Guidelines for the Conservation and Sustainable Use of Biodiversity in Tropical Timber Production Forests

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IUCN
The World Conservation Union

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Glossary

Adaptive management: Process by which research and learning is incorporated into management action. Specifically it is the integration of design, management and monitoring to systematically test assumptions in order to adapt and learn.

Biodiversity: Used in this volume as a synonym for 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: The term widely used to describe 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 small game provides a large proportion of the animal protein consumed by both rural and urban populations

Ecosystem: A community with its 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: 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

Forest: land spanning more than 0.5 ha with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban use.

Forest management: The processes of planning and implementing practices for the stewardship and use of forests and other wooded land 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 plantation: Forest of introduced species and in some cases native species, established through planting or seeding.

Genetic resources: the economic, social or scientific value of the heritable materials contained within and between species. FAO, 1993

High Conservation Value Forest: A concept developed by the FSC to describe forests that have special conservation values that require that they be given special attention in any forest management activities. They are generally considered to be forests that possess one or more of the following attributes:

Forests areas A) containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia); and/or large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of

distribution and abundance. B) that are in or contain rare, threatened or endangered ecosystems; C) that provide basic services of nature in critical situations (e.g. watershed protection, erosion control); D) fundamental to meeting basic needs of local communities (e.g. subsistence, health) and/or critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities). (FSC, 2000)

High forest: Generic term used to describe a forest close to its successional climax – most commonly used as a synonym for climax forest.

Indicator: A quantitative, qualitative or descriptive attribute that, when measured or monitored periodically, indicates the direction of change in aspects of a forest system

Invasive alien species: An alien species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity.

Landscape: 1: A cluster of interacting ecosystem types, 2: A mosaic of land cover types and their institutional and cultural context.

Non-wood forest products:

1. All forest products except timber and wood, including products from trees, plants and animals in the forest area.
2. Products of biological origin other than wood derived from forests, other wooded lands ands trees outside forests

Population: a group of interbreeding individuals occupying a particular area and usually separated to some degree from other similar groups.

Protected area: An area of land and/or sea especially dedicated to the protection and maintenance of biodiversity and of associated natural and cultural resources

Reduced Impact logging: Logging using techniques to reduce the impact on the residual stand –see Box 6.

Residual stand: Forest that remains after timber harvesting

Succession: Progressive change in species composition and forest structure caused by 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.

Silviculture: The art and science of producing and tending forest by manipulating their establishment, species composition, structure and dynamics to fulfil given management objectives.

Stakeholders: Any individuals and groups directly or indirectly affected by, or interested in, a given resource**.**

Threatened species: A species included in the IUCN Red List of Threatened Species. Therefore it is a species that is considered by IUCN to be threatened with extinction.

Acronyms

CBD: United Nations Convention on Biological Diversity
CIFOR: Center for International Forestry Research
CITES: Convention on International Trade in Endangered Species
CPF: Collaborative Partnership on Forests
FAO: Food and Agriculture Organisation of the United Nations
FSC: Forest Stewardship Council
FMU: Forest Management Unit
FRA: Forest Resources Assessment – An FAO global forest monitoring programme
GMO: Genetically Modified Organism
IPCC: Intergovernmental Panel on Climate change
ITTO: The International Tropical Timber Organisation
IUCN: The World Conservation Union
IUFRO: The International Union of Forest Research Organisations
NFP: National Forest Programme
NGO: Non-Governmental Organisation
NTFP: Non Timber Forest Product
SFM: Sustainable Forest Management
UNFF: United Nations Forum on Forests
WWF: Worldwide Fund for Nature

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Introduction

Tropical forests are of enormous importance for the conservation of the world's species. They contain more species than other biomes and a high proportion of these species are threatened. The recent IUCN Global Species Assessment states that "…for many species the habitat degradation that accompanies selective resource exploitation, or that occurs in habitats next to cleared areas, can have serious negative consequences". The importance of tropical forests is shown in the following diagrams.

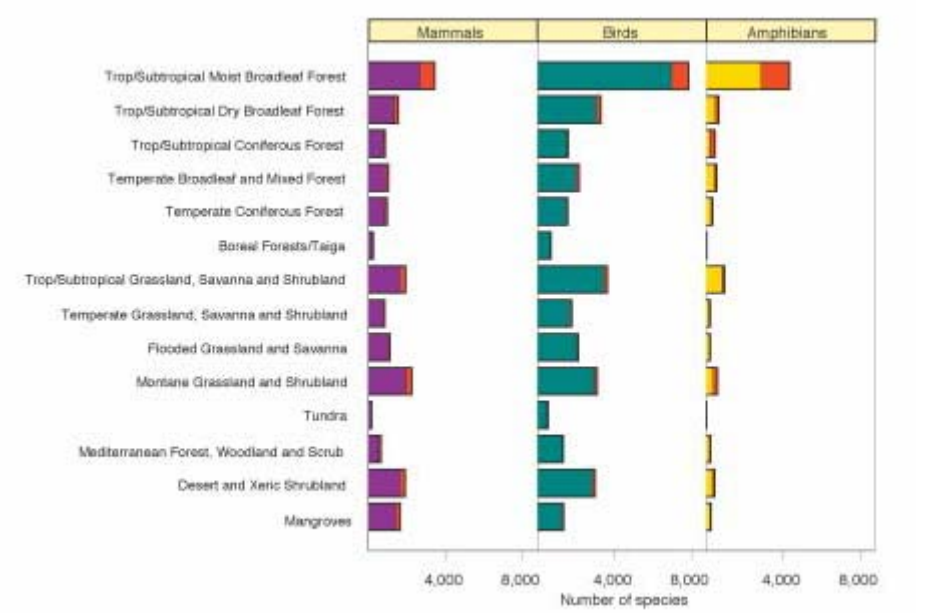


Figure 1. Numbers of threatened mammals, birds and amphibians occurring in each biome (proportion of threatened species indicated in red).

Source: IUCN Red List and Global Species Assessment (2004)

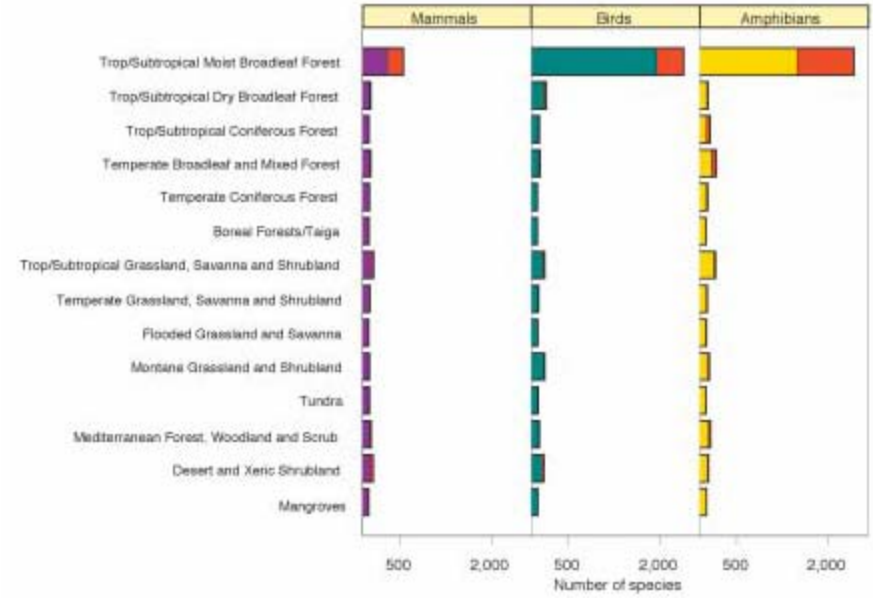


Figure 2. Numbers of threatened mammals, birds and amphibians endemic to each biome (proportion of threatened species indicated in red).

Source: IUCN Red List and Global Species Assessment (2004)

The goal of these Guidelines is to help foresters respond to the gravity of this situation. Bad forest management is one of the world's greatest threats to biodiversity; good forest management could provide a major contribution to conserving this biodiversity. These Guidelines attempt to set out how positive outcomes for biodiversity can be achieved in the management of Tropical Production forests.

The Scope of the Guidelines

Biodiversity, the diversity of genes, species and ecosystems, is under unprecedented global threat. Animal and plant species are becoming extinct more rapidly than ever before. Figures 1 and 2 above show that the highest concentrations of species occur in tropical forests. Deforestation, forest conversion and forest degradation are the leading causes of species extinction. Timber extraction in tropical forests is often cited as a major threat to biodiversity. However under good management tropical production forests can be a major resource for biodiversity conservation. They can complement national parks and other reserves and greatly extend the area of near natural habitats in the tropics. The objective of these Guidelines is to help foresters and forest planners improve the contribution of tropical production forests to global efforts to conserve biodiversity.

The Guidelines are intended to update and replace the 1993 ITTO Guidelines for the Conservation of Biological Diversity in Tropical Production Forests. They complement other ITTO Guidelines covering different aspects of the management of tropical forests (see Box 1). The other existing ITTO Guidelines aim to promote the overall improvement of the management of natural tropical forests, plantations, restored and rehabilitated forests and fire prone forests and they all address to issues of importance for biodiversity conservation. However, they do not specifically focus on biodiversity. The present Guidelines are therefore intended to bring together in one place those specific actions that are needed to improve biodiversity conservation in tropical production forests.

Box 1 : ITTO GUIDELINES AND CRITERIA AND INDICATORS WITH IMPLICATIONS FOR BIODIVERSITY CONSERVATION

1. ITTO, 1998. Criteria and Indicators for Sustainable Management of Natural Tropical Forests. ITTO Technical Series number 7, Yokohama, Japan.
2. ITTO, 1999. Manual for the Application of Criteria and Indicators for sustainable Management of Natural Tropical Forests. ITTO Policy Development Series number 9. Yokohama, Japan.
3. ITTO, 1992. ITTO Guidelines for the Sustainable Management of Natural Tropical Forests. ITTO Policy Series number 1, Yokohama, Japan.
4. ITTO, 1993. ITTO Guidelines for the Establishment and sustainable Management of Planted Tropical forests. ITTO Policy Development series number 4. Yokohama, Japan.
5. ITTO, 1993. ITTO Guidelines for the Conservation of biological diversity in Tropical Production Forests. ITTO Policy Development Series number 5. Yokohama, Japan.
6. ITTO, 1997. ITTO Guidelines for Fire Management in Tropical Forests. ITTO Policy Development Series number 6. Yokohama, Japan.
7. ITTO, 2002. ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests. ITTO Policy Development Series number 13, Yokohama, Japan.

Much that is contained in all the ITTO Guidelines 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. However the present Guidelines focus on additional measures to favour biodiversity that are not covered in the existing Guidelines.

The preparatory work that went into the original 1993 ITTO Biodiversity Conservation Guidelines was carried out between 1990 and 1992. At that time we still did not have a Convention on Biodiversity, the Global Environment Facility had not been established and only the first tentative steps were being taken towards independent forest certification. All of these developments had major implications for the future role of managed forests in biodiversity conservation strategies. At that time many conservationists still believed that logging of tropical forests was the main threat to tropical biodiversity. The view that tropical production forests provide a major opportunity for biodiversity conservation has emerged more recently but is still contested by some conservation groups.

The interest in the significance of managed forests for biodiversity that was generated by the 1993 Guidelines stimulated several scientific studies on the actual impacts of logging on biodiversity and to the beginning of attempts to change forest management in ways that favoured biodiversity. Much of this new work was consistent with these original ITTO Guidelines and was certainly influenced by them and by the debates that surrounded their adoption. Several influential publications that came out during this period have greatly increased our understanding of the potential and problems of reconciling forest management and biodiversity conservation (Box 4). The new Guidelines presented in this paper are an attempt to capture some of this new knowledge and the lessons from a decade of practical experience that has been accumulated since the 1993 Guidelines were published.

A significant change that has occurred since 1993 is that there is now widespread recognition that we should not be trying to develop a "single best way" of managing forests. The main message of the "Ecosystem Approach Principles" that were adopted by the Convention on Biodiversity in 2000 was that all situations are different and that there are multiple ways of managing forests all of which can be considered sustainable and all of which have impacts on biodiversity. The Ecosystem Approach Principles themselves take as their starting point the notions that biodiversity conservation approaches have to be a matter of societal choice and that decisions should be decentralized to local stakeholders to the extent that this is possible. A significant statement in the Criteria and Indicators for Sustainable Forest Management of the Forest Stewardship Council is that biodiversity conservation measures should be "…***appropriate to the scale and intensity of forest management and the uniqueness of the affected resources***".

It is for these reasons that in developing these Guidelines we have attempted to distinguish two levels of intervention. First we address those general approaches to forest management that will have wide application in ensuring that biodiversity values are maintained and should be universally adopted. Second we provide a much broader set of technical suggestions that managers and decisions makers might draw upon in designing locally applicable guidelines, codes of practice, regulations and silvicultural practices. We hope to make these Guidelines as useful as possible for all those who are concerned with conserving tropical biodiversity and managing tropical forests. We have therefore provided examples of practical experience and scientific studies that are relevant to this topic. Our expectation is that this will enable those concerned with forest management to draw on international best practice in designing the approach that is best for their own forest area.

We are also aware that knowledge is growing all the time. Similarly society's expectations both of forest management and of biodiversity conservation are constantly changing. What is

desirable practice in one place today may not be optimal in the same place at some point in the future or even in another location today. Management of forests and their biodiversity will not remain static over long periods. Forest management will need to be more adaptive and this is especially true of the management of biodiversity. We know far too little about the responses of different species to management and this is especially true under conditions of climate change. One of the most important messages in these Guidelines is that managers are going to have to improve their capacity to monitor changes in biodiversity and in society's requirements for biodiversity and adapt their management to achieve the desired outcomes.

We do not think that the main use of the Guidelines will be as a list of "boxes to be ticked" by forest managers but rather a source of understanding and as a mechanism for disseminating the experiences that have been gained in recent years. We hope that the "policy discourse" will be enriched by these Guidelines and by the debates that will surround their adoption and dissemination.

The objective of these guidelines

The overall objective of the Guidelines is to promote the conservation of native animal and plant species in tropical production forests. It is also to ensure that those elements of biodiversity that are important in the functioning of forest ecosystems and in the livelihoods of local communities are maintained. The Guidelines seek to promote understanding of how a healthy balance of these elements can be achieved at the level of nations, regions, landscapes and forest management units. The specific objectives are therefore to achieve:

1. An enhanced role for tropical production forests as components of multi-functional landscapes that contribute to biodiversity conservation at different spatial scales.
2. Equitable distribution of the costs and benefits of biodiversity conservation in tropical production forests.
3. Improved understanding of the impacts of forest management on biodiversity.
4. Adaptation of forest management practices at all spatial scales to favour the conservation of native biodiversity.
5. Improved ecological processes in tropical production forests provided by the presence of locally adopted native biodiversity.
6. Improved practical forest management at all spatial scales aimed at retaining native biodiversity.

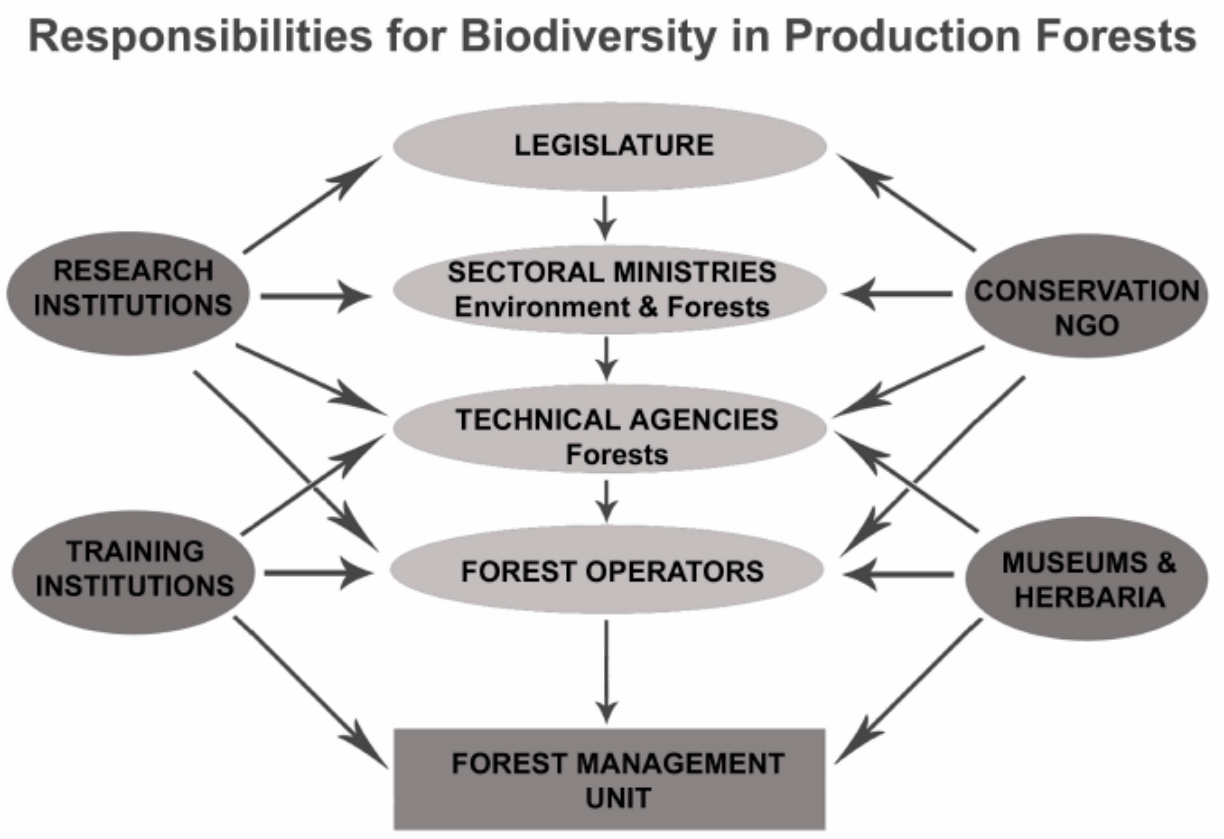
Box 2 : THE TARGET AUDIENCE FOR THE GUIDELINES

The effective maintenance 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 policy making, at the stage of allocation of forest to conservation, production and conversion as well as at the stage of management planning and implementation at the level of each management unit.

These Guidelines are designed to provide information and ideas to all of these concerned parties and are not addressed to any single group. In a subsequent phase of this work we suggest that the Guidelines be presented in a form that allows them to be adapted to the needs of different users and diverse situations.

Achieving the best outcomes for biodiversity will require that forest managers form alliances with specialist biodiversity agencies, scientists and staff of herbaria, zoological collections and other specialised institutions. The Guidelines are therefore also addressed to these strategic partners.

National agencies directly responsible for biodiversity and local and international environmental NGOs will all have a role to play. The Guidelines should be of special value to certification agencies and of course to commercial forestry companies seeking to improve their environmental performance.



Conservation biology and tropical production forests

Some interesting studies of the impacts of logging on biodiversity have been conducted in recent years. In general it has been shown that when best logging practices are applied many species of plants and animals can persist and even thrive in logged forests. In areas where biodiversity features of special conservation concern occur precaution must be exercised and the physical impacts of logging minimized. More research is needed on logging impacts but in the meantime forestry activities must continue on the basis of the limited information that is available. There is a particular need to conduct research on real life situations and learn from real life experience. This means having biodiversity monitoring measures in place that are linked to forest management so that the managers can adapt their practices and researchers can measure the effects of these adaptations on plant and animal populations.

*The crucial questions that scientists must strive to answer are **what** attributes of the forest biodiversity are priorities for protection within logged forest; then **how** this might be achieved, and how to monitor **whether** this is happening in particular cases.*

What is biodiversity

UNEP has defined biodiversity as 'the total diversity and variability of living things and the systems of which they are a part'. This leaves open the question of how much priority should be given to the functioning of the ecological "system" and how much to the list of species that make up that system. Tropical forests are so diverse that it is impossible to explicitly monitor and manage all the living organisms that they contain.

Biodiversity is integrated with the other, physical and social, ecosystem components. The physical environment includes the local and global climate, soils, and watercourses. These are often monitored alongside species diversity when forest health is assessed. Even water and nutrient cycles are poorly understood in tropical forests.

Maintaining a diversity of forest and habitat types in an undisturbed state may be the best way of conserving biodiversity. But this may not always be true, many species are adapted to disturbances similar to those caused by logging. Likewise, storing samples of all variants of all species from some forest in a gene bank or a garden will not completely compensate for loss of that forest. The forest as a whole with it the functions – the products derived from it, the watercourses and nutrient cycles – will be missing. Local, endemic species may be very significant to humanity for cultural reasons but may contribute very little to the function of a forest, its biomass or productivity.

There are major divergences between people who advocate different approaches to biodiversity conservation. The mainstream conservation community holds strongly to the view that all species and variation within species should be maintained in a forest – at least at the landscape scale if not within every management unit. Some pragmatists argue that as long as the forest continues to function as an ecological system and produces the goods and services that society requires then some loss of species can be tolerated. Others would argue that even highly simplified systems such as monoculture plantations can be stable and productive over time and that a high level of species diversity is not important. Local and indigenous people may have very different priorities for biodiversity from forest managers or conservation groups. The general consensus is that society's needs are best met when a balance is achieved between these different levels of modification of biodiversity at the landscape scale.

Many observers have noted that good forestry practice, minimizing the physical damage to the residual stand and to soils and watercourses, is good for biodiversity. Forestry has always sought to conserve populations of good quality trees of those species that are commercially important. However there are few if any cases where special measures to conserve non-

commercial plant or animal species have been built into logging practices. For instance the Reduced Impact Logging – RIL – guidelines focus on commercial trees, regeneration, and soil and water quality and not on species conservation. Forest certification standards in tropical countries have emphasized minimizing damage to biodiversity but have rarely been based on scientific knowledge on species and habitats.

Biodiversity objectives for tropical production forests should balance the concerns of all stakeholders – priorities should include the following:

- Indicators of ecological functions: for instance species whose presence or absence indicates how the ecosystem is functioning? Examples are canopy cover, sensitive understorey species, and regeneration of sensitive canopy trees.
- Globally rare species or varieties for whose survival the forest is significant.
- Species which have a strong influence on other species. These have sometimes been called 'keystone species'.
- Locally or globally valued species, such as species with commercial or subsistence value or cultural significance.

Local conservation priorities should be additional to global priorities, not alternatives. In many situations global conservation priorities will conflict with potential local benefits. Mechanisms will then be needed to compensate local users.

Forest exploitation will inevitably lead to a change in forest biodiversity. As far as possible this should be managed change, where the trade-offs between profit and biodiversity losses are negotiated between stakeholders. A good strategy should strive to define achievable conservation outcomes without imposing excessive limits on productive activities.

Conservation of " native commercial species"

Indigenous commercial timber trees and non-timber forest products – NTFPs – are obviously part of biodiversity. The inventory and sustainable management of these commercial species has been the focus of classical forest management. Exploited species require particular types of management that depend on their ecology. Sustained yield management of these species has been a priority for decades. However, the regeneration, dispersal, growth and other aspects of the ecology of many of these species are often poorly known. Data from Permanent Sample Plots – PSPs – have proved useful in improving understanding of how forests as a whole behave. In some cases, PSP data from one continent have been applied to similar, but different species in other parts of the world.

Concerns about the genetic diversity of timber trees are a relatively new issue. There are approaches that can be adopted that should help conserve genetic variation within logged species, some of these are considered normal practice for sustainable production forestry.

1. At a fine scale, protect significant proportions of trees of economic species within exploited populations - i.e. maintain some mature trees in logged forest. It may be useful to prioritize extremely large trees for this, as they cause most damage when felled; are often hollow; and, for wind-dispersed species will be more effective sources of seed than smaller trees.
2. Ensure that networks of protected patches ('provenance areas' or 'set-asides') include representatives of all main forest and habitat types (e.g. swamps, mountains, rocky areas). These are then likely to include those parts of populations of widespread commercial species that contain unusual genes. A broad range of protected forest types will contain representative samples of little known living organisms such as fungi, arthropods, amphibians etc. Such networks of seed stands and set asides should complement protected areas. They can provide corridors between totally protected areas.

A prime role for scientists who want to optimize the balance between production and conservation is to help make the best use of existing scientific and local information about species ecology and distribution. The following types of information are required:

- National or regional databases (or GIS coverage) of vegetation, forest types, global and local species distributions and sample plots. These should contain information on globally rare or threatened species and on species with special habitat requirements. Bibliographies of studies of species and forest types of concern should be maintained. Detailed national assessment of as many plant and animals groups as possible are needed. Reviews of their global and local distribution and ecology are important. Although ideally such national data bases should include all plant or animal groups (e.g. all woody plants, mammals and birds), it will often be necessary to prioritize species, under the headings given above. Such data bases could be established by state, NGO or academic organizations that would then need to help forest managers interpret the information.
- Research on the ecology of priority species, or the impacts of forest management on key forest functions. Studies need to focus on how the needs of priority species can be better addressed by forest management practices at the FMU level.
- User-friendly field guides accessible to all stakeholders to help identify species and provide information relevant to management

Landscape ecology and conservation

Many aspects of the ecology of rare species are highly specific and most questions about how to manage these species in logged forests can only be answered by new research for each species. However, there are more general trends or rules which apply in many different circumstances and geographic areas. These relate to reserve design, biodiversity in fragmented forests, fire control and invasive species. Landscape ecology helps understand how different parts of the forest landscape interact.

Landscapes can be viewed as a matrix containing patches of different habitats or forest types that are more or less isolated from each other. Examples are protected areas within production forests or forests within an agricultural landscape. Typically forest patches in a matrix exist due to fragmentation of a previously more complete forest cover. However, long-term habitat islands which have been isolated for a long time are also common, e.g. rock outcrops or lakes. Their biodiversity is more likely to be stable than that of recently fragmented forest patches. In the latter it is likely that a decline in species diversity will occur after isolation.

At one stage, the theory of ‘island biogeography’ was a popular framework for predicting changes in species diversity in isolated habitat patches. Species in forest patches were thought to behave like species on oceanic islands. This theory is now thought to be of limited practical value. Protected forest blocks are much more similar to logged forests than an island is to the sea. However, the theory did emphasize that a good knowledge of dispersal, regeneration, and population dynamics is essential if biodiversity in fragmented forests is to be understood and managed. Species that thrive in the patches can ‘diffuse’ through the matrix, or along corridors at different rates, and some can survive in the matrix under certain conditions. Some forest species of high conservation concern may even be more common in the matrix than in the natural patches. The matrix of logged forest may itself be quite heterogeneous – containing small areas of undisturbed forest.

The traditional approach to preserving biodiversity has been to set aside areas for conservation. According to IUCN figures, about 12% of the world’s forests are included in protected areas. However, over 80% of the world’s forests are allocated for timber production

and these clearly form a very large and essential part of the habitat of the majority of wild fauna and flora. A high quality matrix of production forest between the protected areas should increase the probability of reproduction, dispersal and survival of many species in both the protected patches and the matrix itself. Hence, there has recently been an increasing focus on the importance of the matrix of non-protected areas and on the interaction between reserve and off-reserve areas.

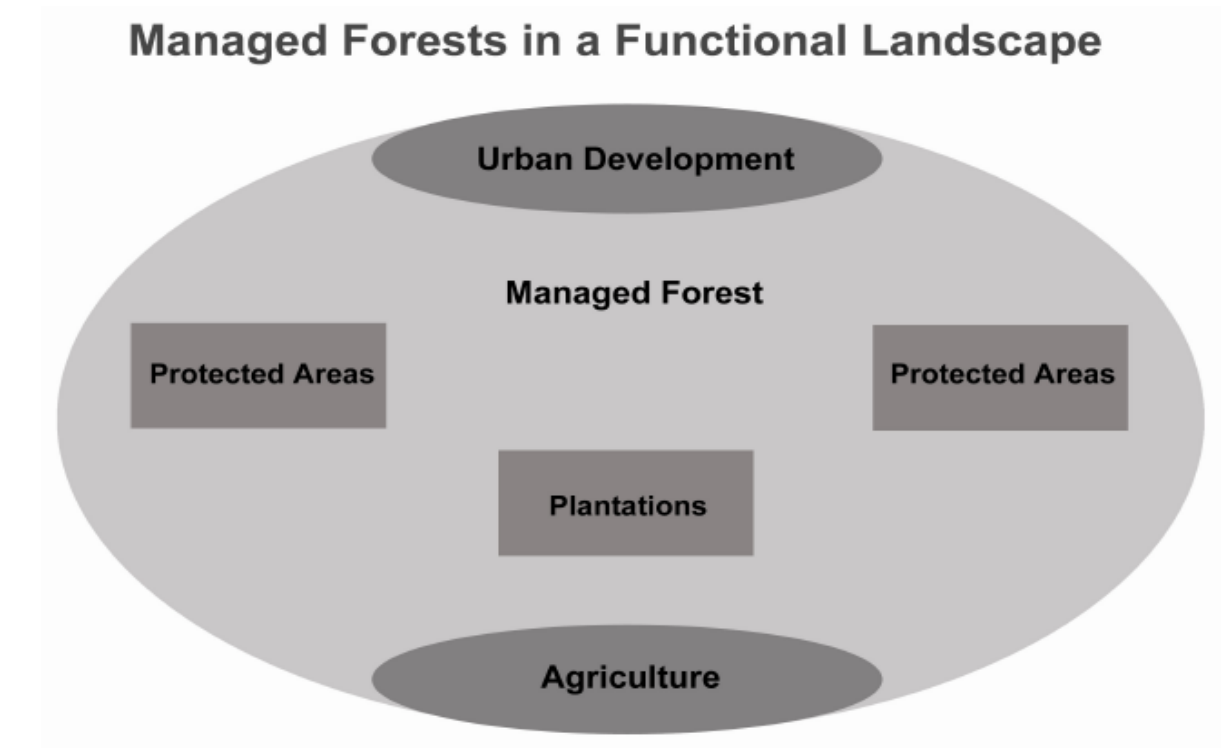
Therefore conservation strategies cannot focus exclusively on a single category of forest but must consider the whole forest landscape with its different forest types, successional stages, and degrees and types of management. Some species are confined to large, undisturbed tracts of forest, while others prefer small fragments. A high quality matrix of secondary forest can be important for the maintenance of species of many plant and animal groups in small fragments of less disturbed forest.

The question of how much forest to protect and how fragmented it can be are key questions, but a single globally applicable solution would be overly simplistic. In some cases, where the whole landscape far beyond the FMU is dominated by light-demanding and pioneer species, there may be little benefit in having large protected areas. Conservation objectives might be met by a system of small, dispersed reserves. Other situations where there has been a limited disturbance may be important for globally rare slow-growing species. Larger reserves connected by corridors are likely to be needed to conserve these species.

Where some large protected areas (like national parks) do exist, corridors or smaller patches at different scales (of different sizes) should still be set aside within the matrix of logged forest around them. These can act as stepping stones or refuges allowing certain species to persist or migrate. Such stepping stones will enhance the value of the larger protected patches, and may enrich the production matrix itself. Protection should not be restricted to set aside patches – small areas of undisturbed forest within logging compartments may be favorable for biodiversity.

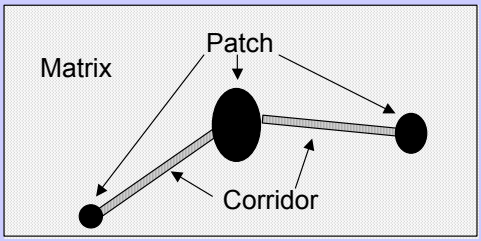
To achieve an optimal outcome in reconciling biodiversity priorities with production forestry objectives biodiversity specialists will need to work closely with forest managers. They will need to jointly define the priority species in their area, and assess how well represented these species are in existing protected forest areas. The potential role of the production forest in complementing protected areas should then become apparent. Within production areas, the priority species might then be protected in smaller set-aside patches. Since not all priority species will survive in protected patches alone, finer-scale measures can be integrated with stock mapping, yield allocation and logging manuals. These will ideally include species-specific measures, with limits on harvest rates and methods to reflect the differing ecologies and regeneration capacities of each species.

Scientists and NGOs should above all strive to help forest managers see beyond their FMU and to see the forests in the context of a range of scales from landscapes, regions through to the global patterns of distribution of species.



Box 3 : SOME IMPLICATIONS OF CONSERVATION BIOLOGY FOR TROPICAL PRODUCTION FORESTS

Providing the matrix: Tropical production forests often provide the matrix within which protected areas are located. The following diagram shows the potential relationship between protected areas, corridors and the production forest matrix.



Enhancing the effective size of populations in the patches. Large populations have a generally lower risk of extinction, and tend also to have higher levels of genetic variation than small populations. Inflow of individuals and genes from the matrix may help to reduce local extinctions in patches. The vulnerability of species in forest fragments is directly related to their ability to use the matrix: not surprisingly, those that can move and feed in the matrix are less sensitive to fragmentation. Forest patches act as a source of species for reinvading fallow land when opportunities arise; fallow patches near to forest reserves in Ghana are more biodiverse with forest species than those further away. They include more of the vestiges of fragmented forest (as the forest has often been cleared inwards towards the centre of patches) as well as being actively colonised from the remnant patches. More information on these dynamics is vital, but maintaining forest trees and patches may have surprising benefits.

Regulating movement. Corridors should promote dispersal of some species between patches, helping the ecosystem in the long term to respond to changes, e.g. in global climate, or in local management regime. However, for some plant species at least, these effects will only be observable in the very long term. A majority of plant species regenerate almost entirely within 100m of adults and take decades to reach maturity. Pioneer and other species that tend to regenerate at greater distances from parents trees are less likely to benefit from corridors anyway, especially if the matrix is hospitable to them. Hence, it may be animal species, and the short-lived plant species that are dispersed by them that benefit from corridors most in the short term.

Buffering sensitive areas and reserves. When forests are cleared, conditions change in the cut area and also in the edges of the remaining forest patches. The most obvious effects are climatic, e.g. there are changes in radiation, temperature, humidity and wind throw of edge trees. But interactions between organisms are also affected, e.g. predation in edge zones is known to increase. The effective size of small set-aside areas might be increased if logging is less intense around their edges.

Maintaining the integrity of aquatic systems. Water bodies are important and critical components in forest landscapes. Habitats with and near water are of special importance to some species. Watersheds are drained through intricate networks and when forest landscapes are logged, their form and function is affected. Felling, skidding and road construction can also seriously damage watershed functions.

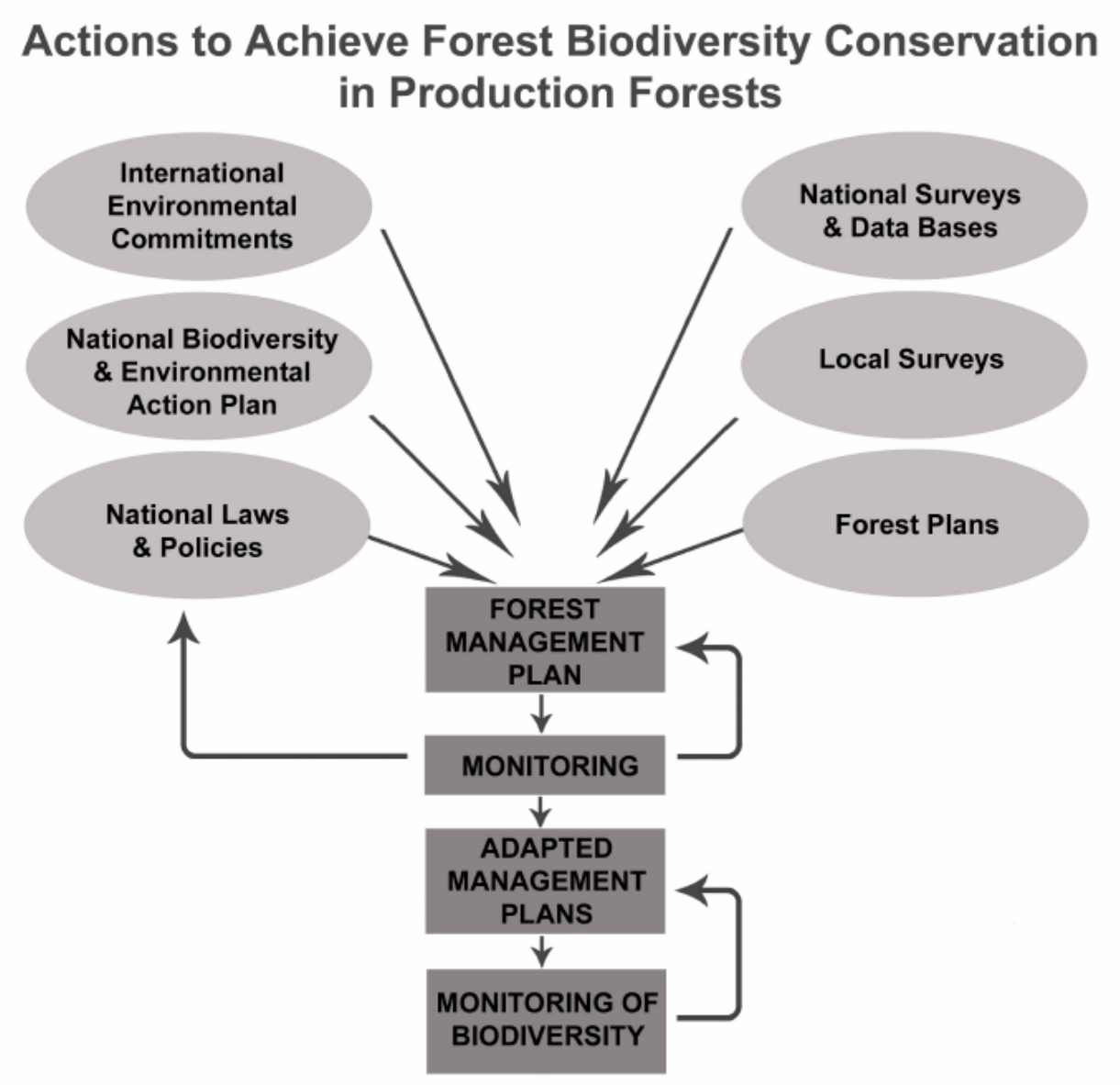
The need for Adaptive Management

Good forest managers are constantly oberving their forests and interpreting changes that occur so that they can adapt their management accordingly. This principle of adaptive management applies with even greater strength to measures to favour biodiversity. Knowledge of biodiversity is so incomplete and our ability to predict the impact on biodiversity of management interventions is so imprecise that we can never plan in advance the details of biodiversity management. So the surveys and inventories of biodiversity that are conducted in advance of forest management cannot be abandonned once logging begins. In many ways that is the time when the real work begins. This has implications for staffing and for the nature of collaboration with specialist biodiversity institutions.

Surveys of biodiversity must be continued during and after forest management interventions. Surveys of species or forest areas of conservation concern must be conducted in the period immediately after logging and then continued whilst the forest is recovering. This is the period when many species of animals and plants will be at greatest risk from changes in their habitat. It is also the time when the forest is most accessible to illegal hunters.

Information gained during the post-logging period will be valuable in helping to understand the impacts of logging on different species. Partner organisations with biodiversity and ecological competence will be valuable at this time as they will be able to alert the logging operators and conservation agencies to any unpredicted changes in biodiversity that occur. This is when adaptive management comes into play. Observations and understanding of the impacts of logging - or other forest management measures - on biodiversity will help managers to adjust their activities to mitigate any harm that might occur.

The figure shows in graphical form how this process should work. Data and analysis from surveys conducted during and after management interventions must be provided to the managers and discussions should take place between biodiversity specialists and the managers to deter,ine if any adapted or other special measures are required. This process must continue throughout the life of a working forest - although in the long periods between logging interventions the surveys may be less intense and frequent. All of this implies the need for a continuing and constructive relationship between the forest manager and the persons from specialist biodiversity institutions with whom she or he collaborates.


Actions to Achieve Forest Biodiversity Conservation in Production Forests
International Environmental Commitments
National Biodiversity & Environmental Action Plan
National Laws & Policies
National Surveys & Data Bases
Local Surveys
Forest Plans
FOREST MANAGEMENT PLAN
MONITORING
ADAPTED MANAGEMENT PLANS
MONITORING OF BIODIVERSITY

What has been achieved since 1993?

All of the Guidelines for forest management that have been adopted by the ITTO – those dealing with natural production forests, planted forests, the restoration, management and rehabilitation of degraded and secondary tropical forests, and fire management – contain provisions for the maintenance of biodiversity. These are however mostly stated in quite general terms. In most cases, notably in the most recent Guidelines – those addressing Restoration, Management and Rehabilitation of Degraded and Secondary Forests – there are a number of principles and recommended actions relevant for biodiversity conservation scattered amongst the different objectives of the Guidelines. The prominence of references to biodiversity in the principles and recommended actions in all of the Guidelines, and not just in the 1993 Biodiversity Conservation Guidelines, is an indication of the great importance that ITTO members have given to biodiversity conservation in the past decade.

The ITTC adopted its current ***Guidelines on the Conservation of Biological Diversity in Tropical Production Forests*** in 1993. The Guidelines were produced at a time of intense international debate on tropical forest conservation and use, much of it centred on the Earth Summit at Rio de Janeiro in 1992. The Guidelines were just one of a number of international initiatives that occurred at that time to promote biodiversity conservation.

The single most significant biodiversity initiative at this time was the adoption of the ***Convention for the Conservation of Biological Diversity – the CBD.*** Since then, the CBD has devoted considerable effort to questions related to forest biodiversity and has recently adopted an ***Expanded Programme of Work on Forest Biological Diversity*** which sets goals and objectives for the conservation of forest biodiversity and includes a number of measures that particularly target issues of biodiversity in managed forests (see Annex I). In 2000 the CBD also adopted, ***12 Principles for the Ecosystem Approach*** to biodiversity conservation and these are relevant to forest management. They set biodiversity conservation in the context of local developmental needs and stress the importance of maintaining ecosystem functions, achieving sustainable economic benefits, exploiting local and traditional knowledge and looking at landscape-scale issues in managing natural systems. More recently the CBD has adopted the ***Addis Ababa Principles and Guidelines for the Sustainable Use of biodiversity.*** These address a number of issues relating to biodiversity in managed systems and are relevant to the issue of Sustainable Forest Management (SFM) as defined by the UNFF, the ITTO and in the various ***Criteria and Indicators (C&I) for SFM***. In preparing the Guidelines in this paper we have tried to reflect the spirit of the targets of the Expanded Programme of Work on Forests, the Ecosystem Approach and the Sustainable Use Principles, and the progress made towards SFM. The general tendency has been for the CBD to give more and more attention to issues of biodiversity conservation in managed systems and thus for its agenda and that of the ITTO to converge.

The emergence and ongoing debate on forest certification has had major significance for biodiversity in production forests. This began with the establishment of the Forest Stewardship Council – the FSC – in 1993. There are now a number of global, regional and national certification initiatives and all of them give attention to the need to conserve biodiversity in any forests that are to be recognized as being sustainably managed. The FSC's set of Principles and Criteria for the certification of sustainable forest management is widely known. It establishes 10 Principles illustrated by a number of Criteria and several of these address directly or indirectly the need to maintain biodiversity. The central statement on biodiversity is contained in Principle 6 – Environmental Impact – Criterion 2 which states:

Safeguards shall exist which protect rare, threatened and endangered species and their habitats (e.g. 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.

The issue of conserving biodiversity in production forests that were seeking certification has been highly contentious. One of the most visible symptoms of non-sustainable management has been biodiversity loss. The failure to restrict commercial-scale bushmeat hunting in production forests has been a major obstacle to the achievement of certification, especially in Africa.

Box 4 : MAJOR NEW SOURCES OF INFORMATION ON BIODIVERSITY IN TROPICAL PRODUCTION FORESTS PUBLISHED SINCE 1992

- **Conserving Biodiversity in Managed Tropical Forests. Blockhus, J.M., M. Dillenbeck, J.A. Sayer and P. Wegge. 1992. 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 Guidelines. Its introductory chapter includes a draft set of technical Guidelines that were prepared for consideration of the ITTO in 1991. This draft was considered too prescriptive and detailed when it was examined by the ITTO expert panel and was considerably 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.
- **Timber Production and Biodiversity Conservation in Tropical Rainforests. Johns, A.G. 1997. Cambridge University Press, Cambridge, UK.** This is a comprehensive review of the literature and also draws heavily on the author's own field work. It is notable that 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 wildlife.
- **The Cutting Edge; conserving wildlife in logged tropical forest. Fimbel, R.A.A., A. Grajal and J.C. Robinson. 2001. Colombia University Press, New York, USA.** 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.
- **Life after Logging; Reconciling Wildlife conservation and Production Forestry in Indonesian Borneo. Meijaard et al 2005. Center for International Forestry Research, 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.

A number of other initiatives relating to forest management also addressed biodiversity issues. Notable amongst these are the FAO Code of Practice for Forest Management, published in 1993 and the Guidelines for Reduced Impact Logging (RIL) subsequently published by FAO and CIFOR. The listing of a number of timber trees on the annexes of the Convention on International Trade in Endangered Species (CITES) also provided some impetus to limit the biodiversity impacts of production forestry. Recent ITTO information requests on Criteria and Indicators ask member countries to provide information on forest biodiversity. FAO's Forest Resource Assessment for the year 2005 will continue to report on forest biodiversity issues.

Other changes that have occurred in the past decade have had an impact on biodiversity in tropical production forests. There has been a continuing loss of tropical forests, mainly through conversion to agriculture. Fires have destroyed or degraded large areas of tropical forests. Infrastructure development has intensified throughout the tropics and many areas that were remote and inaccessible in the early 1990s are now penetrated by roads and railways. In many countries forest management has been decentralized to local communities and this has had both negative and positive impacts on biodiversity.

The rights of local populations to benefit from the biodiversity that occurs in their traditional lands has been the subject of both international debate under the CBD and also of local programmes to exploit the economic value of wild species for medicines and as providers of the wild relatives needed for breeding improved crop varieties. Recently there has been interest in mechanisms for making environmental service payments to local communities and to individuals who bear the cost of biodiversity conservation programmes. So far it has proven difficult to make these effective.

Many countries have revised their forestry laws in the past decade and in most cases these new laws give greater attention to the need to conserve biodiversity. Biodiversity issues are now routinely addressed in forest management plans in many countries and this has certainly been influenced by the ITTO Guidelines as well as by the needs of certification bodies and the pressure exerted by civil society organizations.

Various forms of global change are having impacts on forest biodiversity and some of these changes are still little understood. Economic integration and the reduction of trade barriers are driving processes of increased economic efficiency and this is resulting in a far higher proportion of the world's timber coming from planted forests – this is a trend that is expected to continue. Planted forests may contribute to reducing the pressure for logging of natural forests but plantation schemes can also do a great deal of damage when they replace valuable biodiverse natural forests. Climate change threatens to render species less compatible with their environment (although we are very unclear about how resilient they may prove to be, and how optimally suited they are currently). Climate change will affect the nature of pest and disease problems in forests; it is expected to lead to more frequent storms and may exacerbate the dangers posed by invasive species and fires. All of these changes have major significance for biodiversity – they are increasing the threats to natural biodiversity but at the same time also underline the need to conserve biodiversity in order to maintain resilience and allow forest systems to adapt to changing conditions. Some people are concerned that the commercial use of Genetically Modified Trees may lead to unanticipated environmental hazards – for instance through GMOs becoming aggressive invaders of natural systems.

The past decade has seen major expansions of forest protected areas most of which are established to conserve biodiversity. This expansion has been accompanied by widespread appreciation of the value of production forests in providing buffer zones of near natural forests around totally protected parks and reserves. However, it is also interesting that part of the apparent expansion of protected areas has resulted from the recent trend to consider production forest reserves as important reservoirs for biodiversity and therefore to include them in protected area statistics.

A great deal of new science has become available in the past decade. The science of Conservation Biology has emerged and has become influential – it tells us much about the response of natural systems to various forms of disturbance. Large scale, landscape approaches to conservation have become common. The availability of remote sensing and GIS technologies has greatly improved our knowledge of changes in forest systems and far more information is now available on species distribution and ecology.

Principles, Guidelines and Recommended Actions

Principle 1: Sovereignty and societal choice Rights and responsibilities for biodiversity lie primarily with the states and societies within whose territories the biodiversity is located therefore biodiversity use and conservation are a matter of societal choice and should reflect national and local aspirations.				
Guideline 1.1: National, regional and local biodiversity strategies, plans and regulations that reflect national and local priorities should be respected in planning production forestry.	**Recommended action 1.1.1** Check all national plans and laws for references to biodiversity conservation needs that might be impacted by the forest management programme.	**Main Responsibility** 		
	Recommended action 1.1.2 Species and areas of conservation concern should be identified and this information publicly disclosed and taken into account in forest land allocation.			
	Recommended action 1.1.3 Stakeholders impacted by biodiversity conservation measures should be identified and consulted from the beginning.			
	Recommended action 1.1.4 Biodiversity strategies, plans and regulations should be widely available for consultation for instance on the internet and in electronic and printed forms.			

 **Government Forest and Environment Agencies**

 **Specialised Biodiversity Organisations, International NGOs, research institutes etc.**

 **Local NGOs, civil society and community organisations**

 **Forest managers, concessionaires etc.**

 **Educational and technical training institutions**

Guideline 1.2: Before areas are allocated for production forestry surveys should be conducted to identify populations, species or habitats that are rare, endangered, locally endemic, of importance to local communities or of significance in maintaining the composition and ecological functions of the forest.	**Recommended action 1.2.1** Use participatory processes involving local stakeholders and specialists from competent biodiversity institutions to establish a list of biodiversity features of conservation concern for any tropical production forest	**Main Responsibility** 		
	Recommended action 1.2.2 Local knowledge should be fully integrated into the priority setting and decision making processes on biodiversity conservation measures.			

Principle 2:International commitments Many countries have entered into legal and non-legally binding intergovernmental commitments to conserve biodiversity and these have impacts on arrangements for managing production forests within their territories. The presence of populations, species and assemblages of species of global or international conservation concern within or adjacent to tropical production forests should be subject to surveys and special management measures.				
Guideline 2.1: *International commitments for the conservation of genes, populations, species, assemblages of species or habitats should be taken into account in allocation of land for production forestry.*	**Recommended action 2.1.1** Review texts of international conservation agreements to which the country is signatory to determine whether any proposed forest management schemes will impact on areas with internationally recognised biodiversity values	**Main Responsibility** 		
Guideline 2.2: *Special measures will often be required when species and populations that are globally, nationally or locally rare or endangered occur in or adjacent to forest management areas.*	**Recommended action 2.2.1** Any biodiversity features subject to international agreements occurring in a tropical production forest should be added to the list of features of conservation concern and measures to ensure their conservation should be included in management plans.	 		

Principle 3: Knowledge, learning, technology transfer and capacity building *Although there have been some isolated successful attempts to conserve biodiversity in tropical production forests the knowledge of the ecology of these forests and of the responses of different elements of biodiversity to management interventions is still limited. Appreciation of the importance and the potential value of the biodiversity of tropical production forests at all levels from the society at large to decision makers and forest managers is still insufficient. Learning, experimentation, dissemination of information and transfer of technology should be a continuing process.*				
Guideline 3.1: *Forest and environment agencies should develop systems for collecting and storing data on biodiversity in tropical production forests and for identifying conservation priorities.*	**Recommended action 3.1.1** National and regional forest management agencies should develop databases of priority populations, species and other biodiversity components. Reference collections should be established where these are needed to facilitate identification.	**Main Responsibility** 		
Guideline 3.2: *Governments, research agencies and NGOs should produce manuals, guides and material for the media to communicate the underlying concepts, objectives and values of biodiversity conservation programmes in language that is understandable, relevant and useful for the general public and for all stakeholder groups.*	**Recommended Action 3.2.1** Biodiversity objectives, values and underlying concepts must be expressed in ways that are comprehensible, relevant and useful for all target groups. They will need to be conveyed in different ways to meet the needs of different target audiences.			
	Recommended action 3.2.2 Stakeholder consultations, radio, television, the press and other communication support should be used to raise awareness and exchange information on forest biodiversity issues. This should occur at the global, regional and national levels and should involve research and operational agencies.			

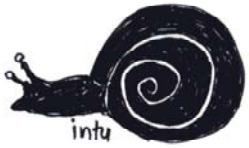
	Recommended Action 3.2.3 Specialized agencies should provide local language field guides, maps, checklists of species and other information to support biodiversity conservation measures in tropical production forests. The lack of such guides is a serious obstacle to progress at present and this recommendation should be treated with urgency.	**Main Responsibility** 		
Guideline 3.3: *The opportunities and options for conserving biodiversity in tropical production forests vary from place to place and change with time. This means that forest managers have to be able to exercise judgment based on local experience. Biodiversity conservation in these complex situations cannot be entirely rules based and requires skills in adaptive management.*	**Recommended action 3.3.1** Forest managers need to be given the skills and the authority to address biodiversity conservation issues in ways that are practical and relevant to local conditions. Incentives and rewards for field foresters should encourage locally sensitive solutions and be based upon conservation outcomes not on rigid application of rules			
Guideline 3.4: *Successful dissemination and uptake of innovative approaches to the conservation of biodiversity in tropical production forests will require new alliances, partnerships and mechanisms to bring together organizations with complementary knowledge and skills*	**Recommended action 3.4.1** Partnerships should be fostered between private companies, universities, museums and forest management agencies as an effective way to access and disseminate knowledge of biodiversity.			
	Recommended action 3.4.2 Universities and other educational establishments should encourage students to participate in research, learning and dissemination that helps forest managers to better incorporate the outputs of conservation science in their forest management activities			

Guideline 3.5: *Monitoring programs for biodiversity in tropical production forests should be conducted in ways that facilitate learning and adaptive management and that make information on achievements and failures widely available*	**Recommended action 3.5.1** Encourage the participation of all stakeholders and of technical specialists in biodiversity monitoring programs. Disseminate the information acquired widely to help researchers and forest managers to understand the relations between biodiversity and forest management.	**Main Responsibility** 		
	Recommended action 3.5.2 Review existing procedures and regulatory measures to ensure that managers and organizations use open and transparent, learning oriented monitoring systems that do not discourage or penalize the reporting of failures			
Guideline 3.6: *Building capacity in technical agencies, planning departments, forest operators and local forest owners and managers on biodiversity conservation in tropical production forests is vitally important. In some countries there has been a decline in capacity in fields such as plant and animal taxonomy and this decline must be reversed.*	**Recommended action 3.6.1** Training courses for field practitioners, technical guidelines and manuals must be provided in order to build capacity to manage biodiversity in tropical production forests. Forestry and Environmental training institutes and universities should all include forest ecology, biodiversity management and taxonomy in forest management courses.			

	Recommended action 3.6.2 Although formal training and education are important the uncertain nature of much practical work on the management of biodiversity in tropical production forests requires that persons concerned have the opportunity of "learning by doing". Experimental biodiversity management in tropical production forests should be undertaken as a learning exercise by both public and private sector managers.	**Main Responsibility** 		
	Recommended action 3.6.3 Technicians and researchers keen to develop their skills to help forest management achieve biodiversity goals should be given the opportunity and incentive to do so and to share their experiences through networks of practitioners			

Principle 4: Planning Production Forests at a Landscape Scale. Biodiversity conservation is the primary objective of national parks and equivalent reserves, production forests and other components of landscapes have complementary but differing roles in contributing to conservation objectives.				
Guideline 4.1: *The allocation of forest lands to different uses should be based upon a sound understanding of landscape scale processes. A balance should be sought between production and conservation forest.*	**Recommended action 4.1.1** Forests should be allocated to different uses in ways that optimizes the provision of forest goods and functions at the landscape scale.	**Main Responsibility** 		
	Recommended action 4.1.2 Forest land allocation should not deprive legitimate stakeholders, and especially local and indigenous peoples, of access to or use of biodiversity resources.			

Guideline 4.2: *It is desirable to retain as much of the natural biodiversity of any forest under management as possible in order to ensure the continued functioning of the forest ecosystem. This is especially important given the impending risks posed by global climate change invasive species and new pests and diseases.*	**Recommended action 4.2.1** Planners should ensure that forest zoning and management maximize the retention of native plant and animal species and within species variation as well as habitat heterogeneity and connectivity.	**Main Responsibility** 		
	Recommended action 4.2.2 Where possible forest management should be carried out at scales that allow for the maintenance of contiguous blocks of forest large enough to support viable forest ecosystems and their component species.			
Guideline 4.3: *Connectivity among different habitats should be maintained to allow the dispersal of plants and animals and ensure the viability of populations at landscape and forest management unit levels.*	**Recommended action 4.3.1** Where possible create or maintain habitat corridors between blocks of forest to permit the movement of forest interior species including, e.g. creating buffer strips along water bodies, retaining canopy connectivity over roads and tunnels under main roads, etc.			
Guideline 4.4: *Ensure that the arrangements for forest ownership and use at the landscape scale are favourable for the conservation of forest biodiversity*	**Recommended action 4.4.1** Coordinate resource use amongst forest managers so that their landscape level impacts on biodiversity will be minimised. This means ensuring continuity of habitats and a mosaic of stands at different successional stages.			



Guideline 4.5: *Private or community forest owners need to be provided with technical support in order that their activities are consistent with biodiversity conservation objectives.*	**Recommended action 4.5.1** Forest or biodiversity conservation agencies should provide technical support and oversight to ensure the maintenance of biodiversity in areas under small scale private or community management	**Main Responsibility** 		
	Recommended action 4.5.2 Measures to favour biodiversity should normally be applied for long time periods however this may discourage small forest operators from adopting such measures. Forest agencies should provide oversight at the landscape scale to address these long term needs.			

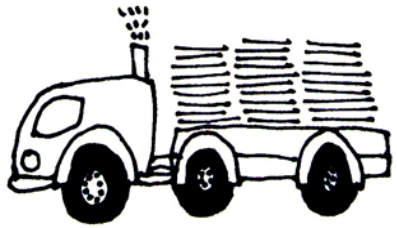
***Principle 5: Political Commitment, Policies and Laws*.** Strong commitment from decision makers and adequate national policies, laws and regulations are needed to ensure that biodiversity interests are adequately addressed in forest management at all scales from the management unit to the landscape and national levels.				
Guideline 5.1: *The values of biodiversity both as a global resource and a vital component of local ecosystems and of local livelihoods should be demonstrated and communicated to decision makers.*	**Recommended action 5.1.1** Ensure the participation of all key decision makers in all stages of establishing policies, laws and regulations for any forest.	**Main Responsibility** 		
	Recommended action 5.1.2 Assess and where possible determine economic and social values of local uses and functions of biodiversity. Participatory biodiversity surveys can be effective in capturing local values.			
	Recommended action 5.1.3 Give prominence to knowledge and understanding of biodiversity values in all forest education and interpretation materials.			

Guideline 5.2: *National land use planning processes, forest laws, logging manuals etc should all explicitly address issues of biodiversity conservation in forests at all spatial scales.*	**Recommended action 5.2.1** Forestry regulations and plans must be checked against national laws and programmes to conserve biodiversity and with commitments under the different international environmental conventions.	**Main Responsibility** 		

Principle 6: **Institutions, Forest Tenure and Access Rights.** Achieving biodiversity conservation goals in production forests may be favoured by improved institutional arrangements both at the level of large scale land allocation and at the level of local peoples' resource access and land tenure rights				
Guideline 6.1*: Forestry and Natural Resource Management agencies need to have the technical capacity to address biodiversity conservation needs. This can be achieved by training or by hiring specialised staff or by collaborating with specialist agencies with competence in biodiversity matters.*	**Recommended action 6.1.1** Ensure that technical capacity to inventory and monitor biodiversity is available to forest management agencies and forest operators.	**Main Responsibility** 		
	Recommended action 6.1.2 Build partnerships between forest managers and specialized agencies with technical competence to inventory and monitor biodiversity.			
Guideline 6.2: *Local populations need to have biodiversity use rights that meet their economic and cultural needs whilst ensuring the maintenance of biodiversity. Favorable tenure and resource use rights may benefit biodiversity by providing incentives for conservation.*	**Recommended action 6.2.1** Ensure clarity of boundaries of local use areas and of use and access rights for timber, non-timber forest products, fish and wildlife.			
	Recommended action 6.2.2 Ensure local populations retain traditional access and use rights by addressing these rights in forest management plans and policies.			

Principle 7: Incentives Society at large benefits from biodiversity conservation measures whereas the costs of conservation fall mainly on local forest managers. Incentives will often be required to make it attractive to forest managers to take special measures to favour biodiversity.				
Guideline 7.1: *The incremental costs of biodiversity conservation measures to managers of tropical production forests should be offset through incentives.*	**Recommended action 7.1.1** Investigate ways of providing incentives to forest managers and owners to favour conservation of biodiversity in production forests. These might include payments for environmental services, corrective taxation or other fiscal measures.	**Main Responsibility** 		
	Recommended action 7.1.2 The ITTO should review technological innovations and the availability of finance to support the management of biodiversity in tropical production forests and disseminate information on successful approaches in tropical timber producing countries.	 		
Guideline 7.2: *Independent voluntary forest certification should be promoted as an incentive to forest managers to take special measures to conserve forest biodiversity.*	**Recommended action 7.2.1** Encourage voluntary certification schemes that favour the conservation of biodiversity.			
	Recommended action 7.2.2 Encourage contact and communication between producers and consumers to promote trade of timber and timber products from forests where biodiversity conservation measures are in place.			
Guideline 7.3: *Land use policies and laws, subsidies and practices which lead to resource degradation and harm biodiversity should be countered or eliminated.*	**Recommended action 7.3.1** Review existing policies, laws and subsidies and seek to revise any that have unfavorable impacts on biodiversity.			

Principle 8: Maintaining Functioning Forest Ecosystems. A fundamental goal of tropical forest management is to maintain ecosystem functions at both the stand and landscape scales. Biodiversity contributes to ecosystem functioning and may enhance the stability of the forest and contribute to sustaining yields of timber and other products.				
Guideline 8.1: *A good understanding of forest ecology is important to ensure that forest management enhances or maintains populations, species and habitats and maintains forest functions such as pollination, seed dispersal and nutrient cycling.*	**Recommended action 8.1.1** Forest agencies and commercial organisations with large forest holdings should encourage and facilitate basic research on forest ecology.			
Guideline 8.2: *The ecology and habitat requirements of species of both commercial and of conservation concern need to be understood and addressed in forest management planning. The habitats of many species require that they use different areas at different times of the year or for different periods of their life cycles and these habitat needs must be provided for in forest zoning and in setting patterns for exploitation.*	**Recommended action 8.2.1** Conservation organisations should be consulted to ensure that information on special habitat requirements of species is taken into account in forest management planning.			
	Recommended action 8.2.2 Studies of the ecology and habitat requirements of species of conservation concern should be encouraged and facilitated by those responsible for tropical production forests.			



Guideline 8.3: *Some species are strongly interactive or play a key role in the ecology of other species or and have important influences on the overall ecology of a forest and on the survival of other species. Elephants, Apes and pollinator and seed dispersing species play these roles and their management in tropical production forests should therefore receive special attention.*	**Recommended action 8.3.1** Forest managers should seek information from conservation organisations on the presence of strongly interactive or key species in forest management areas and take special measures to protect or manage these species.	**Main Responsibility** 		
	Recommended action 8.3.2 Monitoring should give special attention to strongly interactive and other key species and should exploit the data bases maintained by conservation organisations that often provide good baseline information on the status and distribution of these species.			
Guideline 8.4: *Patches of habitats with high species diversity or other special conservation values should be identified within tropical production forests and special measures taken to ensure the retention of these values.*	**Recommended action 8.4.1** Identify high conservation value forests within production areas and ensure that their management needs are addressed in forest management zoning and planning.			
Guideline 8.5: *The principles of sustainable forest management as stated in ITTO Guidelines must be applied to the entire forest system including its biodiversity.*	**Recommendation 8.5.1** Employ ecological knowledge about harvested species to ensure that the rate of exploitation does not compromise the continued presence of a viable population of the species within a tropical production forest.			

Guideline 8.6: *Fires often play an important role in enhancing or reducing forest biodiversity. The fire ecology and susceptibility of a tropical production forest should be understood and biodiversity considerations should be included in fire management measures.*	**Recommended action 8.6.1** Ensure that knowledge of the fire ecology of forests and plant and animal species is used in developing management plans. Identify fire-prone areas in logging plans. Apply very low impact harvesting methods in fire prone areas. Observe the ITTO Guidelines for Fire Management in Tropical Production Forests.	**Main Responsibility** 		
	Recommended action 8.6.2 Provide continuing control or management of fire in the forest management unit and its immediate surroundings.			
	Recommended action 8.6.3 Maintain unlogged buffer strips around fire prone areas.			
	Recommended action 8.6.4 Agricultural encroachment into production forests increases fire risk and should be strongly discourage.			

Box 5 : FOREST FIRES : PREVENTION AND CONTROL[1]

The risk of accidental fire in tropical forest areas discourages landholders from investing in tree-based land-use systems on their properties. This perpetuates the dominance of extensive ranching and slash and burn agriculture system rather than agroforestry or sustainable forest management. For instance, one out of two forest fires in Amazonia is accidentally spread from a neighbouring agricultural field. Fire impoverishes the forest and increases the probability of new fires, initiating a vicious positively reinforcing feedback cycle. 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, power supply interruptions and airport closures. Correspondingly, fires contribute to global warming, by releasing significant amount of carbon to the atmosphere. The negative effect of accidental fires can be better controlled through the following actions:

- Test and improve pre-existing local techniques and social arrangements to reduce fire risks and damage. Encourage the design and implementation of community fire management; this can distribute more equitably the costs and benefits of investments in fire prevention and control. Study further the causes of forest flammability, thus providing the basis for regional early warning systems.
- Quantifying economic losses caused by fires may be used as leverage to increase the adoption of fire prevention and control.
- Propose mechanisms to harmonize contradictory public policies, thus enhancing less fire-prone development pathways.
- Incorporate fire prevention and control measures in agricultural credit, subsidy and incentive programs.
- Develop training programs for extensionists to teach community organizations about integrated approaches to agriculture, forest management and the wise use of fire.

[1] See also the ITTO Guidelines for Fire Management in Tropical Forests (ITTO, 1997)

Principle 9: Management planning and biodiversity

Well balanced forest management respects biodiversity and the physical environment, nonetheless, any intervention during management will have impacts on biodiversity. The management planning process is vital in determining the degree of modification of biodiversity that will be tolerated and in setting goals for biodiversity conservation. The management plan determines the balance between the needs of various stakeholders. Management planning should therefore draw upon and integrate all available local and scientific knowledge on forest ecosystems and their biodiversity.

Guideline 9.1: *Biodiversity needs should be addressed at all stages of the preparation of a forest management plan – from delimitation of the management units, pre-logging inventories, silvicultural treatments and post-logging treatments.*	**Recommended action 9.1.1** Forest management plans, logging manuals, codes of conduct, reduced impact logging guidelines etc must all include explicit provision for the biodiversity conservation.	**Main Responsibility** 		

	Recommended action 9.1.2 Forest agencies should disseminate information about populations, species and habitats of conservation concern and about better practices for their conservation to forest managers.	**Main Responsibility** 		
Guideline 9.2: *Forest plans should include information on the presence and status of plants, animals and habitats of special conservation concern. Assembling this information may require collaboration with museums, herbaria, environmental agencies and NGOs. Local people's traditional knowledge of biodiversity should be consulted in the preparation of plans.*	**Recommended action 9.2.1** Ecological baseline studies, species inventories and monitoring measures such as permanent sample plots should be put in place to support forest management and the information generated should be use to adapt management practices to meet biodiversity objectives.			
	Recommended action 9.2.2 Identify biodiversity features of value to local communities – resin trees, sacred sites, medicinal plants etc., and ensure that forest management does not impact negatively on them.			
	Recommended action 9.2.3 For certain tree species subject to heavy harvesting pressure it may be necessary to establish genetic conservation areas to retain intra-specific variation.			
Guideline 9.3: *Biodiversity conservation objectives for each area of forest under management should be made explicit and measurable biodiversity objectives should be set. These objectives should reflect the biodiversity values of all stakeholders including local communities.*	**Recommended action 9.3.1.** Biodiversity objectives for any tropical production forest must be included within the monitoring and evaluation framework for the management unit. Management may be adapted to ensure that biodiversity objectives are met.			

	Recommended action 9.3.2 In those instances where local communities have rights to, or are making use of, managed forests, they should be involved in monitoring of biodiversity values.	**Main Responsibility** 		
Guideline 9.4: *Harvesting plans, including stock maps at compartment level should include data on populations, species or habitats of conservation concern.*	**Recommended action 9.4.1** Pre-logging inventories (stock maps etc) should identify and map species and assemblages of species of conservation concern, such as nesting and fruit bearing trees, and other important biodiversity features.			
	Recommended action 9.4.2 Care should be taken to protect special habitat features such as small wetlands, dry season water supplies, patches of unusual habitats, saline earths, migratory routes, etc. Many rare plant and animal species are restricted to very specific sites and these should be identified during pre-logging inventories and given special protection.			
	Recommended action 9.4.3 Field biologists aided by para-taxonomists should be employed to provide support to forest managers in measuring and monitoring forest biodiversity.			

Guideline 9.5: *Reduced impact logging methods should be used in tropical production forests, with particular attention to areas known to contain biodiversity features of conservation concern.*	**Recommended action 9.5.1** The impacts of logging infrastructure, particularly skid trail should be minimised by careful planning, wheeled skidders should be used when available. Blades of bulldozers and skidders should be raised when opening up access to the stand or skidding logs out of the forest. Directional felling should be used to protect the residual stand.	**Main Responsibility** 		
	Recommended action 9.5.2 Exercise precaution when applying pre- and post- harvest treatments such as climber-cutting and liberation thinning as such treatments can impact negatively on some plant and animal species. Ensure that such operations are fully justified for individual forest types from the perspective of worker safety, protection of future crop trees and increased growth and productivity.			
	Recommended action 9.5.3 Protective buffer zones should be created along water courses of a dimension appropriate to the size of the watercourse and the nature of local topography.			

	Recommended action 9.5.4 The potential impact on biodiversity of all silvicultural treatments should be considered – for instance non-commercial or malformed trees may have biodiversity values and should not be systematically removed. A balance should be sought between stand improvement measures and retention of biodiversity in the forest.	**Main Responsibility** 		
Guideline 9.6: *Hollow trees should be retained as they will continue to be a seed source, provide important habitats for a wide range of animal species and are generally of low commercial value.*	**Recommended action 9.6.1** Check trees for hollowness prior to felling, and avoid felling hollow trees unless they have high commercial value.			
Guideline 9.7: *Unnecessary removals of nutrients to the forest ecosystem should be minimised.*	**Recommended action 9.7.1** Logs may be debarked in the forest and debris left on site to enhance soil nutrient and organic matter status but only in situations where this does not expose the logs to insect damage that may reduce their commercial value.			
Guideline 9.8: *Selective logging may reach an intensity that threatens the viability of populations of commercial species and reduces their genetic variability. Special measures will be required to protect populations and within species variability of the most valuable timber species.*	**Recommended action 9.8.1** The retention of different age classes and especially of a viable population of those timber species that are commercially preferred should receive special attention from forest managers. Where possible and where justified by the regeneration strategy of the target species, logging operations should be timed to follow periods of seed production.			

Box 6 : REDUCED IMPACT LOGGING (RIL)

It has been known for decades that considerable 'collateral damage' occurs to the residual forest as a consequence of felling and extracting trees: often around 25-75% of the trees in a logged forest are damaged or destroyed. The damage depends upon landscape form and logging intensity. Increased mortality of remnant trees and soil damage from disturbance and compaction can persist for many years after logging. There is considerable scope for improvement over haphazard tree removal. Increasingly, studies have concentrated on RIL concluded that RIL can reduce logging damage by half, for low logging intensities, mainly by reducing mortality by better planning of skidding. Many studies have found similar trends, emphasising the reduction to a half of the numbers of trees damaged during felling, and noting that planned logging (including vine cutting 2 yrs in advance of logging and directional felling) would also increase the timber companies' potential for future harvests, and may increase the profit margins due to greater efficiency. The various components of RIL are:

- All extraction activities should be well planned and the plans adhered to. This includes, FMU layout, stock mapping, rroads, stream crossings, loading bays, skid trails, and location of camps to minimise damage, e.g. to avoid environmentally sensitive areas and biodiversity set-asides.
- Directional felling should be used when possible to minimise gap size, protect future harvest trees, and favour skidding direction to avoid additional damage.
- Stock maps represent a much specialised sort of biodiversity inventory, and their optimisation and use represents a major commitment to sound logging. They should ideally be fully integrated with sound yield allocation procedures, controlling the spatial distribution of logging and indicating trees and or sites to be protected.
- Skid trails in particular should be planned using individual tree (stock) maps and the information provided by them to avoid additional impact.
- The length of skid trails should be minimised and the volume to be extracted limited to avoid excessive impact. Skid trails should avoid steep gradients, if possible sticking to ridge tops, winches and cables should be used for skidding.
- Extraction should be planned during dry seasons (in moist forests) but avoiding the driest seasons in highly fire-prone forests.
- Road building, skidding and felling activities should protect stream and river buffer zones according to regional regulations and or conservation conventions.

RIL operational manuals for forest management have been prepared in a number of countries and regions and an overview account of RIL has been published by FAO, these should be consulted.

	Recommended action 9.8.2 Some valuable commercial tree species do not have a regular age class distribution and the special management needs of these species must be addressed by competent agencies.	**Main Responsibility** 		
Guideline 9.9: *Disruption of the canopy cover may be important in allowing the regeneration of light-demanding species but a balance should be sought between this and the retention of canopy connectivity, reduction of ground exposure to rain and sun and reduction of fire risk.*	**Recommended action 9.9.1** Ensure that biodiversity conservation concerns are taken into account in decisions about the degree of canopy opening that results from logging.			
Guideline 9.10: *Logging operations will often facilitate the arrival and encourage the spread of invasive species and measure should be taken to minimise this risk.*	**Recommended action 9.10.1** Avoid the deliberate introduction of species that may be invasive and take prompt action to eliminate any populations of invasive species that may become established.	 		
	Recommended action 9.10.2 In areas where invasion species are a danger take special measures to avoid movement of seeds and propagules, for instance: wash shoes, equipment and vehicles. Use weed free seed and sterilized potting soil to prevent accidental introduction of invasive species.	 		

Box 7 : ALIEN INVASIVE SPECIES

When forests are disturbed they may be subject to invasion by undesirable plant and animal species. This is becoming an increasing problem now that global transport systems are so interconnected and rapid. Seeds and other propagules of plants are transported in soil, in association with other plants or animals, on people's shoes or vehicle tires etc. Some of these species may lack natural predators in their new habitat and may out-compete local species and become weeds. Invasive alien plant species include fungi, herbaceous plants, shrubs and trees. Changing climates are expected to cause some species to start behaving like invasives in areas where they have existed in a benign state for many years.

Invasive alien species are in general believed to constitute one of the biggest risks to biodiversity conservation. They are already the most serious problem on many islands. In the past tropical forests have tended to be dense and closed and difficult for exotic species to invade. Now with increasing fragmentation and logging damage and in some situations with increasing frequency of fires they are becoming more of a problem. Forest managers and conservation agencies need to be alert to the risks posed by invasive aliens and to respond rapidly if they are detected.

Some tree species that are deliberately introduced into new parts of the world for plantation and agroforestry schemes have the potential to become invasive. *Azadirachta indica*, *Cedrela odorata* and *Leucaena leucocephala* trees are highly useful, valued and actively planted in some regions, yet become troublesome weeds, causing serious economic damage in other situations. *Acacia mangium* has become an aggressive invasive species in some area where it is planted in SE Asia whereas elsewhere it does not propagate itself outside the plantations.

Chromolaena odorata and *Mikania cordata* can become persistent nuisances in disturbed forest, by dominating the soil seedbanks, they benefit from lack of co-evolved predators and are encouraged by repeated fires. They represent a hazard to biodiversity in logged forest.

Some of these invasive species choke out regeneration of indigenous species and may become so dominant that they require massive investments in forest restoration. Eradication of established aliens is vastly more expensive than prevention. Prevention should focus on limiting the transfer of propagules e.g. on lorry tracks and wheels from 'infected areas' and in avoiding using unsterilised soils or pots from other locations or used for other species.

Guideline 9.11: *Hunting and gathering in production forests should be regulated. Although some hunting and gathering for subsistence needs may be tolerated, large scale hunting and gathering for commercial use should be prevented and transport of bush meat etc on logging trucks should be banned.*	**Recommended action 9.11.1** Hunting and gathering for subsistence use should be monitored and tolerated at reasonable levels. Measures to regulate commercial hunting and NTFP gathering should be put in place. Such commercial activities should only be allowed when there is a capacity to establish sustainable harvest levels and regulate offtake. Forest managers should support measures for controlling harvesting and transport of bushmeat and NTFPs in the forests that they manage.	**Main Responsibility** 		
Guideline 9.12: *Logging operations may modify the habitat or change the distribution of some species that are important resources for local people. Logging may increase the likelihood of conflicts between people and wildlife, for instance elephants and apes. Forest managers may have to take special measures to mitigate these conflicts.*	**Recommended action 9.12.1** Management plans should anticipate potential conflicts with wildlife that result from logging activities and include measures to mitigate any risk – dangerous or crop-raiding animals may have to be controlled.			
	Recommended action 9.12.2 Large scale logging operators should ensure that supplies of meat from domestic sources or sustainably produced fish are available for their employees so as to reduce the demand for bush meat.			
Guideline 9.13: *Potential and emerging threats to biodiversity must be anticipated and contingency plans prepared to ensure that technically sound responses can be put into place rapidly when the need arises.*	**Recommended action 9.13.1** Assess potential threats to biodiversity and develop action plans to address them. Ensure all actors are informed of their roles in implementing these plans and receive any necessary training.			

	Recommended action 9.13.2 Ensure that clearly defined communication pathways exist to initiate management responses to emerging threats to biodiversity.	**Main Responsibility** 		

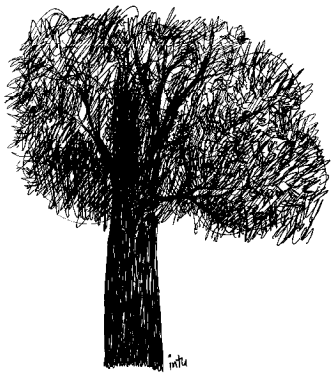
Box 8 : HUNTING IN TROPICAL RAINFOREST

Vertebrate game species in tropical forests are of crucial socio-economic importance as sources of protein and income for rural people. However, over-hunting across the humid tropics is causing local extinctions of many species. The causes are associated to forest loss, increased commercialization and human population growth in Africa, Asia and Latin America. The increased access for hunters to remote forests as a result of road building, particularly exacerbated by extractive industries such as logging, also contributes to over exploitation of wild meat. Hunting and trade in wildlife are linked to other opportunities available for food and income generation. A general rule is that rural communities consume more wild meat than urban communities, either because of availability or preferences. Therefore, acceptable substitutes and/or income increase could in theory reduce unsustainable hunting. It is also clear that successful solutions involve multidisciplinary approaches and collaboration in all levels, involving local people, governments, scientists and companies. For instance, the private sector may have an important role in conservation of wildlife, either via public-private partnerships or full private ownership and operation, including providing financial and technical resources in areas where governmental presence is scarce. In a large logging concession in Congo, an education program has helped logging company staff to establish no-hunting zones, restrict transportation of wildlife and providing feasible alternative protein source for workers and their families. In private land in the Brazilian Amazon, partnerships between logging companies and NGOs have established a program for monitoring of fauna. Priority actions involving the reducing use of wild meat include:

- Promoting of interdepartmental and interagency cooperation within governmental sectors
- Assessing the level of dependence on wild meat by local communities and establishing appropriate solutions
- Determining the drivers of the wild meat trade at national and international levels and increasing consumer access to domestic meat sources
- Including local people and the private sector in education programs and decision-making processes
- Preventing the use of wire snares and high-calibre firearms
- Establishing hunting zones through participatory process, including using local people and private companies to help control these areas
- Law enforcement, especially effectively enforced bans on the hunting of vulnerable species
- Promoting public awareness to educate hunters, traders and consumers about implications for sustainability of biodiversity and rural livelihoods
- Enhancing local capacity and good governance to implement above actions efficiently.

Principle 10: ***: Role of Plantations in Biodiversity Conservation*** The proportion of the tropical production forest estate that is under intensively managed plantations is increasing rapidly. When such plantations replace natural forest they are a threat to biodiversity. However plantations can be managed in ways that favour biodiversity, both within the plantation area and in areas of natural forest that are retained within the plantation matrix. In these situations plantations provide an opportunity for long-term maintenance of biodiversity.				
Guideline 10.1 *Plantations should not be established on areas of natural forest that contain features of biodiversity concern, or on areas of other natural habitat such as wetlands or grassland of conservation value.*	**Recommended action 10.1.1** Potential plantation areas should be surveyed to determine whether they contain biodiversity features of special concern, if such features are identified then the plantation plans should be adapted to ensure that these areas or features are protected.	**Main Responsibility** 		
	Recommended action 10.1.2 High Conservation Value Forests defined according to agreed biodiversity criteria should receive special protection when they occur in proximity to plantations.			
Guideline 10.2 *Large scale forest plantations can provide a matrix within which patches of high conservation value forest can be protected. The plantation company will often have the resources and infrastructure to make such protection effective.*	**Recommended action 10.2.1** Large scale plantation schemes should protect set aside areas of representative natural forest and of high conservation value forests within the plantation estate. Natural habitats should be retained along watercourses.			
Guideline 10.3 *Plantations can provide conditions for the persistence of species and assemblages of species of conservation value.*	**Recommended action 10.3.1** Manage plantations in ways that allow for native plants to colonise and persist. Where commercially viable extend the length of felling cycles as this favours biodiversity in the stand.			

Guideline 10.4 *Management that favours natural processes and native species can enhance soil conditions and provide other ecological benefits which will favour the productivity and resilience of the plantation.*	**Recommended action 10.4.1** Minimise pesticide and herbicide use in plantations wherever it is practicable to do so.	**Main Responsibility** 		
Guideline 10.5 *Where economically viable use native tree species or mixed species plantations to enhance the biodiversity value of the plantation. When exotic species have to be used, choose those which provide the best habitat for native biodiversity.*	**Recommended action 10.5.1** Choose species or species mixtures for plantations that provide habitat for native biodiversity.			
Guideline 10.6: *Measures should be taken to ensure that plantation forestry does not facilitate the introduction of invasive species and this could impact negatively on both the plantations and on neighbouring managed or natural forests*	**Recommended action 10.6.1** Minimize risks of introducing and propagating alien tree species that may become invasive. Care should be taken in selecting and testing any new species of varieties for plantations			



Obstacles to adoption of the Guidelines and enabling conditions

Biodiversity is valued differently at local and global scales. This is the main reason that is has made been difficult for local forest management to be adapted to address global biodiversity conservation needs. Biodiversity is of value to society at large in many different ways and thus the benefits of conservation flow to a wide range of national and global stakeholders and not just to local forest managers or local people. However, most of the costs of conserving biodiversity have to be born by the company or individual managing the forest. Biodiversity is thus a "public good" and ultimately the public has to pay the cost of its conservation either directly or by passing laws so that all forest managers are obliged to adopt conservation measures. When such laws are uniformly applied the playing field is levelled and the costs of biodiversity conservation are incorporated into the cost of forest products.

Unfortunately subsidies and tax incentives to encourage biodiversity conservation are still not operating in tropical production forests. Legal measures to protect biodiversity do exist in many countries but the laws are often inadequate and frequently not respected. The recent publicity of the scale of illegal forest activities and of the weakness of governance in the forest sector in both tropical and temperate zones is indicative of the extent of the problem.

There are also a number of more immediate reasons why biodiversity values are not adequately maintained in tropical production forests. Forest managers are rarely adequately trained in the skills needed to manage biodiversity. In some regions the number and skill levels of field foresters has declined in recent years and staff with the taxonomic skills needed to assess and monitor biodiversity are not available. Many forest operators are only really concerned with timber production – that is the only source of revenue for them – and although they may make statements about biodiversity in their management plans they have almost no incentive to implement those parts of their plans. Government regulatory agencies rarely have the resources or the expertise to monitor implementation of biodiversity commitments. Many forest operations are sub-contracted and the contractors are paid by unit of production – all the incentives are for them to focus exclusively on getting timber to the mill gate.

The fact that there has been scepticism about the realism of achieving biodiversity conservation in managed forests has also created problems. In spite of the abundant evidence in studies such as those referred to in section 3 of this report (Box 4: Major New Sources of Information) some environmental NGOs simply do not believe that logging will ever yield biodiversity benefits – they think that the added costs that would be incurred in achieving biodiversity conservation would make natural forest management uneconomic. Others simply do not trust commercial foresters. This scepticism contributed to the negative position adopted by the World Bank in its 1992 Forest Policy which is widely regarded as having had a "chilling effect" on international support for investments in sustainable forest management in the 1990s. The new World Bank Forest Policy of 2003 has re-assessed this situation and is likely to encourage increased investments in forest management activities, albeit with stringent safeguards.

Another problem that is emerging as an obstacle to investment in sustainable forest management is the declining profitability of tropical timber. Past over-exploitation of timber in many tropical forest areas has depleted the resource; yet processing infrastructure is still in

place and is creating demand for raw materials. Logging companies have strong incentives to continue to over-exploit to keep their mills running. As timber supplies from these over-exploited accessible tropical areas are depleted and supplies of timber from temperate and boreal regions become more competitive it is becoming harder to make a profit from tropical timber. The willingness to invest in long-term management for biodiversity or even to maintain future timber yields is declining.

Although some success has been achieved in implementing Reduced Impact Logging in some areas the uptake of these techniques has in general been disappointing. The prospect of certification has motivated some forest operators to introduce measures to sustain biodiversity but in other cases those companies that have sought certification have been singled out for criticism by environmental groups and the media. Companies that quietly continue with business as usual have often escaped this criticism. The result has been that some of the most environmentally responsible and progressive companies have been the ones singled out for public opprobrium and less responsible companies have been ignored.

Skills, capacity and training

Successful management of biodiversity in tropical production forests requires skills that are no longer given much prominence in the training provided by forestry schools. The result is that forest management agencies and commercial companies have difficulty in recruiting the staff that they would need to implement measures to maintain biodiversity values. Incentives and reward structures for taxonomic and ecological skills are inadequate. One hears frequently of situations where there are only a handful of competent field taxonomists in a country with extensive high biodiversity value forests. 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. Ultimately the required skills will have to be developed and retained in forest agencies and in many cases these agencies will have to provide such specialists as a service to forestry operators. 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.

Forest Departments will therefore have to develop specialist services to assess, monitor and maintain data-bases on biodiversity or else they will have to form alliances with specialized institutions and contract them to provide the expertise required.

Forestry training institutes will have to revise their curricula to adequately address biodiversity issues and the present decline in taxonomic teaching in universities throughout the world will have to be reversed.

Foresters will need their training on inventory techniques to be strengthened so that the scope of inventories is expanded to include multiple resources. Biodiversity will need to be addressed in field manuals. Participatory techniques will need to be more widely adopted to ensure that local and traditional knowledge of biodiversity is adequately taken into account. Para-taxonomists will be needed and this can provide employment to those forest dwelling communities who often fail to obtain benefits when logging operations move into their forests. Field guides to biodiversity will need to be more widely available and of higher quality.

Public awareness of biodiversity values of production forests will need to be raised through the media. Decision makers will need to be sensitized to the potential of production forests to contribute to meeting biodiversity targets.

Looking to the Future

The application of these Guidelines will require that specialized training and financial incentives become available at the national and forest management unit level. Subsidies, environmental payments and/or tax concessions will have to be introduced in tropical producer countries. The international community has a role to play in supporting pilot programmes, funding the conservation of globally threatened species and transferring technology to tropical producer countries

Many international agencies have an interest in biodiversity conservation and many will have a role to play in ensuring that the messages in these Guidelines are put into practice. Several of these agencies have contributed to these Guidelines. The Guidelines themselves build upon the work of the Convention of Biological Diversity, CIFOR and other specialized biodiversity agencies.

Different categories of forest have differing but complementary roles in achieving biodiversity conservation so different international and national agencies also have different roles to play. The expertise that is required is scattered through a range of public and private institutions. Research and operational bodies all have contributions to make. There will be a need for new partnerships and alliances. Some of the most interesting in this field have come where international conservation NGOs have worked closely with logging concessionaires and private forest owners to help them improve their management of biodiversity.

Many tropical production forest countries now have National Biodiversity Strategies and Action Plans and these same countries have National Forest Programmes. Often the links between these two planning frameworks are not as good as they might be. Biodiversity conservation in production forests falls at the interface of NBSAPs and NFPs. This is a symptom of the fact that environmental and forestry issues are often dealt with by separate agencies. More inter-agency collaboration is needed. The FAO Forest Resource Assessment for the year 2005 will include biodiversity. This will provide an opportunity to bring together at a global scale the information from both protected areas and managed forests.

As more of the world's wood fibre is produced in plantations and the remaining natural forests are increasingly valued for their environmental functions it is likely that conserving biodiversity will become an increasingly dominant element of forest management in the tropics. This is already the case in many temperate and boreal countries.

ITTO could play a pivotal role in the process of reconciling biodiversity aims and production aims in tropical forests. It brings together the managers of many of the world most important tropical forests and is already strongly engaged in supporting protected areas. It could make major contributions to the exchange of information and technologies and to the forging of the partnerships that will be required if these Guidelines are to have the impact that is needed.

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Annex I

PROVISIONAL INDICATORS FOR ASSESSING PROGRESS TOWARDS THE 2010 BIODIVERSITY TARGET

Convention on Biological Diversity – Web site

A: Focal area	B: Indicator for immediate testing	C: Possible indicators for development by SBSTTA or Working Groups
Status and trends of the components of biological diversity	Trends in extent of selected biomes, ecosystems and habitats	
	Trends in abundance and distribution of selected species	
		Change in status of threatened species (Red List indicator under development)
		Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance
	Coverage of protected areas	
Sustainable use		Area of forest, agricultural and aquaculture ecosystems under sustainable management
		Proportion of products derived from sustainable sources
Threats to biodiversity	Nitrogen deposition	
		Numbers and cost of alien invasions
Ecosystem integrity and ecosystem goods and services	Marine tropic index	Application to freshwater and possibly other ecosystems
		Connectivity/fragmentation of ecosystems
		Incidence of human-induced ecosystem failure
		Health and well-being of people living in biodiversity-based-resource dependent communities
	Water quality in aquatic ecosystems	
		Biodiversity used in food and medicine
Status of traditional knowledge, innovations and Practices	Status and trends of linguistic diversity and numbers of speakers of indigenous languages	Further indicators to be identified by WG-8j
Status of access and benefit-sharing		Indicator to be identified by WG-ABS
Status of resource transfers	Official development assistance provided in support of the Convention (OECD-DAC-Statistics Committee)	
		Indicator for technology transfer

Annex II

PROVISIONAL FRAMEWORK FOR GOALS AND TARGETS
Convention on Biological Diversity – Web site

Protect the components of biodiversity
Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes
Target 1.1: At least 10% of each of the world's ecological regions effectively conserved.
Target 1.2: Areas of particular importance to biodiversity protected
Goal 2. Promote the conservation of species diversity
Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups
Target 2.2: Status of threatened species improved.
Goal 3. Promote the conservation of genetic diversity
Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and othervaluable species conserved, and associated indigenous and local knowledge maintained.

Promote sustainable use
Goal 4. Promote sustainable use and consumption.
Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, andProduction areas managed consistent with the conservation of biodiversity.
Target 4.2 Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced
Target 4.3:No species of wild flora or fauna endangered by international trade

Address threats to biodiversity
Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.
Target 5.1: Rate of loss and degradation of natural habitats decreased
Goal 6. Control threats from invasive alien species
Target 6.1: Pathways for major potential alien invasive species controlled.
Target 6. 2: Management plans in place for major alien species that threaten ecosystems, habitats or species.
Goal 7. Address challenges to biodiversity from climate change, and pollution
Target 7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change
Target 7.2: Reduce pollution and its impacts on biodiversity

Maintain goods and services from biodiversity to support human well-being
Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods
Target 8.1: Capacity of ecosystems to deliver goods and services maintained.
Target 8.2: biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained

Protect traditional knowledge, innovations and practices
Goal 9 Maintain socio-cultural diversity of indigenous and local communities
Target 9s.1 Protect traditional knowledge, innovations and practices
Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit sharing

Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources
Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources

Target 10.1: All transfers of genetic resources are in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements.
Target 10.2: Benefits arising from the commercial and other utilization of genetic resources shared with the countries providing such resources

Ensure provision of adequate resources
Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention [76]/
Target 11.1: New and additional financial resources are transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20
Target 11.2: Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.

Annex III

CBD GOALS AND TARGETS
Convention on Biological Diversity – Web site

Protect the components of biodiversity	
Goal 1. Promote the conservation of the biological diversity of ecosystems, habitats and biomes	Target 1.1: At least 10% of each of the world's ecological regions effectively conserved.
	Target 1.2: Areas of particular importance to biodiversity protected
Goal 2. Promote the conservation of species diversity	Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups
	Target 2.2: Status of threatened species improved.
Goal 3. Promote the conservation of genetic diversity	Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained.
Promote sustainable use	
Goal 4. Promote sustainable use and consumption.	Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity.
	Target 4.2 Unsustainable consumption, of biological resources, or that impacts upon biodiversity, reduced
	Target 4.3:No species of wild flora or fauna endangered by international trade
Address threats to biodiversity	
Goal 5. Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.	Target 5.1: Rate of loss and degradation of natural habitats decreased
Goal 6. Control threats from invasive alien species	Target 6.1: Pathways for major potential alien invasive species controlled.
	Target 6. 2: Management plans in place for major alien species that threaten ecosystems, habitats or species.
Goal 7. Address challenges to biodiversity from climate change, and pollution	Target 7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change
	Target 7.2: Reduce pollution and its impacts on biodiversity
Maintain goods and services from biodiversity to support human well-being	
Goal 8. Maintain capacity of ecosystems to deliver goods and services and support livelihoods.	Target 8.1: Capacity of ecosystems to deliver goods and services maintained.
	Target 8.2: biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained

Protect traditional knowledge, innovations and practices	
Goal 9. Maintain socio-cultural diversity of indigenous and local communities.	Target 9.1: Protect traditional knowledge, innovations and practices
	Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit sharing
Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources	
Goal 10. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources.	Target 10.1: All transfers of genetic resources are in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements.
	Target 10.2: Benefits arising from the commercial and other utilization of genetic resources shared with the countries providing such resources.
Ensure provision of adequate resources	
Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention.	Target 11.1: New and additional financial resources are transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20.
	Target 11.2: Technology is transferred to developing country Parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.

Annex IV
Examples of National Initiatives

Ghana

The total managed forest reserve area in Ghana is 1,643,100 ha. Within these Forest Reserves the Ghana Forestry Commission is currently implementing a comprehensive forest protection strategy based on an intensive floristic survey. The objective is that the genetic diversity of the forest and its environmental protection functions are not further eroded.

Ghana carried out an extensive botanical survey of the high forest zone between 1990 and 1992. This established a database on forest plant distribution to be used to plan forest protection and management. The botanical survey was based upon 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 provides data for assessing the standing populations of timber but certain patterns in the data have implications for biodiversity conservation. For example, timber trees may be of conservation concern despite being common. By classifying more 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 high centres of endemism within the high forest zone.

Based on these surveys a set of Forest Protection Guidelines was developed and is being implemented through a set of Manuals of Procedures and a Timber Logging Manual. The Forest Protection Guidelines ensure biodiversity protection at two levels – within the management unit and also at larger spatial scales. 4.4% of the total forest reserve area in Ghana is now dedicated to conservation of rare species, ecosystems and economic trees. At the level of the management unit protection aims at 1) selected individual plants, especially trees; 2) small clusters of trees and their understorey in otherwise deforested areas and 3) all forest 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 is also provided for species that have suffered from over exploitation in the past through the use of a reduced yield formula whilst some species, because of very low population and vulnerable ecology like *Tieghemella heckelii,* are only exploited on special permit.

The rules for landscape-scale protection are implemented through a Manual of Procedures for Strategic Planning. In the District level strategic plan of the forest reserves these areas are recorded and clearly designated in the compartment.

Globally Significant Biodiversity Areas. These are representative areas (whole or partial forest reserves) that contain a high concentration of globally rare species and/or are of a special forest types and are therefore of high conservation value.

Provenance Protection Areas have been established for the protection of populations of heavily exploited species. This is required to ensure that the full genetic diversity of species

including any locally adapted 'provenances' is maintained. This prevents the loss of genetically desirable traits such as growth rates, disease resistance or wood qualities through over-exploitation

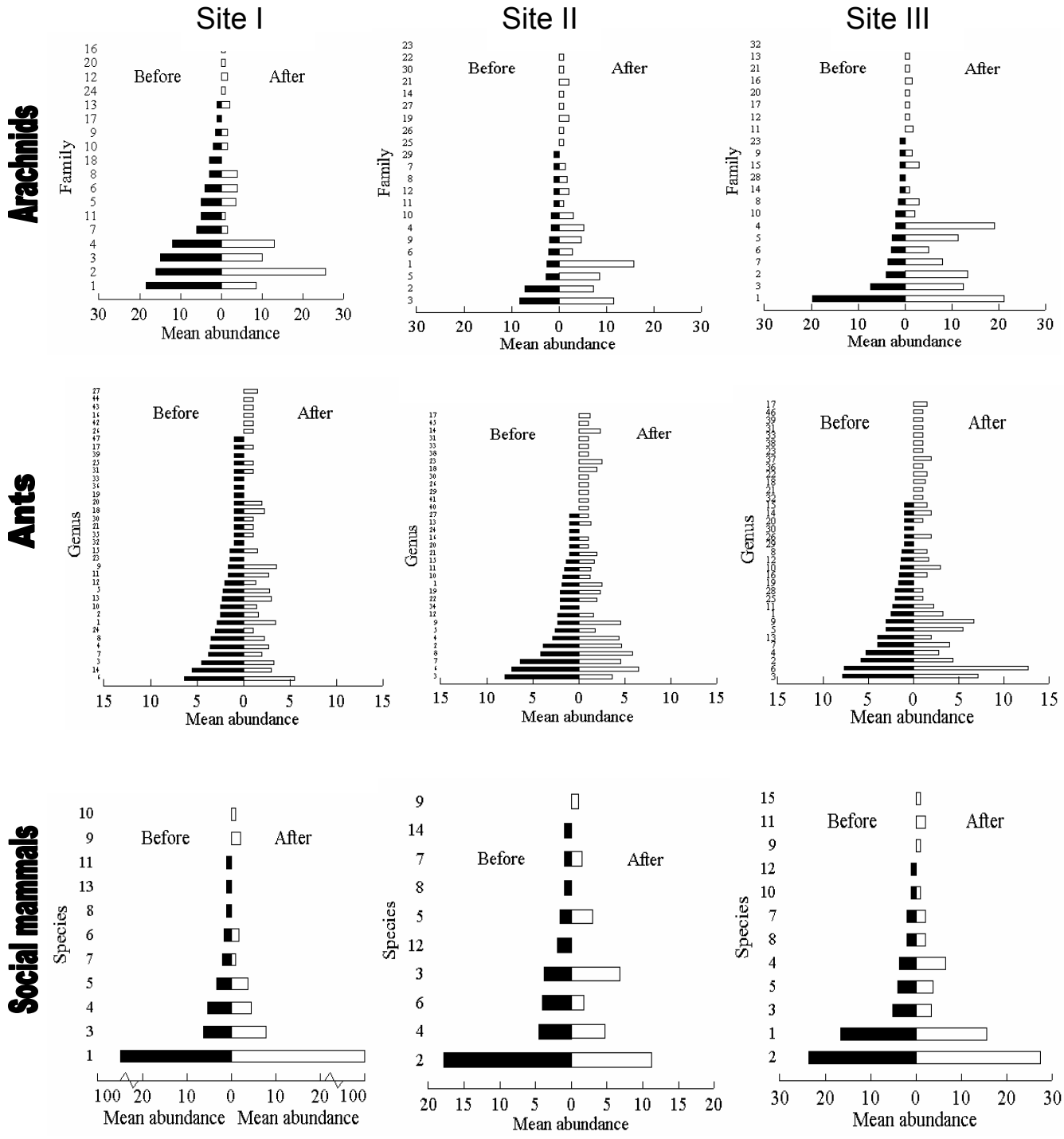
Brazil

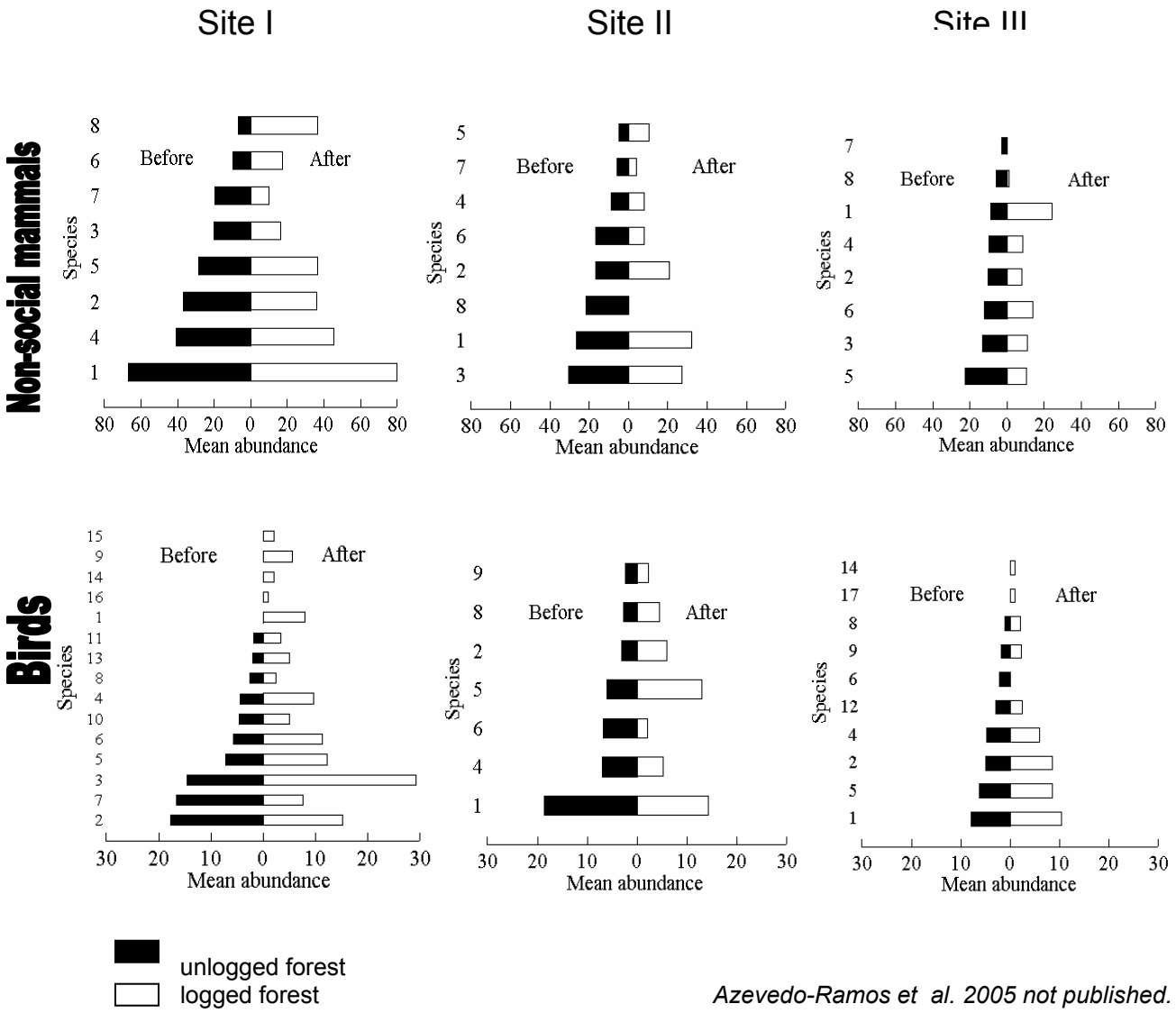
Timber Companies and the Conservation of Fauna

Timber harvesting is still predatory in many areas of Amazonia, but recently some timber companies have begun to seek certification of their forests. Certification requires that the impact of timber harvesting on local fauna be restricted. The evaluation of compliance with this criterion, however, can be difficult due to the lack of established protocols and experience in monitoring fauna by timber companies. To collect this data and encourage timber companies to care about forest "health", timber companies are training their staff to carry out wildlife surveys.

Fauna plays an important role in forest ecosystems, for example, animals act as pollinators and seed dispersers, and also control the growth of some plants through herbivory. 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, have yet acknowledged this link. As a result, monitoring has not been actively pursued or been adequately funded.

However, since 1997 a team from IPAM (Amazon Institute of Environmental Research, 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. These methodologies could now be applied by logging companies. In April 2002, IPAM's team performed a training course for three logging companies with certified areas in the state of Pará, Brazil. The workers were trained to sample arthropods, some species of diurnal birds and mammals. The former were collected with pitfall traps and sardine bait (ants). Mammals and game birds were inventoried over 200 to 400 km of trails in each logged forest. The monitoring was undertaken within six months of logging and then in pre-determined periods every 2 years to evaluate the response of the fauna over the long run. The companies collect the required data independently, maintaining the flexibility required in private business ventures, and then send the data to IPAM, which is responsible for the analyses and reports. The resulting data also provides a good source of information for certification auditors. Monitoring can be conducted at a relatively low cost, since the two month's sampling can be done by four workers with limited experience in the forest. Other environmental variables, such as gap size after logging and forest flammability (vulnerability to fire), can be added to the protocols, enabling the forest manager to better monitor forest "health". In the future, when fauna monitoring protocols are better defined, company staff will be able to generate the final reports themselves, though this will require further training or the hiring of a professional with the necessary background. Until then, however, the company-researcher partnership is effective and desirable. An example of the short-term impact of logging on animals sampled by two certified timber companies in three sites in Para state is given below. Overall, for all animal groups, species richness and composition changed after logging, but abundance of individuals did not change. Also, the effect was more conspicuous in lower taxonomic groups. However, it was demonstrated that Reduced Impact logging resulted in lower species loss and this illustrated the value of RIL as a conservation measure.


Site I
Site II
Site III
Arachnids
Ants
Social mammals
Before
After
Family
Genus
Species
Mean abundance



Azevedo-Ramos et al. 2005 not published.

Philippines

An ITTO project in a 75,745 ha Timber Licence Agreement in Northern Mindanao has assessed the impact of forest management activities in stands under different intensities of management and for periods of up to 30 years after logging. This project was one of the only cases where the 1993 ITTO Guidelines for Biodiversity Conservation in Tropical Production Forests were used explicitly in practical forest management activities. Baseline biodiversity data from the early years of management was not available but under the ITTO project biodiversity was studied in plots with different histories of management and in different parts of the landscape.

Biodiversity declined abruptly in the period immediately after logging but the decline was less marked where lower impact harvesting was used. The diversity of species in forests under management was lower than in undisturbed forest areas. However species abundance and diversity recovered quite quickly after logging. The biodiversity did not return to its state before logging occurred and the biodiversity was influenced by the methods of logging and of post logging management.

Given good levels of protection biodiversity eventually bounced back after logging. The biggest danger came from activities other than planned logging – agricultural encroachment and illegal logging for example. The project concluded that it would be important to determine acceptable levels of decline of biodiversity in production forests and then to make the necessary investments in management to achieve these levels.

Malaysia

Certification criteria and indicators for Peninsula Malaysia incorporated ideas from the ITTO Guidelines for Biodiversity Conservation in Tropical Production Forests. However Malaysian forestry practices have always included measures to protect biodiversity. Malaysia has a system of 72 Permanent Jungle Reserves covering 23,500 ha within the Permanent Forest Estate that are established with the aim of protecting the natural diversity of genotypes and species of the forest management unit. There are 84 Forest Recreational Areas covering 7,000 ha and extensive Water Catchment Areas that all contribute to biodiversity conservation goals.

Within the production forests reduced impact logging is now widely practiced. Seed trees and fruiting species are protected in the residual stand. Specific measures to favour biodiversity are included in the Reduced Impact Logging Guidelines of the Forest Department of Peninsula Malaysia.

Biodiversity Conservation in an Acacia Plantation in Sarawak

The State of Sarawak currently has about 8,500,000 hectares of forest, of which about 1,500,000 ha are earmarked for tree plantations, with species such as 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 a planted forest of *Acacia mangium* in the Bintulu Division, central Sarawak, an area from which commercial timber has been removed beginning about 1970.

To address the full range of socio-economic and environmental issues involved in implementation of the project, Grand Perfect Sdn Bhd has three Departments, e.g., Production, Community Development and Conservation. The Conservation program seeks to maintain high biodiversity values within the Planted Forest Zone (PFZ), and will integrate biodiversity conservation with the economic and social needs of local communities. More than 250 longhouses (of the Iban, Beketan and Punan ethnic groups) are present within the PFZ.

Three types of land use are planned for the project area: State Lands earmarked for Acacia planting (230,000ha), Native Customary Rights lands (NCR) and former shifting cultivation lands (110,000ha), and Conservation Zones (150,000ha) that contain some High

Conservation Value Forest or represent other kinds of forested areas. Two large set-asides, Bukit Sarang and Binyo-Penyilam Conservation Areas (approximately 12,000ha and 18,000ha respectively), contain numerous endemic, or rare or endangered species (orchids, begonias, snails, lizard, birds, mammals, etc). Native customary lands and other former shifting cultivation sites, contain forests of various ages rich in non-timber trees such as those bearing wild fruits, and forming additional feeding opportunities and cover for wildlife.

Grand Perfect's Conservation Program involves a threefold strategy:

1. Production and operations – The entire PFZ has been mapped and activities are covered by a GIS management system, through which activities in every planted compartment are planned, implemented, monitored and controlled. The mosaic pattern of planted or otherwise forested habitats is shown in the landscape level map (Fig. 1). The landscape pattern, a mosaic of natural forest and planted compartments with large and small conservation set-asides (river buffers and wildlife corridors), 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. No pesticides are at present being used. Water quality is regularly (e.g., quarterly) monitored, both before and after planting. All data relevant to planting material (provenance, stocking density, date of planting, area planted or unplanted, etc), and data on flora and fauna (distribution, abundance, vulnerability, use) are incorporated into the GIS Plantation Integrated Management System ("PIMS"). All operational requirements have been developed with a broader, state or national application in mind.

2. Community Development – Continuing communication with more than 200 traditional longhouse communities in the PFZ is in place to ensure the sustainable harvest of forest resources (such as a collaborative study of the distribution, abundance and harvest levels of the Bearded Pig (*Sus barbatus*) the main source of protein). Community education and awareness efforts have been based on provision of natural history guides to local schools and longhouses, and discussions of wild resource use. The values of traditional skills are being recognized by employing longhouse residents as field assistants in taxonomic inventories and by providing technical training that may allow locals to be employed independently for future biodiversity assessments and monitoring.

3. Conservation - Biological inventories are conducted through long-term partnerships with local, regional and international scientific institutions. The Smithsonian Institution's National Museum of Natural History and Conservation Research Center (USA), Field Museum of Natural History (USA), Lund University (Sweden), Singapore Herbarium, Raffles Museum of Biodiversity Research (Singapore), Nanyang Technological University (Singapore), Universiti Malaysia Sarawak, and the Universiti Tuanku Abdul Rahman (Peninsular Malaysia) are among the institutions with whom Grand Perfect Sdn Bhd has signed Memoranda of Understanding, to build comprehensive species databases for the PFZ. All fieldwork is done in cooperation with the Sarawak Forest Department and the Sarawak Forestry Corporation, with whom results are shared. Local NGOs, the Malaysian Nature Society and the Sarawak Nature Society, have been invited to join in these efforts and are supported by Grand Perfect through its corporate membership. Meanwhile, Grand Perfect has been working with institutions like the Sarawak Timber Association (STA) on developing increased capacity in areas such as manpower training, fire management, and nursery management.

The Project will eventually produce five million metric tonnes of industrial wood per year, and simultaneously play a crucial role in biodiversity conservation for the State. By early 2006, a management plan for the PFZ will be completed, and used to integrate economic profitability with the maintenance landscape level biodiversity.

Indonesia

The core of the Indonesian Biodiversity Strategy and Action Plan adopted in 2003 is a system of 315 protected areas covering 22,560,545 ha. Although the ITTO Guidelines for Biodiversity Conservation in Tropical Production Forests were translated into Indonesian there appears to have been only sporadic attempts to implement them on the ground. However Indonesian forestry regulations do require concessionaires to set aside a minimum area of 300 ha for the protection of flora and fauna. There are criteria that ensure that these set asides are located in areas with high conservation value. In plantation forest estates companies are obliged to set aside 10% of their concession area to be retained under natural forest.

Recently some international conservation NGOs (Worldwide Fund for Nature, the Nature Conservancy and Birdlife international) have formed alliances with timber companies to attempt to promote biodiversity conservation within logging concessions. There are ongoing attempts to define and map High Conservation Value Forests based upon biodiversity criteria. The Indonesian Ecolabelling Foundation has been attempting to ensure that existing regulations to protect biodiversity in production forests is observed in any concessions seeking certification.

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