime. Partner organizations with expertise in biodiversity management can often assist forest managers in formulating suitable responses. The monitoring process should continue throughout the production cycle, although in the long periods between harvesting the surveys might be less frequent and less intensive.

Figure 6. Sequence of actions to achieve biodiversity conservation and sustainable use in production forests



Part II Principles, guidelines and priority actions

The following eleven principles should guide the conservation and sustainable use of biodiversity in tropical production forests.

Principle 1: Sovereignty and societal choice

The rights to and responsibilities for biodiversity lie primarily with the states and societies within whose territories it is located. Therefore, the conservation and sustainable use of biodiversity are a matter of societal choice and should reflect national and local goals.

Principle 2: International commitments

Many countries have entered into legally and non-legally binding intergovernmental agreements to conserve biodiversity, with implications for arrangements for the management of production forest landscapes within their territories. The presence in or adjacent to tropical production forests of species, populations of species, or species' assemblages that are subject to international conservation agreements may signal the need for special management measures.

Principle 3: Political commitment, policies and laws

Strong commitment from decision-makers and adequate national policies, laws and regulations are needed to ensure that forest management addresses biodiversity issues at the scale of the forest management unit as well as at the landscape and national levels.

Principle 4: Land use and spatial planning

Achieving biodiversity objectives in production forests requires that land allocation to different sectors and spatial planning within and outside the forest sector take biodiversity objectives into account.

Members of an ITTO/IUCN collaborative team visited a wide range of sites, such as this logging concession in East Kalimantan, Indonesia, to critically evaluate a draft version of the guidelines. The aim was to test the practicability of the measures proposed in the guidelines and to identify obstacles that might limit their implementation.

This, in turn, requires collaboration between sectoral institutions at the national or sub-national scale and negotiation among local land-users at the landscape scale.

Principle 5: Decentralization, forest tenure and natural resource access rights

Decentralized management and improved institutional arrangements and governance can assist the achievement of biodiversity conservation and sustainable use goals in tropical production forests by improving both the large-scale allocation of land and the resource access and land tenure rights of local people.

Principle 6: Incentives

Society at large benefits from biodiversity conservation, but the costs of conservation fall mainly on local forest owners and managers. Incentives will often be required to encourage forest owners and managers to take special measures for biodiversity conservation and sustainable use.

Principle 7: Knowledge, learning, technology transfer and capacity building

Learning, experimentation, the dissemination of information and the transfer of technology are all important for the conservation and sustainable use of biodiversity in tropical production forests.

Principle 8: Managing tropical production forests at a landscape scale

Tropical production forests and other components of landscapes have complementary but differing roles in biodiversity conservation and sustainable use.

Principle 9: Biodiversity considerations at the forest management unit level

An effective forest management planning process, in which economic, social and environmental objectives are balanced in accordance with societal needs and priorities, is essential for setting and achieving biodiversity conservation and sustainable use goals.

Principle 10: Biodiversity conservation in planted forests

Planted forests should be managed in ways that benefit biodiversity, both within the planted forest itself and in areas of natural forest that are retained within the planted forest landscape.

Principle 11: Maintaining functioning forest ecosystems

A fundamental goal of SFM is to maintain ecosystem functions at both the stand and landscape scales. Biodiversity plays an important role in ecosystem functioning and its conservation and sustainable use contributes to maintaining yields of timber and other forest products and services over the long term.

Each of these principles is accompanied by a set of guidelines and each guideline by a set of priority actions that, when taken, will help uphold the principle and put the guideline into effect.

Principle 1: Sovereignty and societal choice

The rights to and responsibilities for biodiversity lie primarily with the states and societies within whose territories it is located. Therefore, the conservation and sustainable use of biodiversity are a matter of societal choice and should reflect national and local goals.

People, societies and communities value biodiversity for different reasons and in different ways. The responsibility for biodiversity management and conservation therefore lies primarily with each country and its civil society.

Biodiversity goals for tropical production forests should be developed with the involvement of all stakeholders, with particular attention paid to the needs and priorities of local communities.

Guideline 1: National, regional and local biodiversity strategies, plans and regulations that are based on national and local priorities should be reflected in the management of tropical production forests.

In most countries, forest laws and regulations include provisions for conserving forest biodiversity. Almost all countries have legislation to protect biodiversity as well as national biodiversity action plans, other national-level and regional plans and strategies, and programs such as national forest programs that provide the context for measures to conserve biodiversity, although these rarely deal explicitly with biodiversity conservation in production forests. Forest agencies should be aware of the governmental commitments contained in these plans and strategies. Forest managers should ensure that their forest management plans conform to national laws and plans related to biodiversity conservation.

In principle, biodiversity laws and plans should provide information on species and areas of conservation concern. In practice, however, this information is often unavailable at a sufficient level of detail to meet all the needs of forest planning. Detailed information might be available on emblematic species such as the orang utan or gorilla, but not on the full wealth of biodiversity in tropical production forests. Local biodiversity values are often overlooked in forest land allocation and planning. To the fullest extent possible, forest agencies, including conservation agencies, should make biodiversity information available during processes of forest land allocation. Local people often have excellent knowledge about biodiversity, as well as their own conservation priorities, and should be involved in processes of forest land allocation and management planning.

Even when biodiversity strategies, plans and regulations exist they are rarely widely available. The knowledge embodied in these plans should be made much more accessible through the better use of printed and electronic media.

PRIORITY ACTIONS

Relevant government agencies should:

- Ensure that forest management plans comply with all national biodiversity laws and plans
- Ensure that the customary laws and practices of local communities are taken into consideration in land-use legislation and planning processes and prior to the designation of production forests
- Make biodiversity information widely available during processes of forest land allocation
- Use electronic and print media to make biodiversity plans, strategies and laws widely known

Guideline 2: Biodiversity goals and targets for tropical production forests should be developed with the involvement of all relevant stakeholders with particular attention to the needs and priorities of local communities.

National-level information on biodiversity is often inadequate for proper forest land allocation and planning and additional surveys are needed to fill information gaps. Surveys should be conducted to identify species, species' populations, and habitats that are rare, endangered, locally endemic, of special importance to local communities, or important for maintaining the composition and ecological functions of the forest. Ideally, such surveys would be conducted before areas are allocated for production forestry.

Most countries have specialized organizations with competence in biodiversity, such as natural history museums, herbaria, university departments, and non-governmental research and conservation organizations. Forest agencies should take the lead in consulting these specialist groups and drawing on their knowledge. Forest agencies should also build links between such specialized groups and forest managers so that

Local knowledge and needs are often given insufficient attention in determining measures for biodiversity conservation. Special efforts are required to include local concerns in priority-setting and decision-making processes for biodiversity conservation and sustainable use.

issues of particular biodiversity concern are taken into consideration in forest land allocation and management planning. Investments are needed to build national capacity for conducting field biodiversity surveys. National and international research organizations and non-governmental organizations (NGOs) could play greater roles as sources of biodiversity information.

Inventories and mapping exercises should use participatory processes involving local stakeholders. Local knowledge and needs are often given insufficient attention in determining measures for biodiversity conservation. Special efforts are needed to include local concerns in priority-setting and decision-making processes for biodiversity conservation and sustainable use.

PRIORITY ACTIONS

Relevant government agencies and other stakeholders should:

- Ensure that biodiversity conservation and sustainable use goals for production forests are included in national, regional and local strategies, plans and regulations
- Mobilize the capacity of conservation NGOs and specialized biodiversity institutions for biodiversity surveys
- Improve methods for consultation with and the participation of civil society, especially local communities, in setting biodiversity conservation and sustainable use goals, strategies and priorities
- Involve all groups with special knowledge of biodiversity in setting priorities
- Strengthen national capacity to conduct biodiversity inventories and prepare maps

Principle 2: International commitments

Many countries have entered into legally and non-legally binding intergovernmental agreements to conserve biodiversity, with implications for arrangements for the management of production forest landscapes within their territories. The presence in or adjacent to tropical production forests of species, populations of species, and species' assemblages that are subject to international conservation agreements may signal the need for special management measures.

Notwithstanding Principle 1, most countries have signed international agreements that commit them to specific biodiversity conservation measures. These commitments might relate to globally threatened or endangered species (as listed by IUCN) or habitats of global concern (such as wetlands listed under the Ramsar Convention, natural areas listed on the World Heritage List, and migratory species that cross international boundaries). For example, several commercial timber species have been listed in CITES Appendix II, requiring adequate inventory and monitoring for those species. Other internationally agreed measures include the development of national biodiversity action plans, national environmental action plans and national forest programs. In many cases, however, national legislation and programs have not yet been fully adapted to deal with such commitments. An important function of forest, conservation and other relevant agencies is to collate up-to-date information on the status of such commitments and to ensure that this information is available to those responsible for forest land allocation and management planning. This requires continuing collaboration between all relevant agencies.

Guideline 3: International commitments for the conservation of genes, populations, species and assemblages of species or habitats should be reflected in the legal and regulatory frameworks guiding the allocation and use of land for production forestry.

Forest agencies should collaborate with other government and non-government bodies engaged in making and implementing international biodiversity-related commitments. Forest agencies should have biodiversity experts on their staff, or access to such experts, who can review texts of international conservation agreements to which the country is a signatory to determine their implications for forest management and to make recommendations on changes to the legal and regulatory frameworks. These specialized biodiversity staff should also take the lead in the implementation of many other aspects of these guidelines.

PRIORITY ACTIONS

Relevant government agencies should:

- Establish a participatory process to ensure that biodiversity conservation commitments made internationally are widely supported domestically
- Strongly encourage collaboration between responsible agencies in implementing international commitments
- Promote the adoption and dissemination of information on, and support the implementation of, relevant international biodiversity-related commitments
- Ensure that sufficient biodiversity expertise exists on staff, or that such expertise is readily available, to review conservation-related commitments made internationally
- Work closely with forest agencies to ensure that all national and international commitments are known to forest planners and operators
- Promote appropriate training activities to enhance the knowledge and skills of government agency staff responsible for the fulfilment of international agreements related to biodiversity conservation

Guideline 4: Special measures will often be required when species and populations that are internationally recognized as rare, threatened or endangered occur in or adjacent to forest management areas.

Many of the measures to conserve biodiversity in tropical production forests will incur costs or reduce the profits of the forest owner or manager. It therefore makes sense to focus conservation efforts on those species or habitats that are of greatest conservation value.

When biodiversity subject to international agreements or otherwise known to be of high conservation importance occurs in production forests, special conservation measures should be taken.

PRIORITY ACTIONS

Forest managers should:

- As part of an overall effort to promote good forest conservation and monitoring practices, pay particular attention to the management of species or habitats that are internationally recognized as rare, threatened or endangered
- Consult with scientific and technical authorities on the species to be protected to identify appropriate conservation measures

Principle 3: Political commitment, policies and laws

Strong commitment from decision-makers and adequate national policies, laws and regulations are needed to ensure that forest management addresses biodiversity issues at the scale of the forest management unit as well as at the landscape and national levels.

A supportive policy environment and the political commitment to create, reform and implement policies within and outside the forest sector are critical for enabling effective biodiversity conservation and the implementation of SFM. Policies and laws provide incentives and disincentives which affect the behaviour and choices of forest managers, users and other stakeholders, including investors. On their own, however, good laws and regulations are insufficient. Political will to finance the enforcement and implementation of laws and regulations is necessary, as is strong leadership to coordinate across sectors. Political will and good governance are, in turn, fuelled by adequate stakeholder participation and awareness in all sectors of the importance of biodiversity conservation and sustainable use.

Guideline 5: The value of biodiversity as a vital component of ecosystems and a key element of local livelihoods should be demonstrated and communicated to all stakeholders, including decision-makers.

Awareness-raising at the national level and among political decision-makers is most effective if the broad array of biodiversity values and benefits can be demonstrated. Economic valuation studies that assess the comparative benefits of biodiversity conservation and sustainable use and the value of the full range of ecosystem services from tropical forests can be useful tools.

In many tropical forests, local knowledge and use of the wide variety of species exists, although this is diminishing in relative importance as species disappear. Local forest users and beneficiaries are positioned to be among the best advocates for conservation.

Awareness is best raised through stakeholder contact. Field trips and workshops which bring national decision-makers to the forest management unit level to meet with other stakeholders and view the forest have proven to be effective in raising awareness.

PRIORITY ACTIONS

Relevant government agencies, conservation NGOs and other relevant stakeholders should:

- Use creative means to raise public and political awareness about biodiversity values, including providing opportunities for stakeholder gatherings and delivering information about the economic roles of biodiversity and tropical forests
- Ensure that local biodiversity values get adequate attention in valuation studies and decision-making processes
- Sensitize all stakeholders to the importance of biodiversity conservation and sustainable use

Guideline 6: Appropriate policies, laws and regulations should be developed and implemented to ensure that biodiversity interests are adequately addressed in the management of tropical production forests.

Policies, laws and regulations for production forests should reflect biodiversity conservation and sustainable use commitments and set clearly defined implementation targets. The process of policy development should include multi-stakeholder consultations. An effective system for monitoring the implementation of such policies, laws and regulations should be in place.

PRIORITY ACTIONS

Governments should:

- Encourage multi-stakeholder involvement in the formulation of policies, laws and regulations related to production forests
- Ensure the effective implementation of policies, laws and regulations relating to biodiversity in production forests through such actions as providing adequate funding and staffing of key programs and units, seeking to diversify sources and sustain funding, reaching out to stakeholders in civil society and the private sector, and coordinating among all relevant agencies

Civil society should:

- Play a major role in reviewing proposed changes in policies, laws and regulations and in monitoring their implementation
- Ensure that all relevant decision-makers are accountable for the implementation of conservation commitments relating to tropical production forests

Principle 4: Land use and spatial planning

Achieving biodiversity objectives in production forests requires that land allocation to different sectors and spatial planning within and outside the forest sector take biodiversity objectives into account. This, in turn, requires collaboration between sectoral institutions at the national or sub-national scale and negotiation among local land-users at the landscape scale.

Most countries have spatial plans by which they allocate forest land to conservation, production and conversion. These plans typically take insufficient account of biodiversity conservation needs, which are often addressed simply by the designation of priority sites as protected areas. Spatial planning, however, has profound long-term impacts on biodiversity conservation because of its role in determining the extent of habitat loss and fragmentation. Strictly protected areas often focus on conspicuous species or unique habitats and give insufficient attention to the biodiversity-dependent needs of local people and the maintenance of broader ecological functions.

Guideline 7: National land-use planning processes and forest and environmental laws should explicitly address issues of biodiversity conservation and sustainable use in forests at all spatial scales.

Land-use or spatial plans should comply with national biodiversity action plans or similar biodiversity conservation and sustainable use initiatives. Similarly, biodiversity conservation goals should be spelt out explicitly in the development of forest-related laws and regulations.

Forests should be allocated to different uses in ways that optimize the provision of forest goods and functions at the landscape scale and that take into account the ecological needs of species whose conservation is desired. This requires good-quality forest maps and knowledge of the ecology of the species to be conserved.

In the past, spatial planning has tended to overlook certain legitimate stakeholders, especially local and Indigenous peoples, who might be dependent on access to or the use of biodiversity resources. The application of traditional knowledge and consultation with local people should be part of the process of land allocation.

PRIORITY ACTIONS

Relevant government agencies should:

- Ensure that national biodiversity action plans or similar biodiversity conservation initiatives are reflected in land-use or spatial plans at all scales
- Ensure that there is a process, established in law or regulation, that is transparent and allows for full public participation in forest land allocations and captures local values, including those of Indigenous and forest-dwelling people

Guideline 8: Inconsistent or contradictory land-use policies and laws at national and sub-national levels that conflict with biodiversity conservation and sustainable use or do not support SFM in general should be identified, reviewed and modified.

The greatest threats to biodiversity in tropical production forests often come from outside the forest sector. Agricultural conversion and mineral exploitation are often undertaken with inadequate consideration of biodiversity conservation and other forest values.

PRIORITY ACTION

Where appropriate, relevant government agencies should:

- Identify, review and modify policies, laws or subsidies outside the forest sector that are unfavourable to biodiversity conservation and SFM

Principle 5: Decentralization, forest tenure and natural resource access rights

Decentralized management and improved institutional arrangements and governance can assist the achievement of biodiversity conservation and sustainable use goals in tropical production forests by improving both the large-scale allocation of land and the resource access and land tenure rights of local people.

Effective biodiversity conservation requires the resolution of often longstanding issues related to forest tenure and natural resource access rights. In many countries, laws governing ownership and resource rights for forests provide little or no incentive for SFM. Concessionaires often claim that the periods for which they are granted concession rights are too short to make it worth their while to invest in better forest management. Local people often claim that since they have no security for the use or ownership of their forests it is better to clear them for agriculture. The reality on the ground is often very complicated. Working out the best governance arrangements for forest biodiversity requires a detailed consideration of local conditions. In many parts of the world, the decentralization of forest governance might help, but to be effective it requires improved institutional arrangements. Special attention should be given to ensure that local governance arrangements yield positive outcomes with respect to biodiversity conservation.

Guideline 9: Local communities should have the right to use biodiversity to meet their economic and cultural needs and should be involved in its management and protection. Clearly demarcated and defined tenure and resource use rights might benefit biodiversity by providing local people with incentives for conservation and sustainable use.

Palm nuts being cooked in Bakbale, Republic of the Congo. Local communities should have the right to use biodiversity to meet their economic and cultural needs and should be involved in its management and protection.

Major initiatives in recent years to decentralize forest governance and give communities a greater role in forest management has increased the importance of small and medium-sized private and community forest enterprises. Local communities, forest managers and owners are more likely to maintain forests and therefore conserve biodiversity if their rights to use forest resources are secure. The interests of biodiversity conservation can often be promoted by clarifying and providing legal protection for the boundaries of local use areas and for access rights to timber, non-timber forest products (NTFPs), fish and other useful biodiversity. The lack of clarity on local rights and access often leads to "a tragedy of the commons" in which different stakeholders deplete resources for short-term benefits.

Various forms of collaborative and joint forest management – under which forest agencies continue to have regulatory oversight to ensure that the public goods values of forests are conserved – have benefited biodiversity. Diverse forms of local management should be encouraged, with particular attention paid to their impacts on biodiversity conservation.

PRIORITY ACTIONS

All stakeholders should:

- Encourage the conservation of biodiversity and the sharing of benefits derived from its use

Governments should:

- Involve local people in the creation, design, negotiation and implementation of legal forest governance mechanisms
- Encourage and regulate community and small-scale forestry, and collaborative and joint forest management agreements in ways that provide incentives to conserve biodiversity
- Encourage arrangements between communities and private enterprises that favour SFM and biodiversity conservation
- Provide safeguards for biodiversity in local forest management schemes

Guideline 10: Arrangements regarding forest ownership and use at the landscape scale should be favourable for the conservation of forest biodiversity.

Forest areas are commonly subject to a variety of ownership or management regimes, but the interests of biodiversity conservation are best served if the entire forest landscape is managed in a coordinated manner. Ideally, forest agencies should maintain an overview of the entire forest estate and coordinate the actions of different forest users to ensure the continuity of habitats. This is best done with adequate knowledge of the forest stakeholders and their land ownership and forest use.

PRIORITY ACTIONS

Governments should:

- Promote the clear demarcation of forest ownership and biodiversity-favourable access rights for local people

Forest agencies and other relevant stakeholders should:

- Maintain databases on forest ownership and use at a landscape scale
- Devise and implement mechanisms to help coordinate the actions of forest owners, users and managers across landscapes to best ensure the maintenance of sufficient high-quality connected habitat for species, populations of species, and species assemblages of conservation interest

A village along the Dzangha River between Cameroon and Republic of the Congo. Governments should promote the clear demarcation of forest ownership and biodiversity-favourable access rights for local people.

Principle 6: Incentives

Society at large benefits from biodiversity conservation, but the costs of conservation fall mainly on local forest owners and managers. Incentives will often be required to encourage forest owners and managers to take special measures for biodiversity conservation and sustainable use.

Since society as a whole benefits from biodiversity, it is unreasonable to expect forest industries and local forest managers to pay the full costs of its conservation. Equitable financial arrangements are needed to encourage operators, including large companies, local people and communities, to conserve biodiversity.[4]

The simplification of regulations and procedures can act as an incentive to small producers to enter into production forestry. It can also reduce the costs of larger producers and help to motivate them to invest in the improvement of management practices. Access to credit remains a significant obstacle to the development of a sustainable forest sector.

Guideline 11: Managers of tropical production forests should be compensated for the incremental costs of biodiversity conservation measures.

[4] Options for innovative incentive measures are discussed further in Part III.

Payments for the ecosystem services provided by forests can provide forest owners and managers with incentives for conserving biodiversity in tropical production forests.

PRIORITY ACTIONS

Governments should:

- Review international experiences in the use of innovative mechanisms to pay forest owners and managers for the ecosystem services their forests provide and the effects of such mechanisms on the conservation of biodiversity
- Support pilot schemes to introduce payments for ecosystem services in tropical production forests
- Consider the introduction of such schemes on a wider scale

All relevant stakeholders should:

- Encourage potential donors and consumers of ecosystem services to contribute to such schemes

Guideline 12: Independent voluntary forest certification should be recognized as a way of encouraging biodiversity conservation in production forests.

Forest certification is a voluntary process by which the planning and implementation of on-the-ground forestry operations are audited by a qualified, independent third party against a pre-determined standard designed to ensure that operations are environmentally sustainable and socially acceptable. Forest operations found to conform to the standard are issued a certificate, which can then be used to demonstrate the legality and sustainability of their wood products.

In 2008, no more than 5% of forests in ITTO producer countries were certified. Interest in certification is strong, however, as consumers continue to express interest in the sources of the products they buy and the methods used in their production. During the testing of a draft of these guidelines it was found that in almost all instances where forest managers were taking measures to conserve biodiversity they were motivated by their desire to attain forest certification in order to access high-value markets for their timber products. A disincentive to certification is the cost of achieving the necessary management standards and the difficulties involved in creating a framework for appropriately engaging all stakeholders.

Certification will only provide an incentive for biodiversity conservation and sustainable use if it continues to help guarantee access to high-value markets or if consumers are willing to pay premium prices for certified timber. This can be achieved by encouraging contact and communication between producers and consumers to promote trade in timber and timber products from forests where biodiversity conservation measures are in place. A number of networks have been set up by timber harvesting, processing and marketing companies with help from international conservation NGOs to support this process.

One of the problems limiting the spread of biodiversity-friendly forest management has been that those companies and agencies that have been most transparent in their operations have sometimes received the most criticism, while those that have been more secretive or have resisted the presence of outside environmental specialists have often escaped such public scrutiny. There is a great need for more transparent, learning-oriented processes that do not discourage or penalize the reporting of failures. Monitoring systems need to be applied to the activities of all stakeholders. Government agencies and NGOs need to be held accountable to the same extent as timber companies.

PRIORITY ACTIONS

All relevant stakeholders should:

- Promote increased emphasis on biodiversity conservation in certification processes
- Ensure that forest owners and managers benefit from forest certification
- Facilitate certification by participating in the development of standards and related participatory processes, providing objective information on all available and appropriate schemes, building local capacity to certify, and identifying resources for technical support and financing
- Promote greater transparency in forest management practices

Guideline 13: Where they do not distort international trade, subsidies and credits should be made available to offset the costs of biodiversity conservation in tropical production forests. Subsidies and credits that favour deforestation or forest degradation should be identified and progressively eliminated.

Some land-use policies, laws, subsidies and credit schemes encourage activities that are harmful to biodiversity, such as the conversion of forest to non-forest uses. Such policies, laws, subsidies and credit schemes should be revised.

PRIORITY ACTIONS

Governments should:

- Where appropriate to specific country situations, identify and eliminate subsidies and credit schemes that favour non-forest uses of forest lands
- Create mechanisms for the exemption or reduction of taxes for forests managed in ways that promote biodiversity conservation and sustainable use
- Ensure that subsidy and credit schemes take into account the value of the forest biodiversity that might be lost as a result of such schemes

Banks, credit facilities and multilateral financial institutions should:

- Take biodiversity conservation values into account in financial analyses of forest-related investments
- Create special credit programs with simplified rules to encourage biodiversity conservation in forest management projects

ITTO members should:

- Consider the provision of funding through ITTO to help support the cost of biodiversity conservation and sustainable use in tropical production forests

Guideline 14: Governments should make use of international payment/financial mechanisms to support and offset the incremental costs of conserving biodiversity values and use these as an incentive to encourage biodiversity conservation and sustainable use in tropical production forests.

The global community values forest biodiversity but the costs of its conservation often fall disproportionately on the poorest people. International financial arrangements of various forms already exist to help offset such costs, particularly in protected areas, and should be broadened to include tropical production forests.

PRIORITY ACTIONS

International donors, investors and consumers should:

- Explore financial mechanisms to favour products sourced from forests in which biodiversity conservation measures are in place
- Explore mechanisms for making direct payments for the ecosystem services provided by tropical forests
- Provide financial support to assist managers of tropical production forests to meet the costs of surveys, monitoring and other measures needed for the conservation of biodiversity

Principle 7: Knowledge, learning, technology transfer and capacity building

Learning, experimentation, the dissemination of information and the transfer of technology are all important for the conservation and sustainable use of biodiversity in tropical production forests.

Knowledge of the ecology of tropical forests and the impacts of management is still limited and the importance of biodiversity in tropical production forests is still under-appreciated. Recognition of and respect for the traditional knowledge and wisdom of Indigenous and local forest-dependent communities can greatly enhance dialogue and mutual learning among stakeholders about biodiversity conservation and sustainable use.

Guideline 15: Relevant government agencies, forest managers, universities, research agencies and other organizations should collaborate in the development of systems for the collection, storage and processing of, and improved access to, existing and new data on biodiversity in tropical production forests.

One of the most significant findings of the national-level studies that accompanied the development of these guidelines is that there is a serious lack of good information on priority populations, species, habitats and other biodiversity values in countries with tropical production forests. However good the intentions of forest agencies and forest operators, the information that they need in order to adequately conserve biodiversity in tropical production forests is often lacking. In recent years the libraries and herbaria that, in the past, were maintained by forest agencies have often been neglected.

There is a need to train more taxonomists and ecologists, to establish and maintain biodiversity databases, and to establish and better care for reference collections. Under appropriate conditions, and with the prior informed consent of the owners and users, traditional forest knowledge, and information on local needs and preferences, should be included in such databases.

PRIORITY ACTIONS

Forest agencies and other relevant stakeholders should:

- Train more ecologists, taxonomists and parataxonomists and provide them with career opportunities
- Establish, restore and maintain libraries and reference collections to support the biodiversity conservation efforts of forest agencies
- Improve the availability of information on biodiversity in tropical production forests
- Make existing information on the presence and distribution of biodiversity from regional zoning surveys, conservation management plans and forest management plans available in databases
- Train forest managers in biodiversity conservation and sustainable use practices

Guideline 16: Governments, universities, research agencies and conservation NGOs should collaborate to produce manuals, guides and other material for communicating the underlying concepts, objectives and values of biodiversity in tropical production forests to forest managers and field personnel, key stakeholders and the media in language that is understandable, relevant and useful for all stakeholder groups.

The field evaluation of a draft of these guidelines showed that many forest managers, timber companies and forest agency personnel do not fully understand the importance of biodiversity. The underlying concepts of biodiversity and the objectives of its conservation need to be communicated in ways that are comprehensible to and useful for each target group. Communication materials must be able to meet the varying needs of different target audiences.

Greater use should be made of stakeholder consultations, radio, television, the press, the internet and other communication methods to raise awareness and exchange information on forest biodiversity issues. This should occur at the local, national and global levels and involve research and operational agencies. Many museums, herbaria and protected-area management facilities have good communication initiatives, but these often only target urban people. Communication efforts should also be directed towards the forest managers, timber companies and rural people whose day-to-day decisions directly affect biodiversity.

A black-capped lori in a logging concession in New Guinea.

Specialized agencies should provide local-language field guides, maps, species' checklists and other information to support biodiversity conservation measures in tropical production forests. The work of the World Bank and the GEF in funding the production of field guides for developing countries is commended and can serve as a model for other initiatives. It is important that, before finalization, all materials generated are subject to critical review by the target populations.

PRIORITY ACTIONS

Government agencies and conservation NGOs should:

- Develop communication strategies emphasizing the importance of tropical production forests for the conservation of biodiversity
- Produce user-friendly field manuals containing maps, lists of species, and information on the benefits of biodiversity conservation in tropical production forests and how best to support it
- Make use of modern print, electronic and visual media to communicate biodiversity concepts and priorities in easily understood terms
- Produce more educational, training and information materials in local languages to assist in effective communication with rural stakeholders

Guideline 17: Biodiversity conservation and sustainable use in the complex ecological, social and economic settings that frequently characterize tropical production forests require skills in adaptive management based on sound data and knowledge of forest conditions derived from monitoring and communication with all stakeholders.

The opportunities and options for conserving biodiversity in tropical production forests vary from place to place. Moreover, the best measures for conserving biodiversity might change over time as new knowledge is gained and as society's perceptions and needs evolve. Forest managers need to adapt biodiversity conservation management to local conditions and to changes over time.

Incentives and rewards for field foresters should encourage locally sensitive solutions based on conservation outcomes rather than the rigid application of rules. In most situations this is only likely to happen if forest agencies and conservation organizations are proactive in collaborating with forest operators. In a number of countries, conservation NGOs have worked successfully with timber companies to achieve biodiversity conservation and sustainable use objectives. The potential commercial advantage provided by certification has often been an important incentive for the concessionaires to collaborate in these initiatives.

Adaptive management also requires the collection and analysis of ecological, social and economic data over time and mechanisms to ensure that the knowledge gained from such monitoring is used to improve forest management.

PRIORITY ACTIONS

Government agencies and conservation NGOs should:

- Ensure that forest managers are trained and motivated to seek locally appropriate approaches to biodiversity conservation and sustainable use
- Encourage collaboration between conservation NGOs and timber companies to adapt management practices to suit local conditions
- Ensure that appropriate monitoring systems are in place that will inform management practices over time

Guideline 18: The successful dissemination and uptake of innovative approaches to the conservation and sustainable use of biodiversity in tropical production forests requires alliances and partnerships between organizations with complementary knowledge and skills.

International conservation NGOs, research organizations, universities and timber companies have shown they can collaborate successfully to achieve conservation objectives. More such partnerships should be fostered between companies, universities, museums and forest agencies as an effective way of accessing and disseminating biodiversity knowledge and promoting conservation action on the ground.

Universities and other educational institutions should encourage students and staff to participate in research, learning and dissemination in ways that help forest managers to better incorporate the outputs of conservation science into their forest management activities.

PRIORITY ACTIONS

Conservation NGOs, research institutions, universities, timber companies and forest agencies should:

- Foster greater collaboration between timber companies, technical agencies and research institutions
- Encourage education and research on biodiversity in tropical production forests

Guideline 19: Low-cost monitoring programs for biodiversity in tropical production forests that serve the needs of forest managers should be developed and conducted in ways that facilitate learning and adaptive management and that make information on achievements and failures widely available. Parataxonomists can provide valuable support to biodiversity assessment and monitoring.

Biodiversity monitoring in tropical production forests is an important element of both SFM and forest certification. Successful monitoring programs, however, are rare. The technical capacity to monitor any but the largest and most conspicuous animals is inadequate in most tropical forest countries.

Biodiversity conservation monitoring is most effective when it involves all stakeholders, including local people as well as technical specialists. Developing the capacity to conduct effective monitoring is a long-term process; as information becomes available it should be used in the review of forest management operations and, where necessary, to modify such operations.

PRIORITY ACTIONS

Governments and other relevant stakeholders should:

- Encourage the development of improved methods for monitoring biodiversity in tropical production forests
- Involve concerned stakeholders in monitoring processes
- Explore alternative biodiversity mapping and monitoring methods, including participatory community-based approaches for mapping biodiversity of particular importance to local communities
- Provide long-term incentives and financial resources for biodiversity monitoring in tropical production forests

Guideline 20: More capacity for biodiversity conservation in tropical production forests is needed in technical agencies, planning departments and timber companies and among local forest owners and managers.

In many countries with tropical production forests, human resource capacity in fields such as plant and animal taxonomy has declined; this decline must be reversed.

The number and level of training of scientists with field competence in biodiversity surveying, mapping and monitoring is often inadequate for the task. Without significantly increased investments in training courses, technical guidelines and manuals, the background studies and surveys that must underpin the implementation of these guidelines will be impossible. Increased skills are needed in forest ecology, biodiversity management, and taxonomy. Training must be mainstreamed in university and technical forestry courses.

Formal training and education should be complemented by practical experience – 'learning by doing'. Both public and private-sector forest managers should undertake, as a learning exercise, experimental biodiversity management in tropical production forests, by which the response of biodiversity to different types of management can be assessed.

Technicians and researchers keen to develop their skills in biodiversity conservation should be offered the opportunity and incentive to attend courses, invest their time in field work, and share their experiences through networks of practitioners.

PRIORITY ACTIONS

Government agencies, timber companies and conservation NGOs should:

- Provide training opportunities in taxonomy for forest management personnel who will work in tropical production forests
- Encourage trained staff to spend time surveying and monitoring biodiversity as part of their normal work
- Encourage the development of networks of field practitioners to share information on their experiences
- Create mechanisms for the formal recognition and valuation of traditional knowledge, particularly related to the botanical identification and use of forest species
- Encourage the creation of specialized courses and training activities in tropical forest taxonomy, ecology and biodiversity management
- Encourage the transfer of knowledge and technology on biodiversity conservation methodologies and measures to producer countries

Principle 8: Managing tropical production forests at a landscape scale

Tropical production forests and other components of the landscape have complementary but differing roles in biodiversity conservation and sustainable use.

Many species require a variety of habitats that they use at different times of the year or for different periods of their life cycles; these habitat needs should be provided for in forest zoning and harvesting patterns. Landscape ecology provides methods to help achieve a balance between different components of the landscape mosaic that will provide optimal conditions for a broad range of species and populations.

Guideline 21: The management of different types of production and plantation forest within the larger landscape has a major influence on biodiversity in that landscape.

It is important to ensure that land allocation and the planning of harvesting cycles and other silvicultural treatments result in patterns of forest cover that provide conditions suitable for biodiversity conservation.

PRIORITY ACTIONS

Land-planning and forest agencies should:

- Plan the allocation of tropical production forest and the development of forest infrastructure at a landscape scale

Forest managers should:

- Plan harvesting blocks in ways that do not disrupt the continuity of mature forests
- Retain natural unlogged refugia adjacent to or within harvesting blocks

Guideline 22: The restoration of native vegetation on degraded sites should be planned to provide a diversity of successional vegetation types, increase the connectivity of forest patches, and allow the dispersal of plants and animals, thereby helping to ensure the viability of populations at landscape and forest management unit scales.

The impact of roads on biodiversity can be reduced by retaining canopy 'bridges' over them and taking other measures to facilitate animal movement.

In many parts of the world, major initiatives are under way to restore degraded forests and forest lands. Much of this restoration work focuses on watershed protection or providing new sources of wood fibre. There are, however, many situations in which the carefully sited planting of native species can provide important biodiversity gains at a landscape scale.

The fragmentation of forests that occurs when areas are cleared or logged can threaten many plant and animal species that are dependent on large, intact forests for their survival. Corridors and 'stepping stones' of natural forest located within non-forest or planted forest areas can facilitate the movement of forest species.

PRIORITY ACTIONS

Forest managers should:

- Incorporate biodiversity conservation goals in the planning of large-scale reforestation or forest landscape restoration activities
- Plant native species on degraded land to increase habitat and to provide opportunities for the movement of biodiversity between fragmented natural forest patches
- Create corridors of habitat between forest patches by:
  - maintaining intact forest along streams and rivers
  - retaining canopy 'bridges' over roads and taking other measures to facilitate animal movement, such as building tunnels under roads
  - ensuring that roads do not impede water movement at stream crossings
  - revegetating degraded land

Guideline 23: Private and community forest owners need technical support to ensure that their activities are consistent with biodiversity conservation objectives.

It would be unreasonable to expect owners of small areas of forest or managers of community forests to acquire sophisticated skills in biodiversity surveying, management or monitoring. Forest agencies should provide technical support and oversight to ensure that, to the greatest extent possible, small-scale private or community forest management contributes to biodiversity conservation. This will require staff that can assess the biodiversity values of large aggregate areas of small forest holdings and, where necessary, assist smallholders to adjust their forest management practices.

Many managers of small forest areas work to short time horizons and might lack the long-term vision necessary to meet biodiversity conservation objectives. Forest agencies should provide oversight at the landscape scale to address these long-term needs.

PRIORITY ACTIONS

Forest and other relevant agencies should:

- Understand the importance of many small forest holdings for biodiversity conservation at the landscape scale
- Ensure that the managers of small or community forests understand and respect long-term needs for biodiversity conservation
- Assist community forest owners and managers to support activities that are consistent with biodiversity conservation objectives

Principle 9: Biodiversity considerations at the forest management unit level

Effective forest management, in which economic, social and environmental objectives are balanced in accordance with societal needs and priorities, is essential for setting and achieving biodiversity conservation and sustainable use goals.

This principle is at the heart of these guidelines. Even assuming that all of the policy and legal measures outlined under the preceding principles were in place, managers would still face major challenges in applying state-of-the-art biodiversity knowledge on a day-to-day basis. All silvicultural treatments will have impacts on biodiversity; the nature and extent of those impacts will depend on how well the treatments are planned and implemented.

Practical forest management ultimately determines biodiversity impacts. Forest management should reflect a process of consultation and, often, negotiation between the various stakeholders. Management planning needs to draw on and integrate available scientific and local knowledge on forest ecosystems and their biodiversity.

Guideline 24: Biodiversity should be given a prominent place at all stages of the preparation and implementation of forest management plans.

Forest-level planning is fundamental to success. Forest management plans, logging manuals, codes of conduct, reduced impact logging guidelines and other elements of SFM must all include explicit provisions for biodiversity conservation. It is vital that management planners and other legitimate stakeholders are able to access the best available information on species, populations of species, and habitats of conservation concern and on the impacts that different practices have on biodiversity conservation.

PRIORITY ACTIONS

Forest managers should:

- Define biodiversity goals at all stages of the preparation and implementation of forest management plans

Relevant government agencies and research institutions should:

- Ensure that technical information on biodiversity is available to forest management planners
- Ensure that biodiversity conservation is dealt with explicitly in manuals, codes of conduct and guidelines related to the implementation of SFM

Guideline 25: All forest management activities affect biodiversity. Forest management must ensure that changes do not impact negatively on biodiversity features identified as having special value.

Forest management inevitably causes changes in biodiversity. The objective of management is not to prevent change but rather to ensure that such change is within limits acceptable to legitimate stakeholders. The studies that occur during spatial planning (Principle 4) and in processes of consultation with local stakeholders (Principle 5) must identify those features of special concern which should be protected against unacceptable change.

PRIORITY ACTION

Forest managers should:

- Identify and monitor biodiversity values that should be protected against excessive change during forest management

Guideline 26: Forest management plans should include information on the presence and conservation status of plants, animals and habitats of special conservation concern.

Adequate baseline information on the biodiversity resources of a forest and a process for monitoring changes in those baselines are both essential for effective biodiversity conservation in tropical production forests and must be provided for in forest management plans. Forest management plans must also be flexible enough so that management practices can be adapted to meet changing biodiversity objectives and to respond to changes in biodiversity detected through monitoring.

During preparation of the forest management plan, biodiversity features of value to local communities, such as resin trees, sacred sites and medicinal plants, should be identified. The plan must include measures to ensure that forest management does not impact negatively on those local values.

There is a risk that significant – and commercially valuable – genetic variation will be lost among tree species subject to heavy harvesting pressure; for example, individuals with the best form might be harvested preferentially. The setting aside of conservation areas would help mitigate this risk.

PRIORITY ACTIONS

Forest managers should:

- When developing forest management plans, encourage collaboration with museums, herbaria, environmental agencies and conservation NGOs to assemble baseline information on biodiversity resources
- In the preparation of forest management plans, consult with local people/communities and ensure that their traditional knowledge of biodiversity is taken into account
- Incorporate baseline information on biodiversity and forest ecology in the forest management plan
- Ensure that forest management plans provide for biodiversity monitoring and that management will be responsive to the results of that monitoring
- Ensure that forest management plans include measures to protect local biodiversity values
- Ensure that forest management plans include provisions to address specific biodiversity issues such as genetic conservation areas for commercial tree species
- Ensure public disclosure of the biodiversity information used in the development of forest management plans

The construction of new infrastructure – particularly roads – can greatly increase the risk of forest loss and forest degradation due to agricultural expansion. These potential threats must be assessed and plans put in place to address them.

Guideline 27: Actual, potential and emerging threats to biodiversity must be anticipated and contingency plans prepared to ensure that, when needed, technically sound responses can be put rapidly into place.

Many threats to biodiversity in tropical production forests – such as illegal mining and agriculture, hunting and the unregulated exploitation of other forest species – can be detected through patrolling or remote sensing and a field presence is vital for their control. Other threats, such as those posed by invasive species and disease, might be harder to recognize, or their control might require specialized support.

New threats to biodiversity are likely to emerge in the future. Climate change, for example, could have dramatic impacts, such as by increasing the risk of fire and disease and by changing moisture regimes. The construction of new infrastructure – particularly roads – can greatly increase the risk of forest loss and forest degradation due to agricultural expansion. These potential threats must be assessed and plans put in place to address them. Conservation NGOs, research institutes and forest agencies all have roles to play.

Some threats to biodiversity could emerge with very little warning and mitigation measures will need to be rapidly deployed. Clearly defined communication pathways are needed so that management responses can be made in a timely and effective manner.

PRIORITY ACTIONS

Forest managers should:

- Plan and implement systems for identifying and responding to present and probable threats to biodiversity
- Establish contingency plans and clear communication pathways to help deal with emerging threats to biodiversity
- Ensure that monitoring systems and protocols established for tropical production forests include assessments of actual and emerging threats to biodiversity within and adjacent to those forests

Guideline 28: Biodiversity conservation objectives should be clearly and explicitly identified for each area of forest under management. These objectives should recognize and reflect the biodiversity values and possible tradeoffs amongst key stakeholders, including local communities.

Vague and general commitments to conserve biodiversity in production forests tend to produce vague and un-measurable outcomes. It is far preferable to focus on biodiversity of known special value and to invest in measures to protect it. Thus, the work on biodiversity in logging concessions in the Congo Basin (see annexes I and II) has focused on a group of forest mammals of high conservation interest – elephants and the great apes. The objective of conserving these species is easy to communicate, the management measures required are readily identified, and the success or failure of the conservation measures is easy to monitor. When the objective is set in more general terms, such as 'to retain all local biodiversity', the questions of what to do and how to measure results are much more difficult. It is also less easy to persuade commercial companies of the value of conserving species whose identity and location are barely known. One of the key elements of successful biodiversity conservation in any tropical production forest is to be very clear about exactly what is to be conserved. Baselines and monitoring measures for these biodiversity values must be included within the monitoring and evaluation framework of the forest management unit and management adapted to ensure that biodiversity objectives are met.

Since local people often have extensive knowledge of the biodiversity in their forest they can play an important role in assessing the changes that result from logging operations. This is especially true in instances where local communities have rights to, or are making use of, managed forests.

PRIORITY ACTIONS

Forest managers should:

- Make the biodiversity priorities of a tropical production forest as explicit as possible by listing species, habitats and populations to be maintained
- Monitor changes in these biodiversity priorities
- Involve local people in participatory monitoring of important biodiversity features

Guideline 29: The preparation of harvesting plans, including stock maps at the compartment level, should take into consideration the local occurrence of species or habitats of special conservation concern.

Foresters and logging crews often have a broad knowledge of the forests in which they work. Pre-logging inventories (stock mapping, etc) provide an excellent opportunity for collecting practical on-the-ground information about biodiversity. This information can be used to develop precise maps of the distribution of species and assemblages of species of conservation concern, such as nesting and fruit-bearing trees, and of other important biodiversity features such as wetlands, dry-season water supplies, patches of unusual habitats, saline earths and migratory routes. The presence of botanists, taxonomists or parataxonomists on the teams will enable the collection of information on rare plant and animal species restricted to specific sites. It is much easier to give such features special protection when stand maps show their locations.

In many cases it might be unreasonable to expect commercial companies to bear the full cost of such detailed surveys. Specialized research organizations and NGOs can make valuable contributions by providing botanical and zoological expertise, training and user-friendly information; international conservation NGOs have done just this in the Congo Basin and Indonesia, with excellent results.

PRIORITY ACTIONS

Forest managers should:

- Ensure that pre-logging inventory teams include biodiversity specialists such as ecologists, taxonomists/parataxonomists, botanists and zoologists, particularly in areas of high biodiversity value

Conservation NGOs and research institutions should:

- Support pre-logging inventories by providing biodiversity specialists, particularly in areas of high biodiversity value

Relevant government agencies, research institutions, universities, timber companies and conservation NGOs should:

- Collaborate to build the capacity of field staff to monitor biodiversity by providing training and appropriate communication materials for the field identification of commercial tree species and other forest biodiversity

Guideline 30: Reduced impact logging should be used in tropical production forests.

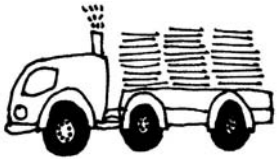
The application of reduced impact logging techniques is probably the simplest and most cost-effective biodiversity conservation measure that can be taken in tropical production forests. Among other things, reduced impact logging reduces the impacts of logging infrastructure, particularly roads and skid trails, encourages the use of wheeled skidders to reduce damage to forest soils, and mandates the use of directional felling to protect remaining trees (see Box 5). All these measures are good for forest biodiversity.

Most of what is widely accepted as good forestry practice is also good for biodiversity. Some silvicultural interventions, however, should be applied with caution. Pre- and post-harvest treatments such as climber-cutting and liberation thinning can impact negatively on some plant and animal species and, in some cases, are unnecessary either for silvicultural or safety reasons. Well-trained foresters should assess the safety, biodiversity and productivity implications of such measures on a case-by-case basis.

Most logging laws require that protective buffer zones should be retained along water courses, primarily to protect hydrological values. Often, these buffer zones are also very valuable for biodiversity, providing an added justification for their retention. Field reports during the testing of these guidelines suggested that such buffer zones are sometimes difficult to protect from log thieves; in such cases, special protection measures might be required.

The potential impact on biodiversity of silvicultural treatments should be considered; non-commercial or malformed trees might have high biodiversity values, for example, and should not be systematically removed. A balance should always be sought between stand improvement measures and biodiversity conservation. After many years of management, some of the better-managed (from the point of view of the commercial forester) forests in Malaysia begin to look like even-aged plantations, with few trees containing hollows that nesting birds might use and few large horizontal branches for epiphytic orchids. Again, the forest manager must assess the tradeoffs and conservation specialists must identify species or communities that could be placed at risk by silvicultural interventions.

PRIORITY ACTIONS



Forest managers and timber companies should:

- Apply reduced impact logging
- Retain buffer strips along water courses
- Ensure that silvicultural treatments do not place important biodiversity features at risk
- Ensure that roads and skidding trails do not block watercourses or impede drainage

Directional felling is an important aspect of reduced impact logging.

5 Reduced impact logging

Conventional logging – practised without regard for environmental values – can cause considerable damage to the residual forest: depending on the nature of the landscape and the intensity of logging, 25–75% of remaining trees in a logged forest can be damaged or destroyed. Moreover, mortality among remnant trees and the effects of soil erosion and compaction can persist for many years after logging. Studies on reduced impact logging show that it can reduce stand damage by half or more, mainly by better-planned log skidding. It can also increase profit margins by improving efficiency and by increasing the value of future harvests. Reduced impact logging comprises the following components:

- *good planning and implementation of all aspects of extraction:* the layout of the forest management unit, showing the location of roads, stream crossings, log loading areas, skid trails and camps, is based on best-available maps and designed to minimize damage and avoid environmentally sensitive areas and biodiversity set-asides.
- *directional felling*: trees are felled in directions that minimize gap size, protect future harvest trees, and skidded in directions that avoid additional damage.
- *high-quality stock maps showing the location of individual trees*: at their best, these maps can act as a biodiversity inventory and their use in stand-level biodiversity conservation represents a major contribution to environmentally sound logging. Ideally, they are fully integrated with procedures to allocate yields, establish the spatial distribution of logging, and indicate trees and sites to be protected.
- *well-planned skid trails*: in particular, skid trails should be planned using stock maps to avoid damaging residual trees and other vegetation. The length of skid trails should be minimized and excessive compaction avoided. On steep slopes, skid trails should be located to the greatest extent possible along ridges and winches and cables used to haul logs upslope; and
- *seasonality*: log extraction should be conducted during dry seasons, particularly in moist forests. It should be avoided, however, during periods of high fire danger.

Guideline 31: Special precautionary measures are required to protect populations, and maintain the within-species variability, of the most valuable timber species.

Timber harvesting that removes a high proportion of individuals of a species can reduce the genetic variability of that species and its ability to adapt to environmental change. While research on the conservation genetics and ecology of tropical timber species has only recently begun to explore this issue, past excessive harvesting of some high-value timber species across their ranges has caused concern.

Forest managers should pay special attention to the retention of different age classes within a stand, and especially of viable populations of commercial timber species. Where possible and where justified by the regeneration strategy of the target species, logging operations should be timed to follow periods of seed production.

Forest managers should also address the special management needs of valuable commercial tree species with irregular age-class distributions. The mahoganies of Latin America and related species in Africa are good examples of trees that require special silvicultural treatments to ensure their sustainability.

PRIORITY ACTIONS

Forest managers should:

- Assess the need for special measures to encourage the retention of viable populations of seed trees and maintain the genetic diversity of commercially important species
- Ensure that the silvicultural requirements of target tree species are known and applied
- Promote research on the conservation genetics and ecology of commercially important species with the aim of providing useful guidance to forest planners and managers
- Encourage the establishment and maintenance of permanent forest sample plots and other monitoring systems to better understand long-term forest dynamics, regeneration, and within-species genetic variability with a special emphasis on actual and potentially valuable tree species

Guideline 32: Hollow trees, although generally of low commercial value, should be retained, as they provide important habitats for a wide range of animal species.

Foresters have often considered hollow trees to be undesirable because they compete with commercially valuable trees and could be sources of disease. They are, however, very important as nesting sites for a variety of mammals and birds. Trees should be checked for hollowness and, unless they have high commercial value, retained.

PRIORITY ACTION

Forest managers should:

- Retain hollow trees in harvest operations

Guideline 33: Unnecessary nutrient losses from the forest ecosystem and impacts on soils should be minimized.

Many tropical forest soils are very low in nutrients. The maintenance of forest productivity depends on the presence of a rich community of soil-dwelling fauna and microflora – invertebrates, fungi and microorganisms – which decompose and recycle essential nutrients. Any disruption of this below-ground biodiversity – by disturbances caused by logging, for example – can reduce productivity and lead to significant ecological change.

Good forestry practice usually requires that logs are debarked in the forest so that nutrients are returned to the soil. In some situations, this practice can cause excessive nutrient enrichment that favours invasion by common weed species at the expense of native species that are adapted to nutrient-poor conditions. In other cases, bark might need to be retained on stored logs to protect them from insect damage that would reduce their commercial value. In general, however, biodiversity conservation is best served by in situ log-debarking and the on-site retention of logging debris.

PRIORITY ACTIONS

Forest managers should:

- Minimize soil disturbance and loss during forest management operations by following reduced impact logging practices
- Debark trees in the forest unless there are sound commercial or ecological reasons for not doing so

Guideline 34: Disruption of canopy cover might be important in allowing the regeneration of light-demanding species but this should be balanced by the need to retain canopy connectivity for canopy-dwelling animals and to reduce fire risk and the exposure of open ground to rain and sun.

Canopy disturbance can have major impacts on biodiversity, including on canopy-dependent species of primate and birds. On the other hand, opening up the canopy can favour other species, such as elephants and some great apes that feed on the shrubs that regenerate on exposed sites. To ensure that biodiversity conservation concerns are taken into account, the best available knowledge should be used in decisions on the extent of canopy disturbance permissible during logging operations.

PRIORITY ACTION

Forest managers should:

- Ensure that decisions on the extent of canopy opening take into account impacts on biodiversity

Guideline 35: Forestry operations can encourage the introduction and spread of invasive alien species and measures should be taken to minimize this risk.

Invasive alien species pose a very significant risk to forest ecosystems (Box 7), a risk increased by climate change. The deliberate introduction of plants, animals, fungi and other microorganisms that might be invasive should be avoided and prompt action taken to eliminate established populations of invasive species.

In areas where invasive alien species are a particular threat, special measures should be taken to avoid the transfer of seeds and propagules via, for instance, shoes, equipment and vehicles.

PRIORITY ACTIONS

Forest managers should:

- In reforestation or enrichment planting activities, use weed-free seed and sterilized potting soil to prevent the accidental introduction of invasive species
- Prior to entry into tropical production forests, ensure that shoes, equipment and vehicles are free of propagules of potentially invasive alien species
- Take measures to eradicate invasive alien species that become established

Relevant agencies should:

- Assist forest managers by providing management-relevant information on the prevention and control of invasive alien species

Guideline 36: Measures should be taken to avoid unsustainable levels of hunting and the gathering of NTFPs.

Many, if not most, communities of people living in forest areas have longstanding dependencies on hunting and the gathering of NTFPs for a wide variety of subsistence uses, including traditional health care and nutrition. At sustainable levels, these practices need not compromise biodiversity conservation objectives (Box 6).

Endangered and threatened species are frequently among those collected and consumed by local people, who might be unaware that these species are of conservation concern but might be willing to change their consumption habits to protect them. Awareness-raising through education, publicity and consultation with forest-dependent communities, hunters and collectors, and the broader public (such as consumers of commercially harvested bushmeat), can play an important role.

Many forest communities have longstanding dependencies on forests for hunting and gathering; at sustainable levels, these practices need not compromise biodiversity conservation objectives. Here a young girl eats wild fruit from the forest.

The opening of forests to logging can expose them to increased levels of hunting and gathering, possibly beyond the limits of sustainability. In these situations, measures to monitor and regulate commercial hunting and NTFP-gathering should be put in place. Commercial activities should only be permitted when there is capacity to determine sustainable harvest levels and regulate off-takes. Forest managers should support measures, including collaboration with local communities, for controlling the harvesting and transport of bushmeat and NTFPs.

To reduce the demand for bushmeat, large-scale logging operators should ensure that domestically raised meat is available to their employees.

PRIORITY ACTIONS

Relevant authorities, timber companies, conservation NGOs and other relevant stakeholders should:

- Assess the level of dependence that local communities have on bushmeat and seek ways of reducing this
- Collaborate to increase awareness among forest-dependent people and the private sector of the risks posed to biodiversity by unsustainable hunting or NTFP extraction
- Compile information on globally, nationally or locally threatened species that are commonly hunted or gathered in forests and make it available in appropriate formats and in local languages and dialects
- Determine the drivers of the bushmeat trade at national and international levels and increase consumer access to domestically raised meat
- Through participatory processes, establish hunting zones and employ local people and private companies to help control these areas

Relevant authorities should:

- Allow, at sustainable levels, subsistence hunting for bushmeat and the subsistence extraction of other NTFPs from tropical production forests and, when it enhances the livelihoods of forest-dependent people, the commercial harvesting of these products
- Establish local rules to regulate hunting to protect sites that are important for wildlife breeding and to restrict hunting and NTFP collection activities for species of conservation concern, especially during periods of the year that are critical for their reproductive success
- Monitor and regulate the commercial exploitation of bushmeat and NTFPs
- Prevent the use of wire snares and high-calibre firearms
- Create opportunities for local people to manage wildlife and NTFPs for local use

Timber companies should:

- Provide forest employees with meat and fish obtained from sustainable sources

To discourage excessive hunting, logging camps, such as this one in southeast Cameroon, should provide employees with meat and fish obtained from sustainable sources.

Forest elephants in the Dzanga-Sangha National Park in Central African Republic. This park is surrounded by logging concessions, which are an important part of the elephant habitat.

6 Hunting in tropical forests

For many rural people living in or near tropical forests, vertebrate game species are crucially important sources of protein and income. Over-hunting across the humid tropics, however, combined with forest loss, increased commercialization and human population growth, is causing local extinctions of many species. New roads – often constructed by or on behalf of extractive industries such as logging and mining – give hunters greater access to previously remote forests, contributing to the over-exploitation of certain species of wildlife. A general rule is that rural communities consume more bushmeat than urban communities because of greater availability and, often, by preference. In theory, however, acceptable substitutes and/or higher incomes could reduce unsustainable hunting. Successful solutions are likely to involve multidisciplinary approaches and collaboration at all levels involving local people, governments, scientists and companies. The private sector could play an important role in wildlife conservation, particularly by providing financial and technical resources in areas where governmental presence is low. On a large logging concession in Congo, for example, an education program has helped timber company staff to establish no-hunting zones, restrict the transportation of wildlife, and provide workers and their families with alternative sources of protein. On private land in the Brazilian Amazon, partnerships between timber companies and conservation NGOs have established programs for monitoring fauna.

Guideline 37: Forest managers and other stakeholders should take special measures to mitigate increases in human-wildlife conflicts that might arise from logging activities.

Logging operations can modify the habitat and change the distribution of species that are important resources for local people. Logging might also increase the likelihood of conflicts between people and wildlife. Conservation programs in northern Congo, for example, have been so successful that elephants concentrate in the area and often destroy the crops of local people. This might have the effect of forcing those people to resort to commercial hunting so they can purchase staple food supplies they would otherwise have grown. Forest management plans should anticipate such potential conflicts and include measures to mitigate risk – such as the control of dangerous or crop-raiding animals.

PRIORITY ACTIONS

Forest managers should:

- Consider, in forest management plans, potential human-wildlife conflicts that could arise from logging activities and take appropriate measures to prevent their occurrence
- Take measures to avoid conflict when timber harvesting reduces the availability of the biodiversity required by other forest users

Timber companies should:

- Assist local people to manage wildlife conflicts caused by their forestry or biodiversity conservation and sustainable use activities

Principle 10: Biodiversity conservation in planted forests

Planted forest areas should be managed in ways that benefit biodiversity, both within the planted forest itself and in areas of natural forest that are retained within the planted forest landscape.

The proportion of the tropical production forest estate that is under intensively managed plantations is increasing rapidly. More and more of the world's wood fibre is coming from planted forests and there has been an expansion of the plantation industry in the tropics and sub-tropics.

As the sector grows, plantation forestry will inevitably have impacts on biodiversity. When planted forests replace natural forests, these impacts will be largely negative. On the other hand there is increasing evidence that planted forests can contribute to biodiversity conservation through management that favours biodiversity within planted forest stands and in set-asides within the plantation landscape.

Guideline 38: Planted forest establishment should focus on previously deforested or other degraded sites and not replace natural forest habitats of conservation concern.

As for any change in forest land use, potential plantation areas should be surveyed to determine whether they contain biodiversity features of special concern. When such features are identified, the forest management plan should include measures to protect them.

PRIORITY ACTIONS

Plantation forest developers and managers and land-use planning agencies should:

- Preferentially establish planted forests on degraded sites in need of rehabilitation
- Take measures to protect features of high biodiversity value, especially when natural forest is to be converted to plantation forest
- Promote research, technologies and innovative strategies and methods to develop planted forests on degraded forest lands

Guideline 39: Large-scale planted forests can provide a forest matrix within which areas of high conservation value can be protected and managed.

A number of large-scale plantation schemes successfully manage biodiversity set-asides within their landscapes. In some cases, the resources available to such companies are sufficient to enable them to provide a higher level of protection than is available in nearby national parks and equivalent reserves.

PRIORITY ACTIONS

Relevant government agencies should:

- Encourage the setting aside of representative natural forest or other natural vegetation types within the plantation estate and, where possible, the restoration of natural forests on appropriate sites
- Ensure that plantation forest developers retain natural habitats along watercourses and take other steps, such as those set out elsewhere in these guidelines, to maximize biodiversity conservation in industrial plantation developments

Plantation forest developers and managers should:

- Undertake rigorous and comprehensive impact assessments that consider the biodiversity value of an area to all relevant stakeholders
- Set aside biodiversity reserves within large-scale plantation schemes
- Retain natural habitats along watercourses within their plantation estates

Guideline 40: Management systems that favour natural processes and native species and enhance the productivity and resilience of the planted forest should be developed.

Appropriately managed planted forests can retain surprisingly high levels of local biodiversity. There are indications that longer rotation lengths, reduced soil cultivation and other silvicultural practices not only favour biodiversity but can also be good for plantation productivity. Reducing the use of herbicides and pesticides can help planted forests to retain more biodiversity, which in turn can benefit soils and forest productivity.

PRIORITY ACTIONS

Plantation forest developers and managers should:

- Encourage research to develop innovative economical and effective silvicultural practices to enhance the biodiversity values of planted forests
- Where economically viable, adjust silvicultural practices to favour local biodiversity in planted forest stands
- Reduce pesticide and herbicide use
- Promote research on alternative non-chemical methods for controlling pests and diseases in forest plantations

Guideline 41: The use of native tree species and species mixes in planted forests enhances the biodiversity value of the stand. When exotic species must be used, choose those which provide the best habitat for local biodiversity.

Planted forests composed of native tree species will always provide better conditions for local biodiversity than those composed of exotics. The production of industrial wood fibre is focused increasingly on a small number of plantation species; a counter-effort is needed to diversify the range of species used. Such diversification, using native species, could increase the sector's resilience to climate change and other threats.

PRIORITY ACTIONS

Government agencies, research institutions, conservation NGOs and plantation forest developers and managers should:

- Encourage the use of native species in planted forests
- Promote collaboration between research institutions and forest industry to develop the silvicultural knowledge and practices needed to increase the use of a wider range of native species in planted forest development

Guideline 42: Measures should be taken to ensure that plantation forestry does not facilitate the introduction of invasive species, which could impact negatively on both the planted forest and neighbouring natural forests.

Climate change will increase the risk posed by invasive species, especially where exotic tree plantations are being established on new sites. To minimize the risk, care should be taken in selecting and testing new species or varieties of trees for planted forests.

PRIORITY ACTIONS

Government agencies, research institutions, conservation NGOs and plantation forest developers and managers should:

- Take precautions to prevent the introduction or spread of invasive alien species in association with plantation schemes
- Avoid introducing tree species that are likely to spread outside the planted forest area

7 Invasive alien species

When forests are disturbed they become vulnerable to invasion by undesirable plants, animals and fungi. As global transport systems become increasingly interconnected and rapid, invasive species are becoming an increasing problem worldwide. Seeds and other propagules of plants are transported in soil, in association with other plants and animals, and on people's shoes and vehicle tires. Some of these species lack natural control mechanisms in their new habitats and out-compete local species. Moreover, changes to the climate are expected to cause some species to behave like invasives in areas where they have existed benignly for many years.

In the past, exotic species have had difficulty invading closed tropical forests. With increasing fragmentation, logging and fire, however, such forests are becoming more susceptible. Forest managers and conservation agencies need to be alert to the risks posed by invasive alien species and to respond rapidly when such species are detected.

Some tree species widely used in plantations and agroforestry schemes have the potential to become invasive. *Azadirachta indica*, *Cedrela odorata* and *Leucaena leucocephala*, all of which are highly useful, valued and widely planted, can become troublesome weeds and cause serious economic damage. *Acacia mangium* has become an aggressive invasive species in some parts of Southeast Asia, although elsewhere it apparently has not moved beyond its plantation areas.

Chromolaena odorata and *Mikania cordata* are two invasive species that can become persistent nuisances and threats to biodiversity in disturbed (eg logged) forest by dominating soil seedbanks; they benefit from a lack of co-evolved predators and are favoured by repeated fire.

Some invasive species choke out the regeneration of indigenous species and might become so dominant that their removal in forest restoration requires massive investment. Prevention is vastly less expensive than eradication and should focus on limiting the transfer of propagules (via, for example, the tires of trucks moving from infected areas) and avoiding the use of unsterilized soils or pots.

Principle 11: Maintaining functioning forest ecosystems

A fundamental goal of SFM is to maintain ecosystem functions at both the stand and landscape scales. Biodiversity plays an important role in ecosystem functioning and its conservation contributes to maintaining yields of timber and other forest products and services over the long term.

An important argument for why forest managers should conserve biodiversity is that it will help ensure the healthy functioning of their forests. In the long run, forests will produce more valuable products and will be more resistant to external changes, including climate change, if they retain as much of their natural biodiversity as possible.

Guideline 43: Ecological knowledge should be improved and applied to ensure that forest management enhances or maintains biodiversity and thus ensures forest functions such as pollination, seed dispersal and nutrient cycling. The ecology and habitat requirements of species of both commercial and conservation concern need to be understood and addressed in forest management planning.

Conservation and research organizations should undertake more work on the ecology and habitat requirements of species of both conservation and commercial interest. These organizations should provide forest management planners with information on the special habitat requirements of species. During the testing of the draft guidelines it became evident that a number of larger industrial forest organizations are already working with trained ecologists to increase the body of ecological knowledge in their forests. This should be encouraged.

PRIORITY ACTIONS

Government agencies, research institutions, conservation NGOs, timber companies and forest managers should:

- Adopt, as a fundamental principle, the idea that as much indigenous biodiversity as possible should be retained in tropical production forests
- Facilitate and encourage ecological research in tropical production forests, including the establishment and maintenance of long-term forest biodiversity monitoring plots
- Encourage research on the ecology and habitat requirements of species of conservation and commercial interest
- Collaborate on the design of studies that will yield new knowledge for application in addressing important biodiversity management questions
- Collaborate to collect, synthesize, analyse and share data on forest biodiversity based on permanent forest plots, inventories and other sources and make these accessible to forest planners, forest managers and other stakeholders
- Encourage ecological research on species assemblages, since this is likely to be more useful to forest managers than more focused studies on individual species
- Assist forest managers to apply research results to forest management

Guideline 44: Special management consideration should be given to species that are strongly interactive or play a key role in the ecology of other species or have important influences on the overall ecology of a forest and the survival of other species.

There is much scientific argument about the existence and role of keystone species in forests. It is clear, however, that some species do have significant impacts on the survival of other species, such as by performing pollination or seed-dispersing functions. Such species should receive special attention from managers and should be monitored. Some conservation organizations maintain databases that can provide good baseline information on the status and distribution of such species.

Young elephants in Bayanga, Central African Republic.

PRIORITY ACTIONS

Government agencies, research institutions, conservation NGOs, timber companies and forest managers should:

- Identify and give special protection to species that perform ecological functions vital to the long-term maintenance of commercial species and to the maintenance of biodiversity features of high conservation value
- Raise awareness among forest workers and managers about the existence and importance of species that play key roles in the ecology of other species or of the forest as a whole

Guideline 45: Particular sites and areas of forest and other habitats that provide important ecological functions should be identified and special measures taken to ensure their protection.

Within any tropical production forest there are certain habitats or features, such as wetlands, salt licks and caves, that are of special importance for biodiversity. Such areas need particular attention in forest land allocation and forest management. Some conservation NGOs have attempted to develop criteria for identifying such high conservation value forests but it has proven difficult to do so in ways that are suitable for all the local conditions and interests that exist in tropical forests. Attempts to develop national definitions of high conservation value forests are under way in several countries and are encountering similar difficulties. Ultimately, the identification of areas requiring special management should occur through normal processes of forest management planning (provided they meet the requirements set out in these guidelines).

PRIORITY ACTIONS

All relevant stakeholders should:

- Identify and give special protection to areas that are identified as providing important ecological functions
- Ensure that forest management in areas identified as providing important ecological functions is adapted to maintain these values

Guideline 46: The fire ecology and fire susceptibility of tropical production forests should be understood and biodiversity considerations included in fire management measures.

Fire poses a significant challenge for biodiversity conservation and sustainable use, particularly in the face of climate change (Box 8). Knowledge of the fire ecology of forests should be used in developing management plans. Such plans should identify fire-prone areas and specify the fire management practices to be applied, such as very low impact harvesting methods. The *ITTO Guidelines on Fire Management in Tropical Forests* provide an excellent basis for addressing fire-related issues in management planning.

Measures to manage fuel loads and fire risk should be a permanent part of the forest management process and fire suppression measures should be available in anticipation of fire events. Fire prevention is generally much cheaper than fire suppression and efforts to prevent fire are therefore a wise investment.

Forest managers and other stakeholders should develop training programs for community organizations on integrated approaches to agricultural practice, forest management and the wise use of fire.

PRIORITY ACTIONS

Forest managers and other relevant stakeholders should:

- Ensure that the fire ecology of a forest is understood and knowledge of the likely consequences of fire built into biodiversity conservation and sustainable use plans
- Use reduced impact logging to reduce fire risk and maintain unlogged buffers to protect fire-sensitive stands
- Use the ITTO *Guidelines for Fire Management in Tropical Forests* in developing forest management plans and measures to prevent and suppress forest fire
- Develop training programs for community organizations on integrated approaches to agricultural practice, forest management and the wise use of fire

8 Forest fires: prevention and control

The risk of fire in tropical forests can discourage landholders from investing in tree-based land-use systems. For instance, one out of every two forest fires in the Brazilian Amazon is spread accidentally from a neighbouring agricultural field. Fire impoverishes the forest and increases the probability of new fires, which lead to a cycle of further impoverishment and increased fire risk. Forest fires cause economic losses of timber, game, vines for construction, medicinal plants, fruits and other non-timber products. They can also harm society by provoking respiratory ailments, interrupting power supplies and causing airport closures. Fires also increase forest-based greenhouse gas emissions. Additional measures that can be taken to combat fire include:

- testing and improving existing local techniques and social arrangements to reduce fire risks and damage;
- encouraging the design and implementation of community fire management, which can distribute the costs and benefits of investments in fire prevention and control more equitably;
- quantify the economic losses caused by fire in order to leverage an increase in fire prevention and control;
- propose mechanisms for harmonizing inconsistent public policies and encouraging less fire-prone development pathways; and
- incorporate fire prevention and control measures in agricultural credit, subsidy and incentive programs.

Part III Implementing the guidelines

During 2006 and 2007, ITTO and IUCN collaborated to critically evaluate a draft version of these guidelines in Brazil, Indonesia, Guyana and Cameroon; feedback was also received from several other countries. The aim was to test the practicability of the measures proposed in the guidelines and to identify obstacles that might limit their implementation. The outcomes of this field evaluation suggest that:

- in many countries, the guidelines are consistent with existing forest regulations. Often, recent revisions of national legislation and harvesting regulations have strengthened biodiversity conservation and sustainable use measures;
- in several countries, measures proposed in the guidelines are currently poorly implemented. The main task, therefore, is to ensure compliance with existing laws and regulations rather than to further regulate the sector;
- many forest operators are opposed to further regulation, fearing it would increase costs and make the forest sector less competitive than alternative uses of the land. There is a risk, therefore, that further regulation would be counterproductive, encouraging the conversion of natural forests to agriculture;
- if implemented strictly, detailed surveys of biodiversity prior to harvesting and the monitoring of harvesting impacts on biodiversity – as proposed in the guidelines – would require specialized skills that are expensive and in short supply in most tropical countries. Many of the people involved in the testing considered such surveys to be unrealistic;
- in a surprisingly large number of situations, conservation NGOs are already collaborating with forest harvesting operators to conserve biodiversity in production forests. In many cases the conservation NGOs were contributing the expertise needed to conduct biodiversity surveys. This collaboration was occurring in locations where forests allocated for harvesting were known to have high biodiversity values. In several instances, international development assistance agencies were contributing to the costs of these collaborative programs;
- in no cases did either forest agencies or concessionaires contest the desirability of biodiversity conservation in tropical production forests – at issue, though, was who should meet the costs;
- some timber companies see the guidelines as another set of constraints, yet another set of rules with which they must comply. They want to know, legitimately, what the benefits are for them.
- the importance of tropical production forests for biodiversity conservation was recognized universally and the valuable role that tropical production forests could play in the achievement of national biodiversity conservation goals acknowledged; and
- in all countries in which the guidelines were evaluated in the field it was apparent that the main threats to biodiversity in tropical production forests did not come from forest harvesting but from land conversion or the illegal harvesting of forest products, especially the illegal hunting of wildlife.

The overall conclusion from the testing was that there is broad agreement on the goals of the guidelines. No one seriously contests the potential value of production forests in meeting biodiversity conservation targets but most timber harvesters believe that they should receive technical and financial assistance to help them to implement the guidelines.

Costs and benefits of biodiversity conservation in tropical production forests

Precedents exist for paying resource managers the additional costs that they must meet in order to provide environmental services for the public good. A well documented example comes from the GEF.

The GEF has developed the concept of incremental costs, using it to estimate the amount of financial support needed to meet the additional cost of providing global environmental benefits. Applied to the ITTO guidelines, such costs are a measure of the amount that timber producers must pay, over and above business as usual, to implement biodiversity conservation measures.

Two methods are available for estimating incremental cost: i) the difference between the total expenditure of the new activity and the cost-saving of the replaced activity; and ii) the extra costs of modifying an activity or adding a new activity. Generally, when complex modifications are made to business-as-usual practices (eg reduced impact logging versus conventional logging) the first method is preferred. The second method is used when new activities are undertaken in addition to those performed as business as usual (eg conducting forest inventories or recruiting new staff with specialized biodiversity skills).

An accurate estimation of incremental costs relies on baselines, which in this case would mean the cost of forest management that does not apply the guidelines. The choice of these baselines is controversial: for instance, should current illegal practices be considered a baseline, or should compliance with national regulations be assumed? Should the baseline assume that certification will be sought, or should the cost of meeting certification standards be considered an incremental cost?

The field evaluation of these guidelines demonstrated the uncertainties around estimates of incremental costs (as well as potential benefits). In particular, activities are often interconnected (eg partnerships with external organizations and field surveys), so estimating their costs separately is difficult. Costs also depend on local conditions (eg the value of timber foregone in set-asides or the prevalence and causes of illegal activities). Few, if any, general rules can be applied to the nature of biodiversity conservation costs – whether they are incremental or business-as-usual – because they depend on national regulations, involvement in certification processes, and the standards followed by certification bodies.

It is therefore more useful to establish a classification of the incremental costs within key categories. Such a classification serves two purposes: making the guidelines easier to understand from the point of view of their implementation costs; and helping to design effective incentives. Several categories are proposed below.

Biodiversity surveys and inventories: Costs are related to the recruitment or training of staff to identify biodiversity resources, the purchase of equipment, data processing, etc.

Opportunity costs resulting from reduced or modified timber production: The analysis of data collected during field studies, or the direct application of some of the priority actions proposed in the guidelines, can reduce the volume of timber harvested and/or change the mix of species harvested. Opportunity costs arise because income is lost while fixed costs are largely unchanged.

Transaction costs: The application of the guidelines will often require greater collaboration between timber producers and external organizations, other nearby timber producers within the same forest landscape, and local populations. This collaboration generates transaction costs: identifying and meeting stakeholders; negotiating the terms of the collaboration or partnership; and putting the collaboration into effect.

Modification of forest management plans: Applying the guidelines will almost inevitably require the modification of existing forest management plans – to provide for, for example, set-asides, improved roading, and changed species mixes. Such modification will impose costs on the forest manager.

Implementation of new activities or modification of standard activities: Many of the actions set out in the guidelines carry significant costs.

Incentives

The following is a list of incentives that, where they do not distort international trade and are applied according to international trade rules, might be applied to help meet the costs described above and therefore encourage implementation of the guidelines. Few are possible in the absence of strong technical institutions and good governance.

Market-like mechanisms: Timber producers could seek financial assistance from the international donor community or discerning timber buyers to apply the guidelines if they prove they can conserve specific biodiversity resources while producing timber. Payment schemes for ecosystem services, including biodiversity conservation, at a national or international level, could help meet the incremental costs of biodiversity-friendly forest management.

Tax systems: The tax regime will influence decisions by timber producers with respect to biodiversity conservation. Taxes on the production or sale of timber tend to be more consistent with biodiversity conservation than those on forest land, which can create an incentive to increase production and a disincentive to set aside conservation areas. Alternatively, taxes could be reduced for species with lower commercial value or low harvesting rates compared to species with high commercial value, with the aim of decreasing the risk of high-grading, increasing the diversity of species included in forest inventories, and increasing investment in forest planning in order to protect small-diameter trees or secondary species. The opportunity costs of applying the guidelines could be compensated by a reduction in taxes.

Optimizing certification: In many ways the guidelines are similar in nature to the requirements of certification. Most certification schemes have flexible and rather vague ecological criteria and indicators, which can allow some operations to get certified despite poor practices. On the other hand, this flexibility opens the door to incorporating the spirit of the guidelines into certification.

The preliminary audit assessments that companies must undertake during the certification process provide auditors with an opportunity to impose activities that support biodiversity conservation. One obstacle to this is that the present competition between certification bodies tends to lead to a lax application of standards.

Reducing administrative/investment costs: In at least two of the countries in which the guidelines were tested, timber companies complained about the repeated and abusive control of their operations by officials. Superficially, the prevalence of illegal operations might seem to justify such control, but not if it hinders those companies operating legally. Regulatory relief to reduce company costs could include the removal of administrative bottlenecks, deregulation, and rewards for firms that achieve good biodiversity outcomes. Independent third-party verification could provide the guarantees required by national authorities to authorize regulatory incentives. This would be a 'win-win' initiative because it would also benefit governments by reducing the operational costs of field inspection and monitoring, increasing revenue because of greater transparency, and increasing international credibility for the nation's wood-based products. The implementation of reduced impact logging and other biodiversity-friendly forest management techniques will often require new equipment (such as wheeled-skidders). As a publicly funded incentive for improved forest management, public banks could provide low-interest loans, or depreciation rates could be accelerated to reduce the amount of profit subject to tax payments in the years following equipment purchase.

Public subsidies for knowledge generation and management: Two key components of the guidelines are training and research. Governments already help meet the costs of both through universities and research institutes, but could do more. For instance, publicly funded taxonomists could train local staff to make more complete inventories, and biologists could contribute to the design of appropriate solutions to conserve specific fauna and flora species.

Rewarding long-term commitments to forest management: Much forest degradation can be attributed to the short time horizons of timber producers; their strategies do not prioritize the regeneration of harvested species or the protection of future crop trees, focusing, rather, on maximizing short-term financial gain. Companies that perform well could be rewarded by having their concessions extended, increasing the incentive to take a longer-term approach. Such companies could also be given priority during the forest concession allocation process or, in those countries with auction systems, a premium during bidding.

Alternative fund sources: The incremental costs of many of the activities recommended in the guidelines should be eligible for funding through the GEF.

Looking to the future

Ultimately, the public must pay the cost of biodiversity conservation. Currently, however, many of the beneficiaries of biodiversity conservation pay little for it. This is of major concern to most forest operators. Although their forest management plans might account superficially for biodiversity there is almost no incentive to put the necessary measures into effect or to ensure that sub-contractors – who are paid per unit of timber produced – do so. Government regulatory agencies rarely have the resources or expertise to monitor the implementation of biodiversity commitments.

There are other reasons why biodiversity values are inadequately maintained in tropical production forests. Forest managers are rarely sufficiently trained in the skills needed to manage biodiversity. In some regions the number and skills of field foresters have declined; those with the taxonomic skills needed to assess and monitor biodiversity are particularly scarce. As a result, forest management agencies and companies have difficulty in recruiting the staff that they need to implement biodiversity conservation measures. Incentives and reward structures for taxonomic and ecological skills are inadequate to encourage their development. Some forest agencies and companies have hired biodiversity specialists from museums and herbaria, but these are in short supply and not always focused on practical forest management or applied ecology.

Scepticism about the value of biodiversity conservation in managed forests has also created problems. Despite abundant evidence, some conservation NGOs still do not believe that logging will ever yield biodiversity benefits; they think that the added costs that would be incurred in achieving biodiversity conservation and sustainable use would make natural forest management uneconomic. Certainly, logging companies have strong incentives to continue to overexploit the forest in order to keep their mills running. As timber supplies are depleted, fuel costs increase, and supplies of timber from temperate and boreal regions become more cost-competitive it is becoming harder to make a profit from tropical timber. The willingness to invest in long-term management for biodiversity or even in maintaining future timber yields is declining.

Although some success has been achieved in implementing reduced impact logging, overall its uptake has been disappointing. The prospect of certification has motivated some forest operators to introduce measures to conserve biodiversity. Ironically, many of these companies have been singled out for criticism by environmental groups and the media, while others that quietly continue with business as usual escape such criticism.

Some of the enabling conditions that must be in place to increase attention to biodiversity conservation in tropical production forests are described briefly below.

Training

It is unrealistic to expect a commercial operator to invest heavily in building up biodiversity expertise when the value of the biodiversity accrues to the public at large and not to the operator. Public-sector forest agencies therefore must develop specialist services to assess, monitor and maintain databases on biodiversity, or else form alliances with specialized institutions and contract them to provide the expertise required.

The worldwide decline in taxonomic teaching in universities must be reversed. Forestry training institutes must revise their curricula to adequately address biodiversity issues. Partnerships with research institutions and universities can help create a critical mass of knowledge about biodiversity to the extent that it starts influencing forest planning and on-the-ground management; Figure 7 provides a conceptual framework for this concept.

To expand forest inventories to account for a greater range of biodiversity, foresters need better training and tools. Participatory survey techniques should be more widely adopted and employment offered to local communities to ensure that local and traditional biodiversity knowledge is taken into account and put to good use. Public awareness of the biodiversity values of tropical production forests should be raised. Decision-makers need to be sensitized to the potential of tropical production forests to contribute to biodiversity conservation.

Incentives

The application of these guidelines requires financial incentives at the international, national and forest management unit levels. Subsidies, environmental payments, tax concessions and other options, such as those described above, should all be considered.

International assistance

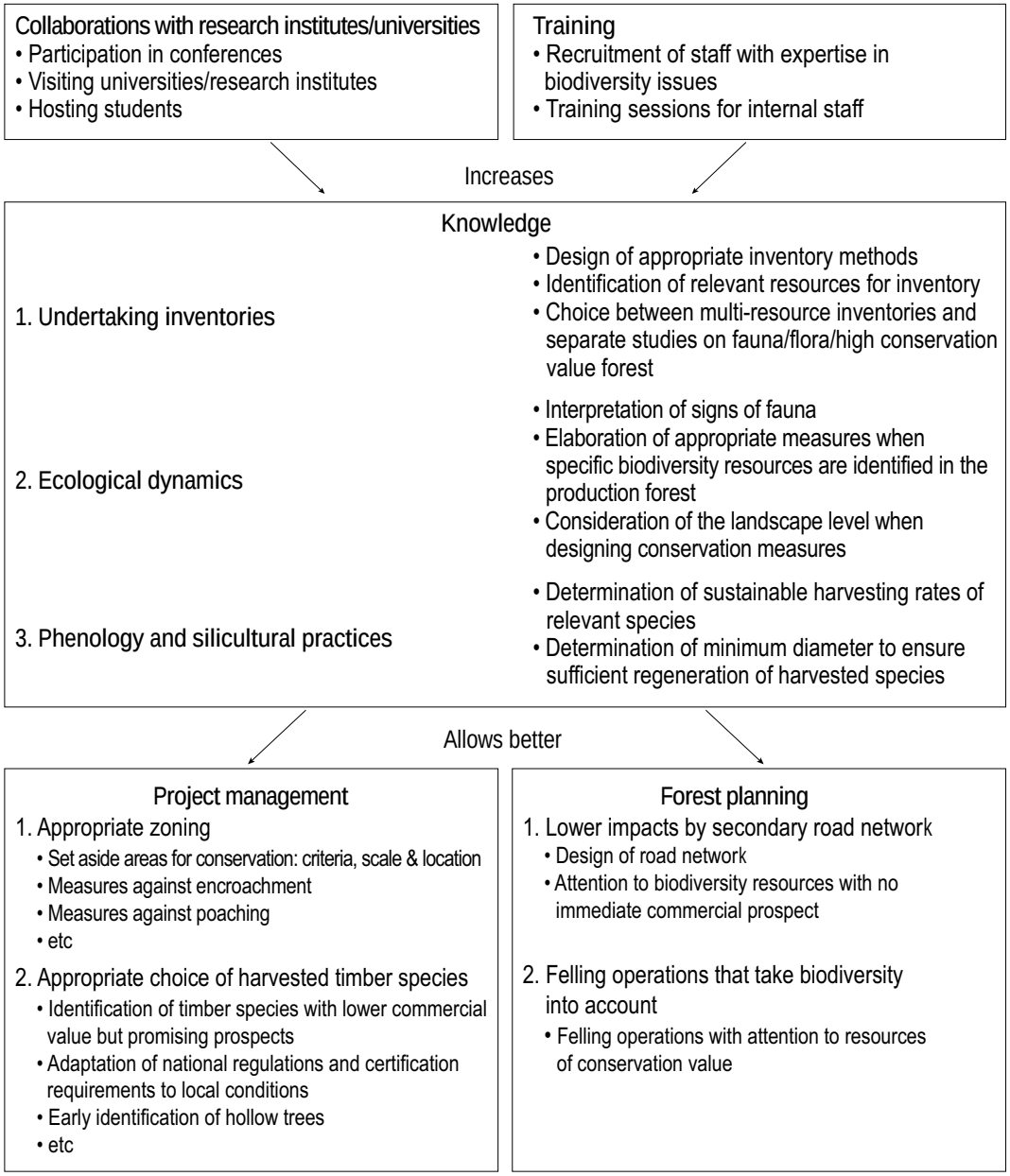
The international community has a role to play in supporting pilot programs, creating payment mechanisms in support of biodiversity conservation services, and transferring technology to tropical producer countries.

Many international agencies can also assist in the implementation of these guidelines. Research and operational bodies all have contributions to make. New partnerships and alliances are needed. Some of the most interesting innovations involve international conservation NGOs working closely with concessionaires and private forest owners to help improve their biodiversity management.

ITTO brings together the managers of many of the world's most biodiverse tropical forests. By continuing to support the implementation of SFM, and by involving as broad a range of stakeholders as possible, it can play a pivotal role in the process of reconciling biodiversity and production aims in tropical forests.

IUCN is a union of members, many of whom are concerned with tropical forest conservation. IUCN will continue to communicate amongst its members and to encourage them to adopt the Guidelines. IUCN can help forge alliances amongst the different specialized agencies with the required competencies and to mediate dialogues amongst the industry, governments and conservation organizations to promote better conservation management of forests.

Figure 7. A conceptual framework for the role of improved biodiversity knowledge on forest planning and management



References and further reading

Alder, D, Oavika, F., Sanchez, M., Silva, J., Van der Hout, P. & Wright, H. (2002). A comparison of species growth rates from four moist tropical forest regions using increment-size ordination. *International Forestry Review* 4(3): 196–205A.

Amacher, G., Brazee, R. & Witvliet, M. (2001). Royalty systems, government revenues, and forest condition: an application from Malaysia. *Land Economics* 77 (2): 300–313.

Azevedo-Ramos, C., de Carvalho Junior, O. and do Amaral, B. (2006). Short-term effects of reduced impacts logging on eastern Amazon fauna. *Forest Ecology and Management* 232: 26–35

Baillie, J., Hilton-Taylor, C. & Stuart, S. (eds) (2004). 2004 *IUCN red list of threatened species: A global species assessment.* IUCN, Gland, Switzerland and Cambridge, UK.

Billand, A. (2005). *Etude sur le plan pratique d'aménagement des forêts naturelles de production tropicales Africaines.* Association Technique Internationale des Bois Tropicaux, Paris, France.

Bull, G., Pulkki, R., Killmann, W. & Schwab, O. (2001). Exploitation coûteuse ou rentable. OIBT *Actualités des Forêts Tropicales* 9 (2).

Bullock. J., Kenward, R. & Hails, R. (2002). *Dispersal ecology*. Blackwell, Oxford, UK.

Carter, J. (1996). *Recent approaches to participatory forest resource assessment.* Overseas Development Institute, London, UK.

Cooney, R. (2004). *The precautionary principle in biodiversity conservation and natural resource management: an issues paper for policy-makers, researchers and practitioners.* IUCN Policy and Global Change Series No 2. IUCN, Gland, Switzerland.

Cronk, Q. & Fuller, J. (1994). *Invasive plants: the threat to natural ecosystems worldwide: a WWF handbook.* Chapman and Hall, London, UK.

Cubbage, F., Harou, P. & Sills, E. (2007). Policy instruments to enhance multi-functional forest management, *Forest Policy and Economics* 9 (7): 833–851.

Curran, L., Trigg, S., McDonald, A., Astiani, D., Hardiono, Y., Siregar, P., Caniago, I. & Kasischke, E. (2004). Lowland forest loss in protected areas of Indonesian Borneo. *Science* 303: 1000–1003.

Diamond, J. (1975). The island dilemma: lessons of modern biogeography studies for the design of nature reserves. *Biological Conservation* 7: 129–146.

Dykstra, D. & Heinrich, R. (eds) (1996). *Forestry codes of practice: contributing to environmentally sound forest operations.* FAO Forestry Paper 133. FAO, Rome, Italy.

Dyskstra, D. (2003). RILSIM: a financial simulation modelling system for reduced-impact logging. Paper presented at the second International Forest Engineering Conference, 13–15 May, Växjö, Sweden.

Estades, C. & Temple, S. (1999). Deciduous-forest bird communities in a fragmented landscape dominated by exotic pine plantations. *Ecological Applications* 2: 573–585 .

Euler, A. (2006). *A vegetation ecological study of floristic and structural composition of a tropical rainforest in Antimary State Forest, Acre, Brazil.* PhD dissertation.

Fahrig, L. (1990). Interactive effects of disturbance and dispersal on individual selection and population stability. *Comments on Theoretical Biology* 1: 275–299.

Fahrig, L. (2003). Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution and Systematics* 34: 487–515.

FAO (2001). *Global forest resources assessment 2000. Main report.* FAO, Rome, Italy.

Flather, C. & Bevers, M. (2002). Patchy reaction-diffusion and population abundance: the relative importance of habitat amount and arrangement. *American Naturalist* 159: 40–56.

Forman, R. (1995). *Land mosaics: The ecology of landscapes and regions.* Cambridge University Press, New York, USA and Cambridge, UK.

FSC (1996). *FSC principles and criteria for forest stewardship.* FSC, Bonn, Germany.

Gascon, C., Lovejoy, T., Bierregard, R., Malcolm, J., Stouffer, P., Vasconcelos, H., Laurance, W., Zimmerman, B., Tocher, M. & Borges, S. (1999). Matrix habitat and species richness in tropical forest remnants. *Biological Conservation* 91: 223–229.

GEF (1996). *Incremental costs*. GEF/C.7/Inf.5. GEF, Washington, DC, USA.

Gordon. J., Hawthorne, W., Reyes-Garcy, A., Sandoval, G. & Barrance, A. (2004). Assessing landscapes: a case study of tree and shrub diversity in the seasonally dry tropical forests of Oaxaca, Mexico and southern Honduras. *Biological Conservation* 117: 429–442.

Haila, Y. (2002). A conceptual genealogy of fragmentation research: from island biogeography to landscape ecology. *Ecological Applications* 12: 321–334.

Hanski, I. & Ovaskainen, O. (2002). Extinction debt at extinction threshold. *Conservation Biology* 16: 666–673.

Hanski, I. (1999). *Metapopulation ecology*. Oxford University Press, Oxford, UK.

Hengeveld, R. (1990). *Dynamic biogeography.* Cambridge Studies in Ecology. Cambridge University Press, Cambridge, UK.

Holmes, T., Blate, G., Zweede, J., Pereira, R., Barreto, P., Boltz, F. & Bauch, R. (2000). *Financial costs and benefits of reduced impact logging in the eastern Amazon*. Tropical Forest Foundation, Alexandria, USA.

Howard, P., Davenport, T., Kigenyi, F., Viskanic, P., Baltzer, M., Dickinson, C., Lwanga, J., Matthews, R. & Mupada, E. (2000). Protected area planning in the tropics: Uganda's national system of forest nature reserves. *Conservation Biology* 14(3): 858–875.

ITTO (2006). *Status of tropical forest management 2005*. ITTO Technical Series No 24. ITTO, Yokohama, Japan.

Jarvis, B. & Jacobson, M. (2006). *Incentives to promote forest certification in Indonesia.* World Bank/ International Finance Corporation, Washington, DC, USA.

Jepson, P. & Canney, S. (2001). Biodiversity hotspots: hot for what? *Global Ecology and Biogeography* 10: 225–228.

Karsenty, A., Roda, J-M., Milol, A. & Fochivé, E. (2006). *Audit économique et financier du secteur forestier au Cameroun* (draft No. 1). Ministère de l'économie et des finances du Cameroun, Yaoundé, Cameroon.

Kollert, W. & Lagan, P. (2007). Do certified tropical logs fetch a market premium? A comparative price analysis from Sabah, Malaysia. *Forest Policy and Economics* 9: 862–868.

Kumari, K. (1996). *An application of the incremental cost framework to biodiversity conservation: a wetland case study in Malaysia.* CSERGE Working Paper GEC 96-15. Centre for Social and Economic Research on the Global Environment, Norwich, UK.

Kumari, K. & King, K. (1997). *Paradigm cases to illustrate the application of the incremental cost assessment to biodiversity*. GEF, Washington, DC, USA.

Küper, W., Sommer, H., Lovett, J., Mutke, J., Linder, H., Beentje, H., Rompaey, R., Chatelain, C., Sosef, M. and Barthlott, W. (2004). Africa's hotspots of biodiversity redefined. *Annals of the Missouri Botanical Garden* 91 (4).

Laurance, W. (1991). Ecological correlates of extinction proneness in Australian tropical rain forest mammals. *Conservation Biology* 5: 79–89.

Laurance, W., Lovejoy, T., Vasconcelos, H., Bruna, E., Didham, R., Stouffer, P., Gascon, C., Bierregaard, R., Laurance, S..& Sampaio, E. (2002). Ecosystem decay of Amazonian forest fragments: a 22-year investigation. *Conservation Biology* 16: 605–618.

Lindenmayer, D., & Franklin, J. (2002). *Conserving forest biodiversity. A comprehensive multiscaled approach.* Island Press, Washington, DC, USA.

MacArthur, R. & Wilson, E. (1967). *The theory of island biogeography.* Princeton University Press, Princeton, USA.

McGarigal, K., Cushman, S., Neel, M., Ene, E. (2002). FRAGSTATS: Spatial pattern analysis program for categorical maps. University of Massachusetts, Amherst, USA.

Meijaard, E., Sheil, D., Nasi, R., Augeri, D., Rosenbaum, B., Iskandar, D., Setyawati, T., Lammertink, M., Rachmatika, I., Wong, A., Soehartono, T., Stanley, S. & O'Brien, T. (2005). *Life after logging: reconciling wildlife conservation and production forestry in Indonesian Borneo.* CIFOR and United Nations Educational, Scientific and Cultural Organisation, Jakarta, Indonesia.

Morgan, D. & Sanz, C. (2007). *Best practice guidelines for reducing the impact of commercial logging on great apes in western equatorial Africa.* Occasional papers of the IUCN Species Survival Commission no 034. IUCN Gland, Switzerland.

Patterson, D. (1987). The principle of nested subsets and its implication for biological conservation. *Biological Conservation* 1: 323–334.

Pulliam, H. (1988). Sources, sinks and population regulation. *American Naturalist* 132: 652–661.

Putz, F., Blate, G., Redford, K., Fimbel, R. & Robinson, J. (2001). Tropical forest management and conservation of biodiversity: an overview. *Conservation Biology* 15: 7–20.

Sheil, D. & Wunder, S. (2002). The value of tropical forest to local communities: complications, caveats and cautions. *Conservation Ecology* 6 (2).

Sheil, D., Rajindra, P., Basuki, I., Van Heist, M., Syaefuddin, Rukmiyati, Sardjono, M., Samsoedin, I., Sidiyasa, K., Chrisandini, Permana, E., Angi, E., Gatzweiler, F., Johnson, B. & Akhmad (2002). *Exploring biological diversity, environment and local people's perspectives in forest landscapes: Methods for a multidisciplinary landscape assessment.* CIFOR, Jakarta, Indonesia.

Sist, P., Dykstra, D. & Fimbel, R. (1998). *Reduced-impact logging guidelines for lowland and hill Dipterocarp forests in Indonesia*. CIFOR Occasional Paper No 1. CIFOR, Bogor, Indonesia.

Southwood, T. (1977). Habitat, the templet for ecological strategies. *Journal of Animal Ecology* 46: 337–365.

Southwood, T. (1988). Tactics, strategies and templets. *Oikos* 52: 3–18.

Van der Hout, P. (1999). *Reduced impact logging in the tropical rain forest of Guyana. Ecological, economic and silvicultural consequences*. PhD dissertation, University of Utrecht, published as Tropenbos Guyana Series 6.

Vermeulen, S. & Koziell, I. (2002). *Integrating global and local values: a review of biodiversity assessment.* IIED Natural Resources Paper 3. International Institute for Environment and Development, London, UK.

Wethered, R. & Lawes, M. (2005). Nestedness of bird assemblages in fragmented Afromontane forest: the effect of plantation forestry in the matrix. *Biological Conservation* 123: 125–137.

Wong, J., Thornber, K. & Baker, N. (2001). Resource assessment of non-wood forest products: experience and biometric principles. *Non-Wood Forest Products* 13. FAO, Rome, Italy.

Wong, J. (2000). The biometrics of non-timber forest product resource assessment: A review of current methodology. Background paper prepared for Forestry Research Programme project ZF0077. Unpublished.

Wunder, S. (2006). Are direct payments for environmental services spelling doom for sustainable forest management in the tropics? *Ecology and Society* 11 (2).

Wright, D., Patterson, B., Mikkelson, G., Cutler, A. & Atmar, W. (1998). A comparative analysis of nested subset patterns of species composition. *Oecologia* 113: 1–20.

Young, A., Boshier, D. & Boyle, T. (eds) (2000). *Forest conservation genetics: principles and practice*. Commonwealth Scientific & Industrial Research Organisation, Melbourne, Australia.

Glossary

Adaptive management	The process by which research and learning is continually incorporated in management planning and practice. Specifically, it is the integration of design, management and monitoring to systematically test assumptions in order to adapt and learn
Biodiversity	See *biological diversity*
Biological diversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
Bushmeat	Meat derived from the hunting of birds, mammals and reptiles, especially in dense forest areas. The term originated in West and Central Africa, where hunting for small game provides a significant proportion of the animal protein consumed by both rural and urban populations
Carbon sequestration	The removal and long-term storage of carbon from the atmosphere
Certification	See *forest certification*
Civil society	The totality of civic and social organizations and institutions that form the basis of a functioning society
Conversion	Human-induced change in land use from forest to non-forest
Ecosystem	All plants, animals and microorganisms in an area together with their physical environment, interacting as a functional system
Ecosystem approach	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way
Ecosystem management	The integrated management of an ecosystem
Endemic species	A species native to and restricted to a particular geographic area
Enrichment planting	The planting of desired tree species in modified natural forests or secondary forests or woodlands with the objective of creating a high forest dominated by desirable species
Fauna	All the animal life of a particular region or time
Flora	All the plant life of a particular region or time
Forest	Land spanning more than 0.5 hectares with trees higher than five metres and a canopy cover of more than 10%, or trees able to reach those thresholds in situ. It does not include land that is predominantly under agricultural or urban use
Forest agency	In these guidelines, a term used to encompass the full range of governmental bodies with jurisdiction over forests and forestry. It includes forest ministries, departments, regional or state forest services, and natural resource and environmental agencies with responsibility for forests. See also *government agency*

Forest certification	A voluntary process by which the planning and implementation of on-the-ground forestry operations are audited by a qualified, independent third party against a pre-determined standard designed to ensure that operations are environmentally sustainable and socially acceptable. Forest operations found to conform to the standard are issued a certificate, which can then be used to demonstrate the legality and sustainability of their wood products
Forest landscape restoration	A process by which forests are managed or restored in ways that contribute to broad environmental and developmental objectives at a landscape scale
Forest management	The processes of planning and implementing practices for the stewardship and use of forests aimed at achieving specific environmental, social, economic and/or cultural objectives
Forest management unit	A clearly defined forest area, managed to a set of explicit objectives according to a long-term management plan
Forest manager	A person or group of people responsible for the planning and implementation of forest management. A forest manager might be a private forest owner, a member of a community, or employed by a forest agency, timber company or NGO
Forest plantation	Forest of introduced or native species established through planting or seeding
Government agency	In these guidelines, a term used to encompass the full range of governmental bodies concerned with land-use planning or the development of policies relating to land use. See also *forest agency*
Habitat	The area or environment in which an organism or ecological community normally lives or occurs
High conservation value forest	An area of forest containing one or more high conservation values that might require special attention in forest management activities. It might include a forest area that: a) contains globally, regionally or nationally significant concentrations of biodiversity values (eg endemism, endangered species, refugia) and/or large landscape-level forests, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance; b) are in or contain rare, threatened or endangered ecosystems; c) provide basic services of nature in critical situations (eg watershed protection, erosion control); d) are fundamental to meeting the basic needs of local communities (eg subsistence, health) and/or critical to local communities' traditional cultural identities (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities)[5]
High forest	Ecologically mature forest
Incremental cost	1) Under the GEF, the amount of financial support needed to meet the additional cost of providing global environmental benefits; 2) The amount that timber producers must pay, over and above business as usual, to implement biodiversity conservation measures such as those suggested in these guidelines

[5] After FSC (1996)

Indicator	A quantitative, qualitative or descriptive attribute that, when measured or monitored periodically, indicates the direction of change in aspects of a forest system
Indicator species	A species whose presence, absence or relative wellbeing in a given environment is indicative of the health of its ecosystem as a whole
Invasive alien species	An alien (non-native) species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens biological diversity
Invertebrate	An animal lacking a vertebral column (backbone)
Landscape	1) A cluster of interacting ecosystem types; 2) A mosaic of land cover types and their institutional and cultural context
Landscape ecology	The science of understanding the ecological consequences of management at landscape scales so as to provide guidance on the implications for biodiversity conservation of different landscape-scale management options
Lekking site	Place where males of a species meet to simultaneously display acoustical, visual or chemical signals to attract females for mating purposes
Logging	See *timber harvesting*
Non-wood forest products	1) All forest products except timber and wood, including products from trees, plants and animals in a forest area; 2) Products of biological origin other than wood derived from forests, other wooded lands and trees outside forests
Parataxonomist	A field-trained biodiversity collection and inventory specialist recruited in the local area
Population	A group of interbreeding individuals of animals or plants occupying a particular area and usually separated to some degree from other similar groups
Production forest	See *tropical production forest*
Protected area	An area of land and/or sea especially designated for the protection and maintenance of biodiversity and of associated natural and cultural resources
Reduced impact logging	A suite of techniques designed to reduce the impact of logging on a forest
Residual stand	Forest that remains after timber harvesting
Silviculture	The art and science of producing and tending forest by manipulating species composition, structure and dynamics to fulfil given management objectives
Species assemblage	A collection of species making up a community of organisms in a given habitat
Stakeholder	Any individual or group directly or indirectly affected by, or interested in, a given resource

Succession	Progressive change in species composition and forest structure that occurs through natural processes over time
Sustainable forest management	The process of managing forest to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undesirable effects on the physical and social environments
Threatened species	A species included in the IUCN Red List of Threatened Species and therefore considered by IUCN to be threatened with extinction or endangered (see Annex IX)
Timber company	A commercial enterprise that carries out timber harvesting operations or sub-contracts such operations. It might also be involved in downstream wood-processing such as milling and manufacturing
Timber harvesting	The removal of timber from the forest for utilization, comprising felling and sometimes further initial processing (eg de-limbing, cross-cutting) and extraction
Tropical production forest	In these guidelines, the term used to denote natural and planted tropical forests in which timber production is an objective. Used synonymously with *tropical timber production forest*
Tropical timber production forest	See *tropical production forest*
Wildlife	Non-domesticated native animals

Annex I Great apes in the forests of Central Africa

In 2007, scientists working with IUCN's Species Survival Commission published guidelines for the conservation of great apes in West Equatorial African forests[6]. These are complementary to the present guidelines, providing specific recommendations for reducing the impact of commercial logging on wild apes. The text below is adapted from the IUCN guidelines; many of the recommendations can be implemented within the framework of reduced impact logging at little or no additional cost.

Best Practice Guidelines for Reducing the Impact of Commercial Logging on Great Apes in Western Equatorial Africa

More than 50% of the range of chimpanzees and gorillas in western equatorial Africa is allocated to logging concessions. This is more than double the amount of their range (17%) in protected areas. The expansion of mechanized logging throughout the forests of equatorial Africa can be seen either as the most widespread and long-term threat to wild gorilla and chimpanzee populations, or as an opportunity to extend protection measures well beyond national parks.

The advantages to logging companies of rapidly implementing measures to conserve remaining great ape populations include: 1) demonstrating to local government, forest certification officials, conservation organizations and timber consumers that timber companies are committed to being good corporate citizens by preserving ape populations and their habitats; 2) increasing the efficiency of timber harvesting operations through better planning; 3) reducing financial and time costs for ecological monitoring in timber concessions through increased collaboration with conservation and/or academic partners who study great apes; 4) increasing legal compliance through the education of timber company employees about wildlife regulations, particularly those related to poaching; and 5) reducing risks to timber company staff of infection by the Ebola virus and other pathogens which can be transmitted to humans from wild apes.

Using wildlife survey data to enhance ape conservation

Great apes can serve as indicator species for assessing the performance of activities aimed at maintaining biodiversity in timber concessions. Timber extraction and associated activities can alter ape habitats, affect food resources, disrupt social groups, fragment populations, and increase exposure to disease. Hunting pressure can increase due to improved access to remote forests via the transport networks constructed by timber companies. Even low hunting pressure adversely affects apes because they are long-lived species with slow rates of reproduction. It is important, therefore, to consider both the direct and indirect effects of logging on resident ape populations when developing strategic plans for maintaining high conservation value forests. Wildlife surveys conducted by timber companies during forest inventories can provide valuable information for adaptive management that favours the conservation of great apes. In many large tracts of forest in western equatorial Africa, the status of chimpanzee and gorilla populations is unknown or information is outdated. Data from ape survey and monitoring efforts in timber concessions will help to address this void and provide essential information for strategic conservation planning.

Gorillas and chimpanzees are likely to be affected in different ways by timber extraction and associated activities, which makes them complementary indicator species for alleviating the direct and indirect threats of logging. Chimpanzees tend to be more affected than gorillas by the ecological impacts of timber exploitation. Gorillas benefit from the rapid growth of herbaceous plants that occurs in gaps created by timber extraction but are generally more affected than chimpanzees by increased hunting pressure.

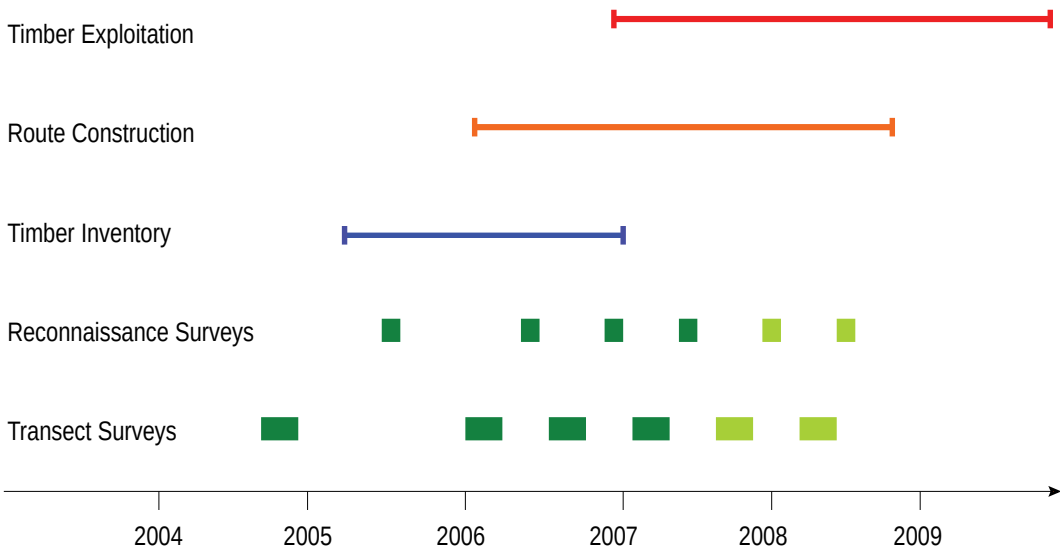
[6] Morgan and Sanz (2007).

Establishing ape population monitoring programs

Monitoring is critical for detecting changes in ape populations. Repeat surveys are needed before, during and after timber extraction to distinguish between changes caused by logging and normal population fluctuations due, for example, to variations in food availability between seasons and years. A robust monitoring system will provide a reliable indication of the impacts of logging on the apes, act as an important wildlife management presence on the ground, and relay to the competent authorities real-time information on human-related threats such as hunting and disease. Assessments of the impact of logging on apes can be improved by monitoring control areas that will not be logged, either within the concession or in a neighbouring protected area; this will help in assessing population trends and the implementation of an adaptive management program. Ape survey and monitoring programs should be well planned, with carefully formulated objectives and standardized methods. The cost of such surveys varies depending on the region and methodology employed, but experience in northern Congo suggests it falls in the range US$50–US$65 per kilometre traversed. The number of kilometres required depends on the encounter rate of ape signs in the region.

Figure 8 shows the timeline of logging operations adjacent to the western border of the Nouabalé-Ndoki National Park in northern Congo and great ape monitoring efforts by the Goualougo Triangle Chimpanzee Project. Dark green markers indicate reconnaissance and transect surveys that have already been completed in the logging zone, and light green markers indicate surveys that are currently under way. The surveys have been conducted in collaboration with the Congolese government and a local timber company but independently financed and executed by conservation scientists.

Figure 8. Timeline for harvesting operations adjacent to the western border of the Nouabalé-Ndoki National Park, northern Congo



Collaborating with conservation scientists

Ape surveys are extremely challenging due to the inherent complications and biases associated with collecting and analysing data in dense forests. Timber companies interested in establishing ecological monitoring programs should forge partnerships with local or international conservation NGOs. Involving conservation scientists in the design and implementation of wildlife monitoring programs has brought considerable benefits to wildlife in logging concessions in Cameroon and Congo. Involving self-financed scientists or conservation NGOs in monitoring efforts can also defray some of the financial and time costs incurred by logging companies in their long-term monitoring programs.

Taking apes into consideration during timber harvesting

Taking apes into consideration during the planning phase of timber harvesting can reduce unnecessary disruptions to their feeding ecology and socio-spatial organization. Efforts should be taken to protect the mature stems of tree species known to be important in ape diets. However, ape food preferences might differ between regions; this should be taken into account when developing site-specific initiatives to reduce the impact of mechanized logging on apes. For example, *Chrysophyllum lacourtiana* is an important food for apes in northern Congo and these trees attract large numbers of apes and elephants during their fruiting periods.

Chimpanzees and gorillas have complex social systems with a multitude of interactions, both within and between social groups in a community or population. Multiple social groups should be preserved within blocks of contiguous forest habitat to maintain the long-term viability of these ape populations. The compartment size of the forest management unit and sequence of extraction sites should be planned in ways that reduce the social disruption caused to ape groups during logging operations. Route construction should also be planned to avoid creating ecological barriers to great apes.

Eliminating poaching in logging concessions

To protect great apes, the increased illegal hunting pressures typically associated with timber operations must be controlled. The logging process can disturb local ape populations and cause their displacement or decline. Forestry teams are sometimes involved in or facilitate the hunting of gorillas and chimpanzees. By taking certain steps, timber companies can completely eliminate this threat. They can prohibit their employees from being directly or indirectly involved in illegal hunting. They can fund or subsidize regular anti-poaching patrols of both active and inactive timber concessions and around sawmills and employee camps. Such patrols would detect poachers, monitor vehicle activity, deter the transport of bushmeat, and remove snares (wire or nylon leg traps). Of particular importance are mobile armed units that conduct frequent, random and well-organized patrols to monitor active and inactive logging concessions for signs of illegal hunting activities. Prohibiting the transport of bushmeat on company vehicles has also proved effective in decreasing the prevalence of illegal hunting in timber concessions.

Snare hunting has been banned in Africa but continues to be used widely. Snare injuries can have debilitating and fatal consequences for gorillas and chimpanzees. Approximately 25% of the chimpanzee population in Uganda, for example, has sustained a snare injury at one time or another. The removal and destruction of snares can have immediate benefits in reducing snare injuries to wild apes and the indiscriminate killing of other species.

Detecting and reporting emergent disease outbreaks

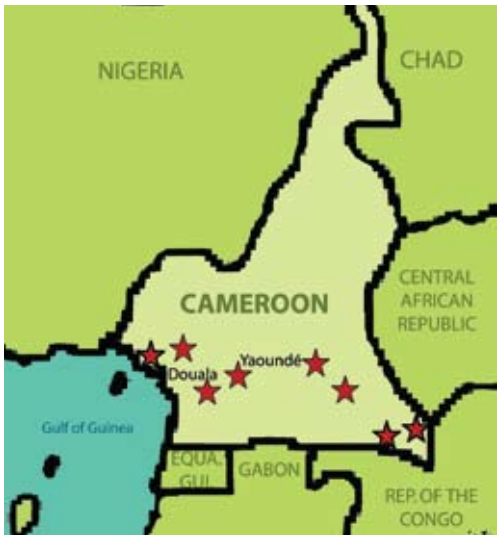
Forest managers should ensure that employees are well-informed about emerging infectious diseases and should develop protocols for detecting and reporting outbreaks of the viral disease Ebola hemorrhagic fever in logging concessions. People working in concessions are likely to be among the first to become aware of new Ebola outbreaks, either by sighting ape carcasses or through communication with hunters in the immediate area. In high-risk areas, employees must be aware of

the threat of Ebola and have the means to convey relevant information to local authorities and conservation organizations. Developing a communication network will help ensure the early detection of outbreaks and a rapid response by the appropriate health officials.

Bushmeat harvested in Africa's rainforests has always been an important and valued part of local diets. Today, a thriving trade supplies urban markets, where bushmeat products command premium prices. Logging tracks provide access to the forest for hunters and logging trucks have been used to transport the meat to cities. Conservation groups speak of a bushmeat crisis and foresee the day when the primates and antelopes that make up the bulk of the trade become extinct. The bushmeat trade has already severely depleted some species but recent studies have shown that other species are quite hard to hunt and when their populations are reduced the hunters move on or turn to other prey. Some species exist in viable populations near major cities, even under heavy hunting pressure.

A female gorilla from the Chimanuka group, Kahuzi Biega National Park, Democratic Republic of the Congo.

Annex II Cyber-tracking in Cameroon



Cameroon's forests are the home of significant populations of gorillas, chimpanzees, elephants and bongos – species of global conservation interest – as well as a high diversity of other primates and of birds. A higher proportion of tropical forests are in national parks and wildlife reserves in Cameroon than in any other tropical country. Conservationists working in the field in Cameroon, however, were quick to realize that for the conservation of many wildlife species the managed production forests were at least as important as the parks and reserves. Indeed, studies of gorillas and elephants have shown that the disturbance caused by selective logging favours a rich understorey of plants that are a favourite food of both gorillas and elephants. Bongos and other forest antelopes also thrive in the areas where logging has opened up the canopy and allowed the development of the rich undergrowth that provides them with shelter and food.

In several locations in Cameroon, conservationists and loggers have started to collaborate to improve biodiversity conservation outcomes. Some of the best examples are in southeastern Cameroon – one of the country's richest areas for biodiversity – much of which is still covered in dense forest. Apart from small areas of local agriculture, the entire landscape is divided into protected areas, national parks and a few small areas of community forests. Almost everyone depends in one way or another on these forests for some part of their livelihoods.

The Worldwide Fund for Nature (WWF) has recognized that conservation must target the entire landscape – both the protected and managed forests – and contribute to the alleviation of poverty. The minority Baka people who inhabit the forests in southeastern Cameroon are of particular concern. They are highly dependent on the forest and have considerable traditional knowledge, but find it difficult to integrate into modern society. Many people now feel that the traditional rights of the Baka need to receive more attention in the allocation of forest land and in sharing the benefits of exploitation.

WWF has collaborated with a number of international biodiversity research organizations in field research on various species of wildlife and flora of conservation concern. One early discovery was that elephants fitted with radio transmitters within protected areas were often found to spend more of their time in the concessions than in the parks. A considerable body of knowledge on the wildlife in concessions has accumulated and was available for the testing of these guidelines.

Many of the timber concessions in Cameroon market much of their timber in Europe. In the past decade European markets have become more demanding in terms of forest certification. This provided an opportunity for WWF to enter into close collaboration with several concessions in improving their management so that they could achieve internationally recognized certification. These concessions now have qualified biodiversity specialists on staff and are incorporating many biodiversity conservation measures into their planning and operations. It is now common for forest survey teams to be equipped with cyber-trackers – specialized geographic information system units fitted with screen icons

representing species of conservation concern. When one of these species is observed, the field worker simply presses the elephant or gorilla icon; the coordinates of the observation can then be downloaded into a computer at the logging camp. In this way a database on the frequency and distribution of these iconic species is developed that can be used to assess trends over time.

Several concessions are now adopting reduced impact logging, setting aside areas of special habitat for wildlife, retaining arboreal bridges over logging roads for primates and other tree-dwelling animals, and policing the activities of their staff to prevent them from hunting or trading in wildlife products. Pragmatism has led WWF and the concession operators to conclude that subsistence hunting of relatively common species for local consumption can be tolerated, but strict measures are taken to prevent the use of log trucks in the bushmeat trade. Some concessionaires have built butcheries, and cattle are trucked in from savannas in the north to provide alternative sources of meat for company staff. Others are bringing in fish from the coast.

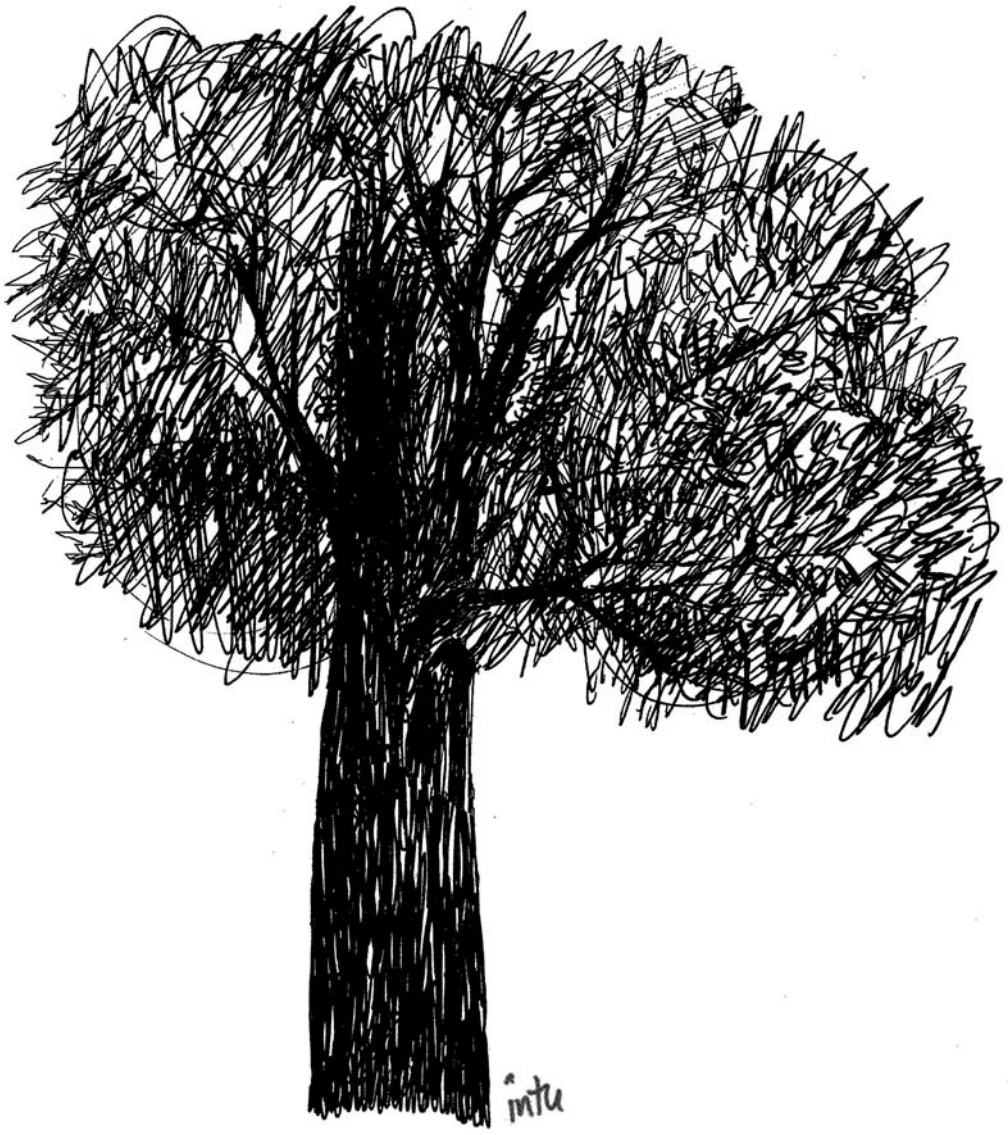
Another interesting conservation initiative has been the development of safari hunting for some scarce forest species. Sport hunters will pay high prices to hunt a bongo or forest buffalo. These species are easier to hunt in logging concessions; the roads there can be used for access and the species concerned tend to concentrate in recently logged areas. Local people, especially the Baka – with their intimate knowledge of the forest – find employment in these hunting camps. A bongo shot by a rich foreign hunter can put a large sum of money into the local economy – the same animal killed for local consumption has little monetary value. Hunting quotas are strictly controlled and the local people have an incentive to protect species so that hunters will have a better chance of finding them. WWF has helped set up local committees to manage the hunting and to ensure that the profits from hunting fees are invested in local infrastructure such as schools, clinics and wells.

A Baka woman collects plantain in the Libongo area, Cameroon.

Much has been achieved in southeastern Cameroon to reconcile biodiversity conservation with timber extraction and the improvement of local livelihoods. WWF models show that the best balance between conservation and development can be achieved through an appropriate mix of production and protected areas. Protected areas alone contribute little to the local economy – few tourists are prepared to make the journey to these very remote areas. Logging generates much more employment and contributes to the construction and maintenance of local infrastructure.

Attempts are being made to increase the role of local people in forest management through the establishment of community forests.

Early efforts have needed to confront a lack of local capacity and investment capital and to build up weak local institutions. Villages are unused to handling the amounts of money involved. The formalities and planning required to establish a community concession are also a barrier for many local people. Progress is being made, however, and some Baka now have their own concessions, often subcontracting logging operations to the larger concession operators in the area. Community concessions tend to occur in more densely settled and accessible areas, sell their timber in domestic markets, and harvest more intensively than large commercial concessions. Community concessions struggle to achieve the standards needed for certification and often have little incentive to attempt this. Conserving rare primates and elephants in community concessions is likely to be more of a challenge than conserving them in the remoter large concessions. On the other hand, the sustainable harvesting of local bushmeat could be an attractive option for community forests if access by outside hunters can be controlled.



Annex III Biodiversity in Indonesian production forests

The core of the Indonesian Biodiversity Strategy and Action Plan adopted in 2003 is a system of 315 protected areas covering 22.6 million hectares. Although the original ITTO Guidelines for Biodiversity Conservation in Tropical Production Forests were translated into Bahasa Indonesia, it appears that only sporadic attempts have been made to implement them on the ground. Indonesian forestry regulations do, however, require concessionaires to set aside at least 300 hectares of their concession areas for the protection of flora and fauna. There are criteria to ensure that these set-asides are located in areas of high conservation value. In plantation forest estates, companies are obliged to retain 10% of their concession area as natural forest. These rules have not always been well respected but APRIL, a concessionaire in the Province of Riau in Sumatra, is one of the more successful examples.

With the exception of some protected areas in Java, which are visited by large numbers of Indonesian tourists, most protected areas are neglected. Recent studies suggest that those in Borneo are losing their forest cover more rapidly than are production forests, many of which have received major investments in reduced impact logging and in protecting the forests for future logging cycles.

Biodiversity studies have been conducted and limited conservation measures taken in a number of selective logging concessions. One of the better examples is that of the 321,000 hectare Bulungan research forest in East Kalimantan. Since 1995, this area has been the site of collaboration between CIFOR, ITTO and the research agency of the Indonesia Ministry of Forestry. Scientists from the Wildlife Conservation Society, the Indonesian research agency LIPI and the United Nations Educational, Scientific and Cultural Organization's Man and Biosphere Programme have also been involved. Extensive baseline studies of biodiversity, especially birds and mammals, were undertaken in the early 1990s. Reduced impact logging was applied but it proved difficult to measure its benefits for biodiversity. The species concerned were so difficult to survey that, with a few exceptions, little impact from either reduced impact logging or conventional logging was detected. The exceptions were a few ridge-top-favouring sago palm species, which provide staple carbohydrates for local people, and the valuable timber tree *Agathis borneensis* – which were affected by logging roads located along ridges.

More detailed studies of the impacts of conventional logging and reduced impact logging on aquatic invertebrates were conducted with the collaboration of scientists from the Lausanne Polytechnic in Switzerland. Even there, the differences between conventional logging and reduced impact logging were not as pronounced as might have been expected. The major review of logging and biodiversity in Indonesian Borneo published by Meijaard et al. in 2005 (see references) is an excellent source of

information on the impact of logging on biodiversity in Asia's tropical forests. It shows that little long-term harm will be caused to most elements of forest biodiversity if good logging practices are employed.

An interesting additional set of studies in the CIFOR research forest examined the values that local people attach to biodiversity. Teams of scientists from Indonesian research institutes worked in the field with groups of local people to compare their appreciations of biodiversity. The conclusion was that local people valued biodiversity differently to the scientists, attaching particular value to certain species and communities – those that benefited them. The local people had very extensive knowledge of the distribution and ecology of the many species they used for food, fibre, medicines and condiments. They also valued the fertility of the soils under mature forests – or at least forests that had been undisturbed for many years.

Recently, some international conservation NGOs (WWF, the Nature Conservancy and Birdlife International) have formed alliances with timber companies to promote biodiversity conservation within logging concessions. There are ongoing attempts to define and map high conservation value forests based on biodiversity criteria. The Indonesian Ecolabelling Foundation has been attempting to ensure that existing regulations to protect biodiversity in production forests are observed in concessions seeking certification.

Annex IV Biodiversity in the production forests of Guyana

Guyana's forests are part of the Guyana Shield, a geological formation characterized by an ancient Precambrian continental crust. Weathering has depleted the region of soluble plant nutrients, resulting in poor soils. Many soils of Guyana's interior are composed primarily of almost pure quartz sands, in contrast to the rich sediments of the adjoining alluvial expanses of the Amazonian lowlands.

Guyana is located on the northern seaboard of the Atlantic Ocean; its population of 751,000 is concentrated predominantly on the narrow coastal plain. Approximately 75% of the country is forested, with 136,000 km^2 (66%) classified as state forests under the jurisdiction of the Guyana Forestry Commission and the remainder as Amerindian (Indigenous) land, other types of state land, or private property.

Guyana's tropical rainforests are home to a rich and varied biodiversity. For centuries they have been subject to timber production, mining, subsistence hunting and agriculture, but low population pressure and limited access to the interior have ensured that the impacts of these activities on biodiversity have been minimal.

Increased multiple use of the forest resource was always seen as integral to the country's socioeconomic development. Since the 1970s, concessions have been granted to large multinational companies for forestry and mining activities. Currently, about 50% of the state forest estate is allocated to logging concessions and a large number of mining permits have been issued.

The government recognizes that these activities could have negative impacts on biodiversity. Many initiatives have been taken to mitigate these impacts, including the preparation, through a consultative process overseen by the Forestry Commission, of comprehensive guidelines to encourage foresters to adopt better environmental best practices in the harvesting and use of forest resources. These guidelines were specifically designed to address SFM with the expectation that their implementation on the ground would also minimize negative impacts on forest biodiversity. However, the draft ITTO/IUCN *Guidelines on the Conservation of Biological Diversity in Tropical Timber Production Forests* suggested that activities additional to the Forestry Commission guidelines were needed to better guarantee biodiversity conservation. The Iwokrama International Centre for Rain Forest Conservation and Development therefore agreed to critically evaluate the ITTO/IUCN guidelines in collaboration with a community forestry group.

The Iwokrama International Centre for Rain Forest Conservation and Development

The Iwokrama Centre was established as a model to address the conservation and sustainable use of tropical rainforests globally. Iwokrama Forest covers 360,000 hectares in central Guyana bordering the Rupununi wetlands. The Iwokrama Act, 1996 states that the objective of the initiative is to: "… demonstrate that tropical rain forests can maintain biological diversity while supporting economic activity".

The forest is located about 345 km south of Georgetown in Guyana's central highlands. It forms about 2% of the Essequibo River basin, which, with all its tributaries, drains close to 80% of Guyana. Approximately 75% of the area (in the north) can be described as tropical moist forest, the remaining 25% (in the south) as tropical dry forest.

The ecology of the Guyana region is special in a number of respects. The low availability of nutrients leads to slow vegetation growth and recovery rates. Seeds from many Guyana Shield timber species are dispersed by animals: an analysis of 172 timber species found that 51% were mammal-dispersed and 21% were bird-dispersed.

Logging standards in Iwokrama Forest are high. Detailed operational planning has received considerable input from the many biologists who have worked in the forest and also from local communities. The biodiversity of Iwokrama Forest is perhaps the best documented of any tropical production forest in the world.

Reduced impact logging is being implemented and efforts are made to follow both the Guyana Forestry Commission guidelines and the FSC principles and criteria. There is a general consensus that logging as currently undertaken is not a major threat to biodiversity in Iwokrama. Nevertheless, there are issues of concern, including:

- the loss of nutrients caused by skidding whole logs. The Iwokrama ecosystems are nutrient-limited, so any additional losses are likely to bring changes in species composition and declines in productivity;
- specific conservation improvements would require a clearer identification of key biodiversity sites or species relationships and this would require even more intense ecological studies than those already undertaken (however, most large animal species are ecological generalists and the impacts of such low-level and long-cycle logging is likely to be low);
- it is unknown if the noise of logging activities affect the behaviour some species (eg in nesting and breeding); and
- there is inadequate information on the impact of skid trails and roads on wildlife movements and interactions.

The most obvious threats to biodiversity in the area are external to logging. Traditionally, local communities have employed practices to prevent the over-exploitation of resources – such as stripping bark from only part of a tree, and poisoning streams (for fishing) only once a year or less. There is concern, however, that such traditional precautions are being abandoned.

Terrapin (turtle-like reptiles) and arapaimas (large fish) have already been collected to near-extinction, while some macaws, parrots, parakeets and aquarium fish have been overexploited for the pet trade. In some places, fish-poisoning is used too frequently, and savanna fires have become more common, with impacts at the forest margins.

Animals that have declined in many places include long-lived, slow-growing species such as tapirs, primates, large ground-dwelling birds, macaws, parrots, caiman (a group of alligator-like species), arapaima and terrapin. In the wider region, the skins trade has had an impact on large cats, the black caiman, the giant river otter and howler monkeys.

The use of bright spotlights for night hunting on the roads has been a concern (tapir, deer). A decline in ducks is also noted by villagers and ascribed to hunting. Animals considered of special value to tourism include: the large cats, the harpy eagle, the arapaima, black caiman, giant river otter, the red howler monkey, the black spider monkey and other primates.

Logging by Amerindian communities

Logging within Iwokrama Forest is under the control of the Iwokrama Centre, but areas immediately to the south of the forest have been allocated as community forests. As part of the evaluation of the ITTO/IUCN guidelines, local managers of the Annai district community concession were assisted to conduct biodiversity surveys in their logging areas. The aim was to determine how biodiversity concerns could be addressed in smaller forest areas and in places where the scientific capacity and resources of a centre like Iwokrama were unavailable.

The Annai district community concession has recently been legally titled to the District of Annai as Indigenous land. Prior to this, in 2003, two state forest permits for a total of 14,579 hectares were issued to a local community NGO called the North Rupununi District Development Board by the Guyana Forestry Commission for the purpose of timber extraction. The board, which represents 16 communities in North Rupununi, including the five satellite villages of the Annai District, then created a separate subsidiary body called the Macushi Yemeken Co-operative. This body was delegated to assume responsibility for forest management and the management of the timber business. An additional 16,508 hectares of forest contiguous to the Annai district community concession but within Iwokrama Forest was also covered in the resource inventory conducted during the evaluation.

In order to develop a baseline for the resource use area, the forest management team set out to determine what biodiversity was present in the concession (and adjacent forest) and where it was located. Specifically, it aimed to:

- conduct a baseline survey to assess the presence of different species, estimate species numbers, and identify areas of high conservation value;
- using the IUCN Red List classification (see Annex IX), determine the level of international conservation interest in the species occurring in the forest; and
- identify the ecological and socioeconomic importance of wildlife and plants recorded during the baseline survey.

A forest resource inventory (management-level inventory) was conducted to evaluate the productivity of the forest. This was done using a standard 2 km x 2 km Universal Transverse Mercator grid already overlaid on the Annai concession map. Each grid intersection served as a randomly selected point for locating the primary sampling units (transects). Prior to the field work, 72 transects measuring 2 km each were pre-established in the office of the Annai concession. On each of these, 20 plots measuring 0.1 hectares each were established to record tree inventory data, including forest and soil types. In the field, transect lines were cut with cutlasses and marked with stakes and flagging tape.

The biodiversity survey was carried out by people from the surrounding villages and was therefore able to make use of local knowledge of the species present and the relationships of those species to the livelihoods of local people. Basic training in inventory methodologies, the use of geographic positioning systems, compasses and clinometers, and on tree identification was provided in the field. Survey teams were directed to record sites of spiritual and cultural significance to the local people. The booking forms used were developed by Iwokrama personnel in consultation with the survey teams.

The teams attempted to capture as much information as possible on wildlife presence by employing multiple observation methodologies: sound, sightings and signs. Wildlife data were recorded along each 2 km transect and in the 0.1 hectare tree inventory plots. Instead of a pre-established list of indicator species, field workers were requested to record all animal observations.

Phenology information was captured by including a section on the booking forms to document biodiversity within the community logging area. Although the standard forms for resource inventory recommended by the Guyana Forestry Commission cater for wildlife sightings, they do not capture phenological information (relationships of fruiting and flowering trees with wildlife); this was rectified in the adapted booking forms for a pre-determined list of plants.

Conclusions

The biodiversity survey was able to generate a preliminary list of animal species, ecological relationships and socioeconomic information sufficient for use as a baseline against which future monitoring could be assessed.

The data allow a rough estimate to be made of the numbers and kinds of animals that are present within the forest types surveyed. The survey team was able to determine various observation rates per species but was limited by the quality of the data. The surveys also confirmed local knowledge about the relationships between certain plants and animals and their value to the local people.

Annex V Measuring biodiversity in production forests in Brazil

Brazil has the world's largest expanse of tropical forests. In the past, threats to forests and their biodiversity have come mainly from agriculture in the Mata Atlantica and cattle ranching in the Amazon. Since land-clearing generated a large amount of timber, few investments were made in SFM.

In recent years this situation has changed dramatically, with increased emphasis on forest conservation and the enforcement of forest regulations. New federal laws and institutions are giving priority to the needs of biodiversity. Some states are following this with their own regulations to promote biodiversity conservation in production forests.

Brazilian policy on public production forests

In 2006 the Brazilian government approved an innovative law (Law 11.284) on the allocation of public lands in the Amazon to production forestry. It established the Brazilian Forest Service as a branch of the Ministry of Environment, a National Fund for Forestry Development, and rules for public forest concessions.

Procedures for the allocation of concessions by auctioning include specific measures related to biodiversity conservation. They state that, in addition to price, best practice and low-impact techniques will be taken into account. Moreover, at least 5% of the total forest management area must be designated as a fully protected reserve and contain representative samples of the forest ecosystems under management.

Brazilian Amazon forest's 'dynamic monitoring network'

In March 2004 the Brazilian Institute of Environment and Natural Resources (IBAMA) created the Inter-Institutional Brazilian Forests' Dynamic Monitoring Working Group. Its main objectives are to build, throughout the Amazon, a monitoring network to collect information on the growth of production forests, generate baseline data about production forest yields, promote information exchange through expert panels, and communicate existing knowledge on forest dynamics.

Continuous forest inventories are used to monitor forest change and generate information about species' composition, growth and mortality. They build on studies undertaken in the Amazon since the 1980s; there is a need, however, to increase the number of permanent sample plots to cover the full diversity of forest types.

Timber companies and fauna conservation[7]

Fauna plays an important role in forest ecosystems; animals act as pollinators and seed dispersers, for example, and also control the growth of some plants through grazing. Thus, forest managers are encouraged to see the conservation of fauna as an important factor contributing to the regeneration and recuperation of harvested areas; few managers, however, appear to have acknowledged this link. As a result, monitoring has been neither actively pursued nor adequately funded.

To encourage timber companies to care about forest health, certified timber companies and research institutes are working together to train company staff to carry out wildlife surveys. Since 1997, a team from the Amazon Institute of Environmental Research (IPAM), a Brazilian research NGO, has been evaluating the impact of logging on different animal groups. This has led to the development of simple methodologies for monitoring fauna which can be applied by logging companies. At a relatively low cost, companies collect the required data independently, maintaining the flexibility required in private business ventures. They send the data to IPAM, which is responsible for analysis and reporting. The resulting data also provide a good source of information for certification auditors. In the future, when fauna monitoring protocols are better defined, company staff will be able to generate the final reports themselves, although this will require further training or the hiring of staff with the necessary professional backgrounds. Until then, however, the company-researcher partnership has proven effective. The overall result of the research carried out to date is that the short-term impacts of logging on animals were minor.

Species richness, community structure and other characteristics in the Antimary State Forest Reserve, Acre, Brazil[8]

The Antimary State Forest is a protected area for sustainable use located in the Alto Acre region, Purus river watershed, in the southwestern Amazon Basin. It is about 100 km from Rio Branco, the Acre state capital, on the edge of the so-called Amazonian deforestation arc. As part of the Southwest Amazon ecoregion, this area is considered to have high conservation value because it still has some of the largest tracts of intact tropical rainforest in the world.

The vegetation in the region is characterized by transitional forests, especially open forests. Due to its marked seasonality and diverse climatic and edaphic conditions, the Southwest Amazon complex is considered to be a phytogeographic unit very distinct from the rest of the Amazon.

Tropical rainforests in Antimary are mostly semi-closed forests stratified into five recognized layers. In 48 samples taken during biodiversity surveys, a total of 946 plant species belonging to 326 genera and 118 families were recognized among the 14,157 individuals recorded. Figure 9 shows these species sorted into life form categories; tree species represent the major group, with 51% of all species, followed by shrubs (16%), epiphytes (11%), climbers (10%), herbs (9.9%), palms (2.6%) and bamboos (0.5%).

Understanding vegetation and its internal 'social' relationships is a key to developing strategies for conservation and sustainable use. Lowland tropical rainforest is well known to be the most diverse biome in the world. Species diversity in other areas tends to increase with a decline in climatic seasonality, with greatest diversity found in areas that have no significant annual dry period. However, it seems that this does not apply in the Antimary forests.

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[7] This example is summarized from Azevedo-Ramos et al. (2006).

[8] This example is summarized from Euler (2006).

Detailed surveys of vegetation composition in the Amazon are rare; therefore, the importance of the understorey has been seriously underestimated in Amazonian forests. Most practical forestry has been almost entirely driven by measures to protect the growth and regeneration of commercial trees, but the understorey is a functionally integral part of the forest ecosystem.

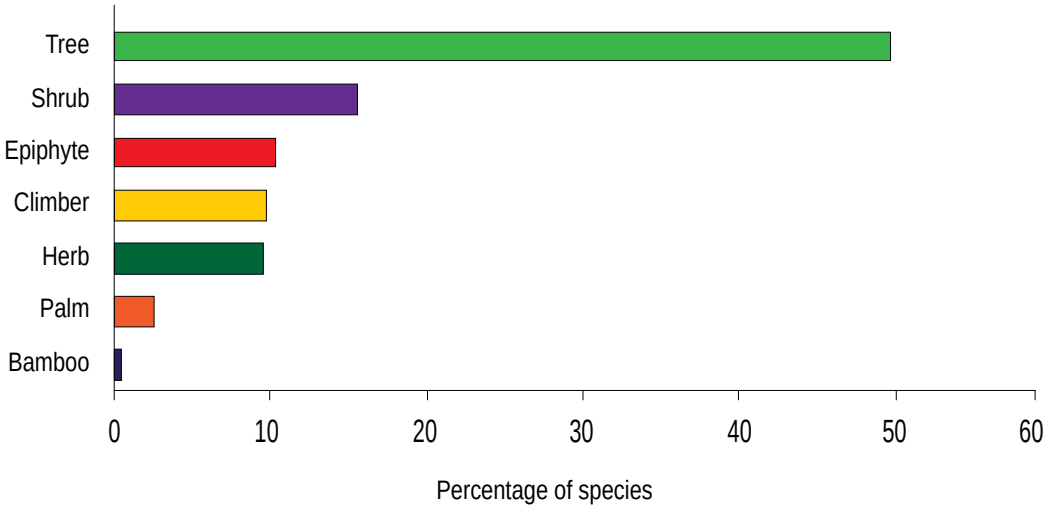
The information derived from this study of Antimary State Forest shows that forest managers in Brazil and elsewhere should be aware of some fundamental aspects of the ecology of their forests. First, a great part (49%) of the species richness in this area is in non-tree species; special attention should be given to these species. Shade-tolerant ground herbs and epiphytes such as orchids and *Araceae,* among others, will probably be affected by logging and might decrease in abundance and diversity. Measures to monitor such changes should be considered. Studies of the distribution and ecology of many rare and unique species will be needed if there is any intention of harvesting them in the future.

Considerable numbers of species are undescribed or could not be identified during the study; they could be new to science. Some are traditionally used by local communities as medicines or for religious ceremonies. Tangible and intangible values of the forest – not just timber – should be taken into account.

Biodiversity conservation in planted forests

Brazil has been a pioneer in industrial-scale plantation forestry. In their early years, the Jari plantations in Para state faced many technical problems. As knowledge of tropical plantation management improved, however, and as the most appropriate tree species were identified, these problems were surmounted and the Jari scheme has become an exemplary model of tropical plantation forestry. The scheme now includes significant areas of natural forest under sustainable management and set aside for biodiversity conservation. Several other plantation companies are now taking similar steps to conserve biodiversity in areas under their control.

Figure 9. Contribution of different life forms to total species diversity, Antimary State Forest



Note: Total number of species = 946.

Source: Euler (2006).

Annex VI Applying the 1993 guidelines in the Philippines

An ITTO project in a 75,745-hectare Timber Licence Agreement area in northern Mindanao assessed, for periods of up to 30 years after logging, the impact of forest management activities in stands under differing management intensities. The project was one of the few examples of explicit field application of the 1993 ITTO *Guidelines for Biodiversity Conservation in Tropical Production Forests.* Baseline biodiversity data from the early years of management were unavailable; instead, biodiversity was studied in plots with differing management histories and in different parts of the landscape.

Biodiversity declined abruptly in the period immediately following logging, although the decline was less marked where lower-impact harvesting was used. Species abundance and diversity recovered quite quickly after logging; the extent of the recovery was influenced by the logging method and post-logging management.

The project found that, given good levels of protection, biodiversity eventually returns to levels similar to those in undisturbed areas. The biggest long-term threat is posed by activities other than forest management – such as agricultural encroachment and illegal logging. The project concluded that an acceptable level of biodiversity decline in production forests should be determined and the necessary investments in management made to ensure that these levels are not exceeded.

Annex VII Investments in biodiversity in production forests in Malaysia

Within its permanent forest estate, Malaysia has a system of 72 permanent jungle reserves covering 23,500 hectares established with the aim of protecting the natural diversity of genotypes and species in the forest management unit. In addition, 84 forest recreational areas covering 7,000 hectares and extensive water catchment protection areas all contribute to biodiversity conservation.

Within the production forests, reduced impact logging is now widely practised. Seed trees and fruiting species are protected in residual stands. Specific measures to help conserve biodiversity are included in the Forest Department of Peninsula Malaysia's reduced impact logging guidelines.

Biodiversity conservation in an acacia plantation in Sarawak

In the State of Sarawak about 1.5 million hectares of mostly degraded forest are earmarked for tree plantations as part of the state's development plan, with species such as *Hevea brasiliensis* (rubber) and *Acacia mangium*. Grand Perfect Sdn Bhd, a consortium of three local timber companies, has received a contract from the Government of Sarawak to develop an *A. mangium* plantation in the Bintulu Division, central Sarawak.

To address the full range of socioeconomic and environmental issues involved in implementing the project, Grand Perfect Sdn Bhd has established three departments: production, community development, and conservation. The conservation program seeks to maintain high biodiversity values within the planted forest zone, minimize biodiversity losses due to development, and integrate biodiversity conservation with the economic and social needs of local communities. The planted forest zone encompasses more than 250 longhouses of the Iban, Beketan and Punan ethnic groups.

Three types of land use are planned in the project area: state lands earmarked for *A. mangium* planting (230,000 hectares), indigenous customary rights and former shifting cultivation lands (110,000 hectares), and conservation zones (150,000 hectares) that contain high conservation value or other kinds of ecologically important forest. Two large set-asides, the Bukit Sarang and Binyo-Penyilam conservation areas (approximately 12,000 hectares and 18,000 hectares respectively) contain numerous endemic, rare or endangered species (orchids, begonias, snails, lizards, birds, mammals, etc). Indigenous customary lands and other former shifting cultivation sites, which contain forests of varying ages and are rich in non-timber trees such as those bearing wild fruits, provide additional feeding opportunities and habitat for wildlife.

As described below, Grand Perfect Sdn Bhd's Conservation Program involves a threefold strategy.

Production and operations: The entire planted forest zone has been mapped and the geographic information system-based Integrated Plantation Management System used to plan, implement, monitor and control activities in every planted compartment. A landscape-scale map shows the mosaic pattern of natural and planted forests, and large and small conservation set-asides (river buffers and wildlife corridors). This pattern is recreated on a smaller scale within all planted compartments. A set of conservation rules has been developed to ensure that clearing, planting and infrastructure development minimize erosion and siltation and minimize or exclude the use of herbicides. At present, pesticides are not used. Water quality is monitored regularly (ie quarterly), both before and after planting. All relevant data on planting material (eg provenance, stocking density, date of planting, and area planted or unplanted), and flora and fauna (eg distribution, abundance, vulnerability, use) are incorporated in the Integrated Plantation Management System. All operational requirements have been developed with a broader state or national application in mind.

Community development: Continuing communication with more than 200 traditional longhouse communities in the planted forest zone is in place to ensure that forest resources are harvested sustainably; for example, a collaborative study is under way on the distribution, abundance and harvest levels of the bearded pig (*Sus barbatus*), one of the main sources of protein in the area. Community education and awareness efforts are based on the provision of natural history guides to local schools and longhouses and discussions of wild resource use. Longhouse residents are employed as field assistants in taxonomic inventories and technical training is provided to encourage the employment of locals in future biodiversity assessment and monitoring.

Conservation: Biological inventories are conducted through long-term partnerships with local, regional and international scientific institutions. Memoranda of understanding to build comprehensive species databases for the planted forest zone have been signed with the Smithsonian Institution's National Museum of Natural History and Conservation Research Center, Field Museum of Natural History, Lund University, Singapore Herbarium, the Raffles the Museum of Biodiversity Research, Nanyang Technological University, Universiti Malaysia Sarawak, and the Universiti Tuanku Abdul Rahman. All fieldwork is done in cooperation with the Sarawak Forest Department and the Sarawak Forestry Corporation, with which results are shared. The Malaysian Nature Society and the Sarawak Nature Society have been invited to join in these efforts and are supported by Grand Perfect Sdn Bhd through its corporate membership. Meanwhile, the company has been working with institutions like the Sarawak Timber Association to build capacity in areas such as human resources training, fire management, and nursery management.

The project will eventually produce 5 million tonnes of industrial wood per year and simultaneously play a crucial role in biodiversity conservation in the state.

Annex VIII Mapping biodiversity in the forests of Ghana

Based on an intensive floristic survey the Ghana Forestry Commission is implementing a comprehensive forest protection strategy for the country's 1.64 million hectares of managed forest reserves. The objective is to arrest the erosion of the forest's genetic diversity and its environmental protection functions.

Between 1990 and 1992 Ghana carried out an extensive botanical survey of its high forest zone. This established a database of forest plant distribution to be used in planning forest protection and management. The botanical survey was based on over 600 samples spread throughout the high forest zone and was combined with forest inventory data. Information was also collected on the history and management of forest reserves. An index of global biodiversity (the Genetic Heat Index) was developed for all forests and used as a basis for prioritization.

The inventory mainly provided data for assessing standing populations of timber species, but certain patterns in the data have implications for biodiversity conservation. For example, even common timber trees might be of conservation concern. By classifying common trees into guilds, trends in the response of the forest to various types of disturbance can be monitored. The surveys included Ghana's endemic plants and identified centres of endemism within the high forest zone.

Based on these surveys a set of forest protection guidelines was developed and is being operationalized through manuals of procedures and a timber logging manual. The forest protection guidelines ensure biodiversity protection at two levels – within the forest management unit, and at larger spatial scales. In total, 4.4% of Ghana's forest reserve area is now dedicated to the conservation of rare species, ecosystems and economic trees. At the level of the management unit, protection is aimed at: 1) selected individual plants, especially trees; 2) small clusters of trees and their understories in otherwise deforested areas; and 3) forests in sensitive parts of the landscape which are too small or impermanent to be catalogued at the national level.

Globally rare species are protected wherever they occur. Protection in the form of a 'reduced yield' formula is also provided for species that have suffered from overexploitation in the past, while some species with very small populations or vulnerable ecology, such as *Tieghemella heckelii,* can only be exploited under special permits.

The rules for landscape-scale protection are implemented through a manual of procedures for strategic planning. The following areas are recorded and clearly identified in district-level strategic plans for forest reserves:

globally significant biodiversity areas: representative areas (whole or partial forest reserves) that contain a high concentration of globally rare species and/or rare forest types and are therefore of high conservation value; and

provenance protection areas: established for the protection of populations of heavily exploited species. Such areas are required to ensure that the full genetic diversity of species, including any locally adapted provenances, is maintained.

Annex IX IUCN categories for rare and endangered species

How do species enter the Red List and who decides?

Approved experts assess species based on five quantitative criteria and then classify the species into one of 9 categories in the IUCN Red List.

What do the categories mean?

Of the categories, three are considered to be "threatened categories" (Critically Endangered, Endangered and Vulnerable). Species in these categories are threatened with global extinction and currently, 16,119 species are assessed as threatened.

What are the decisions based upon?

The criteria are based on a combination of biological factors including rate of decline, population size and distribution, and area of geographic distribution (range). For more detail see the Red List Categories and Criteria Booklet Version 3.1.

The categories defined

- **Extinct (ex)**
  A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat at appropriate times throughout its historic range have failed to record an individual.
- **Extinct in The Wild (Ew)**
  A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times throughout its historic range have failed to record an individual.

The threatened categories:

- **Critically Endangered (CR)**
  A taxon is Critically Endangered when it is considered to be facing an extremely high risk of extinction in the wild.
- **Endangered (EN)**
  A taxon is Endangered when it is considered to be facing a very high risk of extinction in the wild.
- **Vulnerable (VU)**
  A taxon is Vulnerable when it is considered to be facing a high risk of extinction in the wild.

- **Near Threatened (NT)**
  A taxon is Near Threatened when it does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future without ongoing conservation measures.
- **Least Concern (LC)** A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
- **Data Deficient (DD)**
  A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
- **Not Evaluated (NE)**
  A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.
- NOTE: **Critically Endangered (Possibly Extinct)**: This is not a new Red List category, but is a flag developed to identify those Critically Endangered species that are in all probability already Extinct but for which confirmation is required (for example, through more extensive surveys being carried out and failing to find any individuals).

Annex X Principles, guidelines and actions for the conservation of biological diversity in tropical production forests, by indicative stakeholder group

PRINCIPLE *Guideline* Priority action	Indicative stakeholder group[9]					
	Government	Forest managers	Private sector	Civil society	Research and learning institutions	Other relevant stakeholders
1. SOVEREIGNTY AND SOCIETAL CHOICE						
1: National, regional and local biodiversity strategies, plans and regulations that are based on national and local priorities should be reflected in the management of tropical production forests						
Ensure that forest management plans comply with all national biodiversity laws and plans	✓					
Ensure that the customary laws and practices of local communities are taken into consideration in land-use legislation and planning processes and prior to the designation of production forests	✓					
Make biodiversity information widely available during processes of forest land allocation	✓					
Use electronic and print media to make biodiversity plans, strategies and laws widely known	✓					
2: Biodiversity goals and targets for tropical production forests should be developed with the involvement of all relevant stakeholders with particular attention to the needs and priorities of local communities						
Ensure that biodiversity conservation and sustainable use goals for production forests are included in national, regional and local strategies, plans and regulations	✓					
Mobilize the capacity of NGOs and specialized biodiversity institutions for biodiversity surveys	✓					
Improve methods for consultation with and the participation of civil society, especially local communities, in setting biodiversity conservation and sustainable use goals, strategies and priorities	✓					
Involve all groups with special knowledge of biodiversity in setting priorities	✓	✓			✓	✓
Strengthen national capacity to conduct biodiversity inventories and prepare maps	✓					✓

[9] These groupings summarize the stakeholders identified in the main body of the text. See main text for greater detail and supporting information.

PRINCIPLE *Guideline* Priority action	Indicative stakeholder group					
	Government	Forest managers	Private sector	Civil society	Research and learning institutions	Other relevant stakeholders
2. INTERNATIONAL COMMITMENTS						
3: International commitments for the conservation of genes, populations, species and assemblages of species or habitats should be reflected in the legal and regulatory frameworks guiding the allocation and use of land for production forestry						
Establish a participatory process to ensure that biodiversity conservation commitments made internationally are widely supported domestically	✓					
Strongly encourage collaboration between responsible agencies in implementing international commitments	✓					
Promote the adoption and dissemination of information on, and support the implementation of, relevant international biodiversity-related commitments	✓					
Ensure that sufficient biodiversity expertise exists on staff, or that such expertise is readily available, to review conservation-related commitments made internationally	✓					
Work closely with forest agencies to ensure that all national and international commitments are known to forest planners and operators	✓					
Promote appropriate training activities to enhance the knowledge and skills of government agency staff responsible for the fulfilment of international agreements related to biodiversity conservation	✓					
4: Special measures will often be required when species and populations that are internationally recognized as rare, threatened or endangered occur in or adjacent to forest management areas						
As part of an overall effort to promote good forest conservation and monitoring practices, pay particular attention to the management of species or habitats that are internationally recognized as rare, threatened or endangered		✓				
Consult with scientific and technical authorities on the species to be protected to identify appropriate conservation measures		✓				

PRINCIPLE *Guideline* Priority action	Indicative stakeholder group					
	Government	Forest managers	Private sector	Civil society	Research and learning institutions	Other relevant stakeholders
3. POLITICAL COMMITMENT, POLICIES AND LAWS						
5: The value of biodiversity as a vital component of ecosystems and a key element of local livelihoods should be demonstrated and communicated to all stakeholders, including decision-makers						
Use creative means to raise public and political awareness about biodiversity values, including providing opportunities for stakeholder gatherings and delivering information about the economic roles of biodiversity and tropical forests	✓				✓	✓
Ensure that local biodiversity values get adequate attention in valuation studies and decision-making processes	✓					✓
Sensitize all stakeholders to the importance of biodiversity conservation and sustainable use	✓	✓				✓
6: Appropriate policies, laws and regulations should be developed and implemented to ensure that biodiversity interests are adequately addressed in the management of tropical production forests						
Encourage multi-stakeholder involvement in the formulation of policies, laws and regulations related to production forests	✓					
Ensure the effective implementation of policies, laws and regulations relating to biodiversity in production forests through such actions as providing adequate funding and staffing of key programs and units, seeking to diversify sources and sustain funding, reaching out to stakeholders in civil society and the private sector, and coordinating among all relevant agencies	✓					
Play a major role in reviewing proposed changes in policies, laws and regulations and in monitoring their implementation				✓		
Ensure that all relevant decision-makers are accountable for the implementation of conservation commitments relating to tropical production forests				✓		
4. LAND USE AND SPATIAL PLANNING						
7: National land-use planning processes and forest and environmental laws should explicitly address issues of biodiversity conservation and sustainable use in forests at all spatial scales						
Ensure that national biodiversity action plans or similar biodiversity conservation initiatives are reflected in land-use or spatial plans at all scales	✓					

PRINCIPLE *Guideline* Priority action	Indicative stakeholder group					
	Government	Forest managers	Private sector	Civil society	Research and learning institutions	Other relevant stakeholders
Ensure that there is a process, established in law or regulation, that is transparent and allows for full public participation in forest land allocations and captures local values, including those of Indigenous and forest-dwelling people	✓					
8: Inconsistent or contradictory land-use policies and laws at national and sub-national levels that conflict with biodiversity conservation and sustainable use or do not support SFM in general should be identified, reviewed and modified						
Identify, review and modify policies, laws or subsidies outside the forest sector that are unfavourable to biodiversity conservation and SFM	✓					
5. DECENTRALIZATION, FOREST TENURE AND NATURAL RESOURCE ACCESS RIGHTS						
9: Local communities should have the right to use biodiversity to meet their economic and cultural needs and should be involved in its management and protection. Clearly demarcated and defined tenure and resource use rights might benefit biodiversity by providing local people with incentives for conservation and sustainable use						
Encourage the conservation of biodiversity and the sharing of benefits derived from its use	✓	✓			✓	✓
Involve local people in the creation, design, negotiation and implementation of legal forest governance mechanisms	✓					
Encourage and regulate community and small-scale forestry, and collaborative and joint forest management agreements in ways that provide incentives to conserve biodiversity	✓					
Encourage arrangements between communities and private enterprises that favour SFM and biodiversity conservation	✓					
Provide safeguards for biodiversity in local forest management schemes	✓					
10: Arrangements regarding forest ownership and use at the landscape scale should be favourable for the conservation of forest biodiversity						
Promote the clear demarcation of forest ownership and biodiversity-favourable access rights for local people	✓					
Maintain databases on forest ownership and use at a landscape scale		✓				
Devise and implement mechanisms to help coordinate the actions of forest owners, users and managers across landscapes to best ensure the maintenance of sufficient high-quality connected habitat for species, populations of species, and species assemblages of conservation interest		✓				✓

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6. INCENTIVES						
11: Managers of tropical production forests should be compensated for the incremental costs of biodiversity conservation measures						
Review international experiences in the use of innovative mechanisms to pay forest owners and managers for the ecosystem services their forests provide and the effects of such mechanisms on the conservation of biodiversity	✓					
Support pilot schemes to introduce payments for ecosystem services in tropical production forests	✓					
Consider the introduction of such schemes on a wider scale	✓					
Encourage potential donors and consumers of ecosystem services to contribute to such schemes	✓	✓	✓	✓	✓	✓
12: Independent voluntary forest certification should be recognized as a way of encouraging biodiversity conservation in production forests						
Promote increased emphasis on biodiversity conservation in certification processes	✓		✓	✓	✓	✓
Ensure that forest owners and managers benefit from forest certification	✓	✓	✓	✓		✓
Facilitate certification by participating in the development of standards and related participatory processes, providing objective information on all available and appropriate schemes, building local capacity to certify, and identifying resources for technical support and financing	✓	✓	✓	✓	✓	✓
Promote greater transparency in forest management practices	✓	✓	✓	✓	✓	✓
13: Where they do not distort international trade, subsidies and credits should be made available to offset the costs of biodiversity conservation in tropical production forests. Subsidies and credits that favour deforestation or forest degradation should be identified and progressively eliminated						
Where appropriate to specific country situations, identify and eliminate subsidies and credit schemes that favour non-forest uses of forest lands	✓					
Create mechanisms for the exemption or reduction of taxes for forests managed in ways that promote biodiversity conservation and sustainable use	✓					
Ensure that subsidy and credit schemes take into account the value of the forest biodiversity that might be lost as a result of such schemes	✓					

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Take biodiversity conservation values into account in financial analyses of forest-related investments						✓
Create special credit programs with simplified rules to encourage biodiversity conservation in forest management projects						✓
Consider the provision of funding through ITTO to help support the cost of biodiversity conservation and sustainable use in tropical production forests						✓
14: Governments should make use of international payment/financial mechanisms to support and offset the incremental costs of conserving biodiversity values and use these as an incentive to encourage biodiversity conservation and sustainable use in tropical production forests						
Explore financial mechanisms to favour products sourced from forests in which biodiversity conservation measures are in place						✓
Explore mechanisms for making direct payments for the ecosystem services provided by tropical forests						✓
Provide financial support to assist managers of tropical production forests to meet the costs of surveys, monitoring and other measures needed for the conservation of biodiversity						✓
7. KNOWLEDGE, LEARNING, TECHNOLOGY TRANSFER AND CAPACITY BUILDING						
15: Relevant government agencies, forest managers, universities, research agencies and other organizations should collaborate in the development of systems for the collection, storage and processing of, and improved access to, existing and new data on biodiversity in tropical production forests						
Train more ecologists, taxonomists and parataxonomists and provide them with career opportunities	✓					✓
Establish, restore and maintain libraries and reference collections to support the biodiversity conservation efforts of forest agencies	✓					✓
Improve the availability of information on biodiversity in tropical production forests	✓					✓
Make existing information on the presence and distribution of biodiversity from regional zoning surveys, conservation management plans and forest management plans available in databases	✓					✓
Train forest managers in biodiversity conservation and sustainable use practices	✓					✓

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16: Governments, universities, research agencies and conservation NGOs should collaborate to produce manuals, guides and other material for communicating the underlying concepts, objectives and values of biodiversity in tropical production forests to forest managers and field personnel, key stakeholders and the media in language that is understandable, relevant and useful for all stakeholder groups						
Develop communication strategies emphasizing the importance of tropical production forests for the conservation of biodiversity	✓			✓		
Produce user-friendly field manuals containing maps, lists of species, and information on the benefits of biodiversity conservation in tropical production forests and how best to support it	✓			✓		
Make use of modern print, electronic and visual media to communicate biodiversity concepts and priorities in easily understood terms	✓			✓		
Produce more educational, training and information materials in local languages to assist in effective communication with rural stakeholders	✓			✓		
17: Biodiversity conservation and sustainable use in the complex ecological, social and economic settings that frequently characterize tropical production forests requires skills in adaptive management based on sound data and knowledge of forest conditions derived from monitoring and from communication with all stakeholders						
Ensure that forest managers are trained and motivated to seek locally appropriate approaches to biodiversity conservation and sustainable use	✓			✓		
Encourage collaboration between conservation NGOs and timber companies to adapt management practices to suit local conditions	✓			✓		
Ensure that appropriate monitoring systems are in place that will inform management practices over time	✓			✓		
18: The successful dissemination and uptake of innovative approaches to the conservation and sustainable use of biodiversity in tropical production forests requires alliances and partnerships between organizations with complementary knowledge and skills						
Foster greater collaboration between timber companies, technical agencies and research institutions	✓		✓	✓	✓	
Encourage education and research on biodiversity in tropical production forests	✓		✓	✓	✓	

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19: Low-cost monitoring programs for biodiversity in tropical production forests that serve the needs of forest managers should be developed and conducted in ways that facilitate learning and adaptive management and that make information on achievements and failures widely available. Parataxonomists can provide valuable support to biodiversity assessment and monitoring						
Encourage the development of improved methods for monitoring biodiversity in tropical production forests	✓					✓
Involve concerned stakeholders in monitoring processes	✓					✓
Explore alternative biodiversity mapping and monitoring methods, including participatory community-based approaches for mapping biodiversity of particular importance to local communities	✓					✓
Provide long-term incentives and financial resources for biodiversity monitoring in tropical production forests	✓					✓
20: More capacity for biodiversity conservation in tropical production forests is needed in technical agencies, planning departments and timber companies and among local forest owners and managers						
Provide training opportunities in taxonomy for forest management personnel who will work in tropical production forests	✓		✓	✓		
Encourage trained staff to spend time surveying and monitoring biodiversity as part of their normal work	✓		✓	✓		
Encourage the development of networks of field practitioners to share information on their experiences	✓		✓	✓		
Create mechanisms for the formal recognition and valuation of traditional knowledge, particularly related to the botanical identification and use of forest species	✓		✓	✓		
Encourage the creation of specialized courses and training activities in tropical forest taxonomy, ecology and biodiversity management	✓		✓	✓		
Encourage the transfer of knowledge and technology on biodiversity conservation methodologies and measures to producer countries	✓		✓	✓		
8. MANAGING TROPICAL PRODUCTION FORESTS AT A LANDSCAPE SCALE						
21: The management of different types of production and plantation forest within the larger landscape has a major influence on biodiversity in that landscape						
Plan the allocation of tropical production forest and the development of forest infrastructure at a landscape scale	✓					

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Plan harvesting blocks in ways that do not disrupt the continuity of mature forests		✓				
Retain natural unlogged refugia adjacent to or within harvesting blocks		✓				
22: The restoration of native vegetation on degraded sites should be planned to provide a diversity of successional vegetation types, increase the connectivity of forest patches, and allow the dispersal of plants and animals, thereby helping to ensure the viability of populations at landscape and forest management unit scales						
Incorporate biodiversity conservation goals in the planning of large-scale reforestation or forest landscape restoration activities		✓				
Plant native species on degraded land to increase habitat and to provide opportunities for the movement of biodiversity between fragmented natural forest patches		✓				
Create corridors of habitat between forest patches by: maintaining intact forest along streams and rivers; retaining canopy 'bridges' over roads and taking other measures to facilitate animal movement, such as building tunnels under roads;ensuring that roads do not impede water movement at stream crossings; and revegetating degraded land		✓				
23: Private and community forest owners need technical support to ensure that their activities are consistent with biodiversity conservation objectives						
Understand the importance of many small forest holdings for biodiversity conservation at the landscape scale	✓					
Ensure that the managers of small or community forests understand and respect long-term needs for biodiversity conservation	✓					
Assist community forest owners and managers to support activities that are consistent with biodiversity conservation objectives	✓					
9. BIODIVERSITY CONSIDERATIONS AT THE FOREST MANAGEMENT UNIT LEVEL						
24: Biodiversity should be given a prominent place at all stages of the preparation and implementation of forest management plans						
Define biodiversity goals at all stages of the preparation and implementation of forest management plans		✓				

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Ensure that technical information on biodiversity is available to forest management planners	✓				✓	
Ensure that biodiversity conservation is dealt with explicitly in manuals, codes of conduct and guidelines related to the implementation of SFM	✓				✓	
25: All forest management activities affect biodiversity. Forest management must ensure that changes do not impact negatively on biodiversity features identified as having special value						
Identify and monitor biodiversity values that should be protected against excessive change during forest management		✓				
26: Forest management plans should include information on the presence and conservation status of plants, animals and habitats of special conservation concern						
When developing forest management plans, encourage collaboration with museums, herbaria, environmental agencies and conservation NGOs to assemble baseline information on biodiversity resources		✓				
In the preparation of forest management plans, consult with local people/communities and ensure that their traditional knowledge of biodiversity is taken into account		✓				
Incorporate baseline information on biodiversity and forest ecology in the forest management plan		✓				
Ensure that forest management plans provide for biodiversity monitoring and that management will be responsive to the results of that monitoring		✓				
Ensure that forest management plans include measures to protect local biodiversity values		✓				
Ensure that forest management plans include provisions to address specific biodiversity issues such as genetic conservation areas for commercial tree species		✓				
Ensure public disclosure of the biodiversity information used in the development of forest management plans		✓				
27: Actual, potential and emerging threats to biodiversity must be anticipated and contingency plans prepared to ensure that, when needed, technically sound responses can be put rapidly into place						
Plan and implement systems for identifying and responding to present and probable threats to biodiversity		✓				

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Establish contingency plans and clear communication pathways to help deal with emerging threats to biodiversity		✓				
Ensure that monitoring systems and protocols established for tropical production forests include assessments of actual and emerging threats to biodiversity within and adjacent to those forests		✓				
28: Biodiversity conservation objectives should be clearly and explicitly identified for each area of forest under management. These objectives should recognize and reflect the biodiversity values and possible tradeoffs amongst key stakeholders, including local communities						
Make the biodiversity priorities of a tropical production forest as explicit as possible by listing species, habitats and populations to be maintained		✓				
Monitor changes in these biodiversity priorities		✓				
Involve local people in participatory monitoring of important biodiversity features		✓				
29: The preparation of harvesting plans, including stock maps at the compartment level, should take into consideration the local occurrence of species or habitats of special conservation concern						
Ensure that pre-logging inventory teams include biodiversity specialists such as ecologists, taxonomists/ parataxonomists, botanists and zoologists, particularly in areas of high biodiversity value		✓				
Support pre-logging inventories by providing biodiversity specialists, particularly in areas of high biodiversity value				✓	✓	
Collaborate to build the capacity of field staff to monitor biodiversity by providing training and appropriate communication materials for the field identification of commercial tree species and other forest biodiversity	✓		✓	✓	✓	
30: Reduced impact logging should be used in tropical production forests						
Apply reduced impact logging		✓	✓			
Retain buffer strips along water courses		✓	✓			
Ensure that silvicultural treatments do not place important biodiversity features at risk		✓	✓			
Ensure that roads and skidding trails do not block watercourses or impede drainage		✓	✓			

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31: Special precautionary measures are required to protect populations, and maintain the within-species variability, of the most valuable timber species						
Assess the need for special measures to encourage the retention of viable populations of seed trees and maintain the genetic diversity of commercially important species		✓				
Ensure that the silvicultural requirements of target tree species are known and applied		✓				
Promote research on the conservation genetics and ecology of commercially important species with the aim of providing useful guidance to forest planners and managers		✓				
Encourage the establishment and maintenance of permanent forest sample plots and other monitoring systems to better understand long-term forest dynamics, regeneration, and within-species genetic variability with a special emphasis on actual and potentially valuable tree species		✓				
32: Hollow trees, although generally of low commercial value, should be retained, as they provide important habitats for a wide range of animal species						
Retain hollow trees in harvest operations		✓				
33: Unnecessary nutrient losses from the forest ecosystem and impacts on soils should be minimized						
Minimize soil disturbance and loss during forest management operations by following reduced impact logging practices		✓				
Debark trees in the forest unless there are sound commercial or ecological reasons for not doing so		✓				
34: Disruption of canopy cover might be important in allowing the regeneration of light-demanding species but this should be balanced by the need to retain canopy connectivity for canopy-dwelling animals and to reduce fire risk and the exposure of open ground to rain and sun						
Ensure that decisions on the extent of canopy opening take into account impacts on biodiversity		✓				
35: Forestry operations can encourage the introduction and spread of invasive alien species and measures should be taken to minimize this risk						
In reforestation or enrichment planting activities, use weed-free seed and sterilized potting soil to prevent the accidental introduction of invasive species		✓				

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Prior to entry into tropical production forests, ensure that shoes, equipment and vehicles are free of propagules of potentially invasive alien species		✓				
Take measures to eradicate invasive alien species that become established		✓				
Assist forest managers by providing management-relevant information on the prevention and control of invasive alien species	✓					
36: Measures should be taken to avoid unsustainable levels of hunting and the gathering of NTFPs						
Assess the level of dependence that local communities have on bushmeat and seek ways of reducing this	✓		✓	✓		✓
Collaborate to increase awareness among forest-dependent people and the private sector of the risks posed to biodiversity by unsustainable hunting or NTFP extraction	✓		✓	✓		✓
Compile information on globally, nationally or locally threatened species that are commonly hunted or gathered in forests and make it available in appropriate formats and in local languages and dialects	✓		✓	✓		✓
Determine the drivers of the bushmeat trade at national and international levels and increase consumer access to domestically raised meat	✓		✓	✓		✓
Through participatory processes, establish hunting zones and employ local people and private companies to help control these areas	✓		✓	✓		✓
Allow, at sustainable levels, subsistence hunting for bushmeat and the subsistence extraction of other NTFPs from tropical production forests and, when it enhances the livelihoods of forest-dependent people, the commercial harvesting of these products	✓					
Establish local rules to regulate hunting to protect sites that are important for wildlife breeding and to restrict hunting and NTFP collection activities for species of conservation concern, especially during periods of the year that are critical for their reproductive success	✓					
Monitor and regulate the commercial exploitation of bushmeat and NTFPs	✓					

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Prevent the use of wire snares and high-calibre firearms	✓					
Create opportunities for local people to manage wildlife and NTFPs for local use	✓					
Provide forest employees with meat and fish obtained from sustainable sources			✓			
37: Forest managers and other stakeholders should take special measures to mitigate increases in human-wildlife conflicts that might arise from logging activities						
Consider, in forest management plans, potential human-wildlife conflicts that could arise from logging activities and take appropriate measures to prevent their occurrence		✓				
Take measures to avoid conflict when timber harvesting reduces the availability of the biodiversity required by other forest users		✓				
Assist local people to manage wildlife conflicts caused by their forestry or biodiversity conservation and sustainable use activities			✓			
10. BIODIVERSITY CONSERVATION IN PLANTED FORESTS						
38: Planted forest establishment should focus on previously deforested or other degraded sites and not replace natural forest habitats of conservation concern						
Preferentially establish planted forests on degraded sites in need of rehabilitation	✓	✓	✓			
Take measures to protect features of high biodiversity value, especially when natural forest is to be converted to plantation forest	✓	✓	✓			
Promote research, technologies and innovative strategies and methods to develop planted forests on degraded forest lands	✓	✓	✓			
39: Large-scale planted forests can provide a forest matrix within which areas of high conservation value can be protected and managed						
Encourage the setting aside of representative natural forest or other natural vegetation types within the plantation estate and, where possible, the restoration of natural forests on appropriate sites	✓					

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Ensure that plantation forest developers retain natural habitats along watercourses and take other steps, such as those set out elsewhere in these guidelines, to maximize biodiversity conservation in industrial plantation developments	✓					
Undertake rigorous and comprehensive impact assessments that consider the biodiversity value of an area to all relevant stakeholders		✓	✓			
Set aside biodiversity reserves within large-scale plantation schemes		✓	✓			
Retain natural habitats along watercourses within their plantation estates		✓	✓			
40: Management systems that favour natural processes and native species and enhance the productivity and resilience of the planted forest should be developed						
Encourage research to develop innovative economical and effective silvicultural practices to enhance the biodiversity values of planted forests		✓	✓			
Where economically viable, adjust silvicultural practices to favour local biodiversity in planted forest stands		✓	✓			
Reduce pesticide and herbicide use		✓	✓			
Promote research on alternative non-chemical methods for controlling pests and diseases in forest plantations		✓	✓			
41: The use of native tree species and species mixes in planted forests enhances the biodiversity value of the stand. When exotic species must be used, choose those which provide the best habitat for local biodiversity						
Encourage the use of native species in planted forests	✓	✓	✓	✓	✓	
Promote collaboration between research institutions and forest industry to develop the silvicultural knowledge and practices needed to increase the use of a wider range of native species in planted forest development	✓	✓	✓	✓	✓	
42: Measures should be taken to ensure that plantation forestry does not facilitate the introduction of invasive species, which could impact negatively on both the planted forest and neighbouring natural forests						
Take precautions to prevent the introduction or spread of invasive alien species in association with plantation schemes	✓	✓	✓	✓	✓	
Avoid introducing tree species that are likely to spread outside the planted forest area	✓	✓	✓	✓	✓	

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11. MAINTAINING FUNCTIONING FOREST ECOSYSTEMS						
43: Ecological knowledge should be improved and applied to ensure that forest management enhances or maintains biodiversity and thus ensures forest functions such as pollination, seed dispersal and nutrient cycling. The ecology and habitat requirements of species of both commercial and conservation concern need to be understood and addressed in forest management planning						
Adopt, as a fundamental principle, the idea that as much indigenous biodiversity as possible should be retained in tropical production forests	✓	✓	✓	✓	✓	
Facilitate and encourage ecological research in tropical production forests, including the establishment and maintenance of long-term forest biodiversity monitoring plots	✓	✓	✓	✓	✓	
Encourage research on the ecology and habitat requirements of species of conservation and commercial interest	✓	✓	✓	✓	✓	
Collaborate on the design of studies that will yield new knowledge for application in addressing important biodiversity management questions	✓	✓	✓	✓	✓	
Collaborate to collect, synthesize, analyse and share data on forest biodiversity based on permanent forest plots, inventories and other sources and make these accessible to forest planners, forest managers and other stakeholders	✓	✓	✓	✓	✓	
Encourage ecological research on species assemblages, since this is likely to be more useful to forest managers than more focused studies on individual species	✓	✓	✓	✓	✓	
Assist forest managers to apply research results to forest management	✓	✓	✓	✓	✓	
44: Special management consideration should be given to species that are strongly interactive or play a key role in the ecology of other species or have important influences on the overall ecology of a forest and the survival of other species						
Identify and give special protection to species that perform ecological functions vital to the long-term maintenance of commercial species and to the maintenance of biodiversity features of high conservation value	✓	✓	✓	✓	✓	
Raise awareness among forest workers and managers about the existence and importance of species that play key roles in the ecology of other species or of the forest as a whole	✓	✓	✓	✓	✓	

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45: Particular sites and areas of forest and other habitats that provide important ecological functions should be identified and special measures taken to ensure their protection						
Identify and give special protection to areas that are identified as providing important ecological functions	✓	✓	✓	✓	✓	✓
Ensure that forest management in areas identified as providing important ecological functions is adapted to maintain these values	✓	✓	✓	✓	✓	✓
46: The fire ecology and fire susceptibility of tropical production forests should be understood and biodiversity considerations included in fire management measures						
Ensure that the fire ecology of a forest is understood and knowledge of the likely consequences of fire built into biodiversity conservation and sustainable use plans		✓				✓
Use reduced impact logging to reduce fire risk and maintain unlogged buffers to protect fire-sensitive stands		✓				✓
Use the *ITTO Guidelines for Fire Management in Tropical Forests* in developing forest management plans and measures to prevent and suppress forest fire		✓				✓
Develop training programs for community organizations on integrated approaches to agricultural practice, forest management and the wise use of fire		✓				✓

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