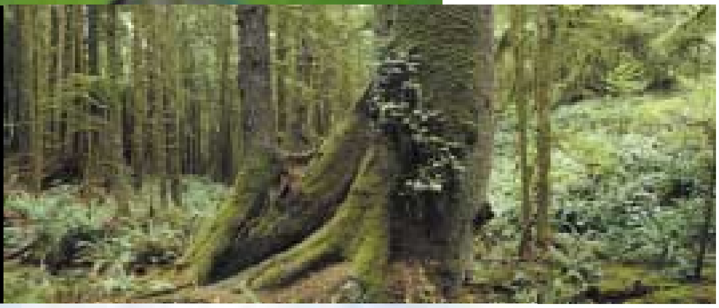
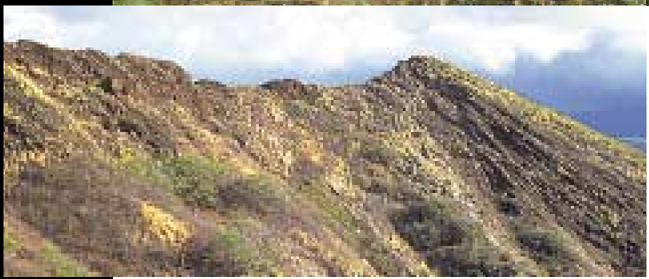
Secretariat
of the Convention on
Biological Diversity

CBD Technical Series No. 3

ASSESSMENT, CONSERVATION AND SUSTAINABLE USE OF FOREST BIODIVERSITY





UNEP

CBD

CBD Technical Series No. 3

Assessment, Conservation
and
Sustainable Use of Forest Biodiversity

Montreal 2001

Published by the Secretariat of the Convention on Biological Diversity ISBN: 92-807-2110-0

Citation
Secretariat of the Convention on Biological Diversity (2001). Assessment, Conservation and Sustainable Use of Forest Biodiversity. Montreal, SCBD, 130p. (CBD Technical Series no. 3).

For further information, please contact:

Secretariat of the Convention
on Biological Diversity
World Trade Centre
393 St. Jacques Street, suite 300
Montreal, Quebec, Canada H2Y 1N9
Phone: 1 (514) 288 2220
Fax: 1 (514) 288 6588
E-mail: secretariat@biodiv.org
Website: http://www.biodiv.org

FOREWORD

The Convention on Biological Diversity (CBD), negotiated under the auspices of the United Nations Environment Programme (UNEP), was adopted in 1992 and entered into force in 1993. Its aims are the conservation of biological diversity, the sustainable use of biological resources, and the fair and equitable sharing of benefits arising from the use of genetic resources. One of the major challenges facing the Convention on Biological Diversity is the communication of research results in a way that provides the policy makers, their advisors, the scientific community and other stakeholders with helpful insights

Major factors leading to biodiversity loss are habitat loss and degradation, invasive alien species, overuse of resources and pollution. Due to the complexity of these factors, various approaches and strategies are being used to reduce biodiversity loss. All, however, require the best available scientific information that allows the development and implementation of sound management strategies.

The goal of the CBD Technical Publications Series is to contribute to the dissemination of up-to-date and accurate information on selected topics that are important for the conservation of biological diversity, the sustainable use of its components and the equitable sharing of its benefits. A large and growing body of evidence has clearly established the need to disseminate synthesis publications relevant to CBD objectives and selected reports presented at CBD meetings.

The Technical Publications Series is intended to:

- Foster scientific and technical cooperation;
- Improve communication between the Convention and the scientific community;
- Increase awareness of current biodiversity-related problems and concerns; and
- Facilitate widespread and effective use of the growing body of scientific and technical information on conserving and using biological diversity

The CBD Technical Publications Series comes at a time when the international community through the Conference of the Parties to the Convention has committed itself to achieving tangible results in all aspects of the sustainable management of biological diversity for social and economic purposes. We therefore believe that this series will be useful to the broader scientific community and those concerned with biodiversity management.

I am very pleased to make available to the scientific community and those actively involved in biodiversity management the third publication in the CBD Technical Series, addressing Forest biodiversity. It is my hope that this publication will broaden our understanding of the complexity of the issue and at the same time facilitate the implementation of remedial measures to reduce or halt biodiversity loss.

I wish to express my sincere gratitude to all those who have contributed in one-way or another in the preparation and production of this series.

Hamdallah Zedan
Executive Secretary

CONTENTS

Conservation and Sustainable Use (sustainable forest management)

Keynote Addresses

THE NEEDS FOR TARGETS IN THE IMPLEMENTATION OF THE CONVENTION ON BIOLOGICAL DIVERSITY

This presentation reviews the needs for targets for the Convention on Biological Diversity and the context in which targets may be adopted at national and international levels. To date, target-setting has not been a significant part of the operations of the Convention during its first decade. Although many goals have been achieved, in the form of valuable outputs and processes, so far little focus has been given to the development and realisation of outcome-orientated targets.

A target may be defined as "an objective or result towards which efforts are directed". It is a word that is not included in the text of the Convention, however, the Convention uses similar words, such as objectives, goals and aims, which define desired outcomes, but which lack the precision of the term "target" (in the context of its general or common usage). Targets are often defined to be "measurable" or "SMART", that is: **S**pecific, **M**easurable, **A**greed (or **A**chievable), **R**ealistic (or **R**elevant) and **T**ime-bound. It is the need for such measurable or SMART targets for the Convention that is addressed in this presentation.

Many fundamental questions can be posed, such as the following, that need to be addressed when considering whether targets are a useful addition to the measures currently employed by the parties to the Convention:

- Are targets needed and if so why are they needed?
- Will the development of targets help to achieve the objectives of the Convention, and go beyond existing measures adopted or set in motion?
- If targets are to be adopted, how can they be developed, and by whom?
- How would targets be used and for what aspects of the Convention would they address?
- Can they become a means by which progress towards the achievement of the Convention's objectives and work programmes can be measured?
- Who would targets be for – individual parties to the Convention; the broader international biodiversity conservation community; COP and SBSTTA; the CBD Secretariat, all of the above?
- What are the positive and negative aspects of developing and adopting targets?
- Can or should targets be SMART targets, or should they be more broadly aspirational?
- Can realistic and useful targets be defined for the Convention which are both process targets and action-orientated outcome target?

Decision V/20 of the Conference of the Parties initiated an inter-sessional process to develop a Strategic Plan for the Convention, with a view to preparing a full draft Plan in time for consideration and adoption by the Conference of the Parties at its sixth meeting. The draft elements of the Strategic Plan have now been completed, included in a note by the Executive Secretary (UNEP/CBD/MSP/2 of 17th September 2001. The note describes the process to develop the Strategic Plan, its rationale and possible elements. Decision V/20 decided that the Strategic Plan shall be based on the longer-term programmes of the work of the Conference of the Parties and of SBSTTA and provide strategic and operational guidance for the implementation of these programmes of work. It is proposed that it would initially cover the period 2002 to 2010. A workshop on the Strategic Plan was convened by the Executive Secretary in the Seychelles from 28-30 May 2001. The conclusions of this workshop agreed that the basic structure of the Plan should include a mission statement, a vision, operational goals, action plans to achieve the operational goals and a process for monitoring, reporting, assessment and the review of outcomes and communication. The workshop concluded that the action plans adopted should include outcome-orientated targets (which differ from the "output" targets or "process" targets used so far under the Convention).

Peter S. Wyse Jackson
Secretary General, Botanic Gardens Conservation International,
Descanso House, 199 Kew Road, Richmond,
Surrey, TW9 3BW, U.K.
E-mail: pwj@bgci.rbgkew.org.uk

It is clearly important that measures are taken to ensure that an evaluation process is embedded into strategic planning for the Convention. The adoption of measurable targets could considerably enhance the means available by which evaluation can be achieved. The step towards achieving effective evaluation of the Convention may be to develop explicit performance review systems that allow the parties to evaluate what they are achieving in relation to the expressed purposes of the Convention and of their decisions. Evaluation rests at the heart of any strategic planning system. Judgements can be formed about the value of achievements, and the direction and cohesion of the implementation of the Convention sharpened. Each stage of the planning process adopted should incorporate reflection upon the purposes and conditions of evaluation and the means of monitoring.

The issue of who is evaluating progress and for what purposes is an important one. The Convention must be effective in developing strategies to meet its objectives that are responsive to the needs of parties. The Convention can become a means to encourage and obtain agreement and consensus on targets in biodiversity conservation at all levels for the parties and other bodies and communities. However, the Convention must take its lead from those parties and other relevant bodies themselves in the determination of what are meaningful and realistic targets. The Convention is always reliant on individual parties and other bodies to make progress and to provide data. Thus, any target-setting or activity involving evaluation has to have the backing of all those involved. The current discussions on the proposed Strategic Plan also recognise that the imposition of a top-down approach to the Plan is neither desirable nor feasible as a means of imposing discipline or order on existing activities. Parties have noted that the Strategic Plan should bring about co-ordination through harmony and gradually over time bring about convergence of action around agreed goals and collective objectives (UNEP/CBD/MSP/2/page 7). The same approach must be taken to target setting under the Convention.

The task of any evaluation system adopted is to establish criteria for assessing performance and to choose indicators or measures which allow progress towards agreed targets to be assessed. Performance can be judged by assessing progress over time from a base-line towards a target. The base-line establishes the starting point, while the target defines the distance to be travelled towards a desired end point. Defining those starting points is however not always straightforward or easy. The careful choice and use of relevant biodiversity indicators can help to resolve the base-line starting points from which progress can be measured. Biodiversity indicators addressing, for example, wild species and genetic diversity, community diversity and domesticated species diversity can be adopted based on status surveys of species and their genetic diversity, ecosystems and on conservation measures undertaken for each. A range of other indicators are needed to address other aspects of the implementation of the objectives of the Convention, related to such aspects as, for example, public awareness and understanding of biodiversity, its value and vulnerability and on access to genetic resources and benefit sharing. Considerable progress has already been made by the parties in considering the need for and utility of indicators. The incorporation of suitable indicators into the defined goals for the Convention would result in the greatly increased ability to determine very useful measurable targets.

The use of benchmarking at national and international levels is a valuable way of helping to determine whether targets chosen are realistic and achievable. Benchmarking involves the comparison of operations, practices, and performance against others by which “best” practices may be identified and determined. Through an ongoing and systematic benchmarking process parties might find suitable reference points for setting their own goals and targets.

A suggested cycle for evaluating and improving achievement is:

> What has been achieved to date?
> How does this compare with our targets?
> What more should we seek to achieve during the next plan period?
> What action should now be taken based on what has been learnt.

The COP has recognised the need for evaluation of measures taken. As stated in COP Decision II/8 "There is a need for each party to start assessing the effectiveness of measures taken under the Convention. However, methods for assessing the effectiveness of measures to conservation or sustainable use of biological diversity should be reviewed. The use of indicators of biological diversity and the status of its components is particularly time- and cost-effective".

Clearly the setting of meaningful measurable targets must often be subject to the availability of adequate quantitative data – if we wish to set targets in forest biological diversity conservation, for example, we need to have adequate knowledge of the present basis, extent and status of such diversity. Of course, such data are often lacking, unreliable or inadequate and so our efforts must be directed towards identifying targets that can act as indicators of broader or related targets, or where our targets also address the need for establishing baseline data.

Worldwide there is an increasing trend towards the incorporation of measurable or SMART targets into strategic and other plans adopted for biodiversity conservation. Several countries throughout the world have included measurable target in their Biodiversity Action Plans. The presentation includes several illustrative examples, such as the National Targets for Biodiversity included in the First National Report to the COP from Guyana. Its national targets include the maintenance of 60% of Guyana as natural forest and the designation of approximately 10% of Guyana under protected status. The U.K. Biodiversity Action Plan (1994) contains a major section on Targets and Monitoring containing a total of 50 targets. For many of these targets measurable performance indicators are provided whereby the achievement of the targets can be monitored. For example, the U.K. Action Plan sets the target of managing and maintaining all existing 12,500 ha of woodland remaining of the important Caledonian Pinewoods of Scotland, and during the 1990s, proposes to begin the process of regenerating a further 5,000 ha.

At the international level a series of measurable outcome targets have been proposed for a draft Global Strategy for Plant Conservation (GSPC), currently being considered by SBSTTA. 14 SMART targets have been proposed under the headings understanding and documenting plant diversity; conserving plant diversity; using plant diversity sustainably; raising awareness about the importance of plant diversity and building capacity for the conservation of plant diversity.

In the proposal for a global strategy for plant conservation (UNEP/CBD/SBSTTA/7/10), the Executive Secretary notes that "The strategy and its 14 targets are intended to provide a framework for policy makers and public opinion and catalyse the reforms necessary to achieve plant conservation. Clear, stable, long-term targets that are adopted by the international community can help to shape expectations and create the conditions in which all sectors, whether governments, the private sector, or civil society, have the confidence to develop solutions to address threats to plant diversity. For the targets to be widely understood, and appealing to public opinion, they need to be kept fairly simple and straightforward. They should be understood in a commonsensical rather than a literal way. In order that the number of targets be kept manageable, they need to focus on a set of activities that are strategic, rather than aiming to be comprehensive". The time-scale proposed for the achievement of these targets is 2002-2010, to bring them in line with the Strategic Plan of the Convention. The setting of global targets in plant conservation may, if adopted, provide a valuable pilot exercise in evaluating the utility of such global targets for other areas of biodiversity conservation.

The draft targets included in the GSPC have already helped to stimulate the development of targets in plant conservation at regional levels. For example, a draft European Plant Conservation Strategy, prepared jointly by the Council of Europe and Planta Europa, proposes 41 SMART targets for the conservation of Europe's plant diversity, each linked to and addressing the European component of the targets in the GSPC. The adoption of measurable targets has also been considered by several other international instruments and initiatives, such as the International Agenda for Botanic Gardens in Conservation, prepared by Botanic Gardens Conservation International based on submissions from over 300 botanic gardens and individuals and adopted at the World Botanic Gardens Congress in 2000. It proposes a series of targets and measurable indicators to assess the implementation of the recommendations and proposed actions it contains, each one of which is closely linked to the achievement of different aspects of the proposed targets in the GSPC.

Measurable targets have also been increasingly used in recent years to provide a framework for actions by multiple actors. Probably the best known example is the set of International Development Goals which has been adopted by most countries, both donors and developing countries, as well as by relevant international institutions. They are drawn from the goals adopted by a series of UN conferences in the 1990s. These goals address needs and targets for poverty reduction, universal primary education, gender equality, reduction of infant and maternal mortality, reproductive health and environmental sustainability and regeneration. For each of the seven goals adopted a number of indicators have been developed, to allow progress towards the goals to be monitored.

The presentation concludes that the development and adoption of measurable targets in the Convention on Biological Diversity provides a valuable tool to enhance the achievement of the objectives of the Convention. They can provide useful reference points for monitoring progress and for rallying public opinion behind issues of priority concern. Nevertheless targets chosen need to be developed through consensus, but at the same time present demanding but realistic challenges to the global community. The adoption of targets at the global level in the Convention may also be used to stimulate the development of related targets for biodiversity conservation at all levels, helping to address different priorities in biodiversity conservation throughout the world. Targets can also assist in the identification of gaps in work currently being undertaken. Consensus on the development of shared global targets and work for their achievement can also be expected to enhance synergies and result in added value from the actions undertaken by a broad range of players.

MANAGEMENT OF GOODS AND SERVICES FROM NEOTROPICAL FOREST BIODIVERSITY: DIVERSIFIED FOREST MANAGEMENT IN MESOAMERICA

Introduction

The main threat to neotropical biodiversity is the persisting high rates of deforestation and forest degradation in the region. For example in South America 3.7 million ha of tropical forests are lost every year (FAO 2000), while in Central America the forests lost between 1990 and 1995 is estimated at 2.5% annually (FAO 1996; 1997; Guevara and Villamizar 2001). One important underlying cause of this phenomenon are policies that in the past, and even today, have promoted agricultural development and colonisation in most countries, without a proper assessment of the possibilities for sustainable management and conservation of natural forests. This has resulted in an undervaluation of these ecosystems by society in general. Furthermore, the need for short-term income of the poor rural population has exacerbated this process of continuous environmental degradation.

A report by the International Tropical Timber Organisation (Poore et al. 1989), concluded that tropical America was in the late 80´s the region with the least progress towards sustainable forest management (SFM). However, in the last decade a great deal of efforts have taken place and today more than one million ha of natural forest have been certified by the Forest Stewardship Council (FSC), the region accounting for the majority of tropical forest certified by this international system.

Several natural resources that are raw material for industrial processes are still harvested from natural populations in tropical forests, as is the case for more than 30% of the medicinal plants used in Costa Rica (Ammour *et al*. 1994). Although several authors have pointed out the need to increase the number of species and products utilised from tropical forests in order to make SFM more feasible and attractive (Panayotou 1990; Wickens 1991), there is still a great deal of work to be done to develop systematic methods that could incorporate more forest species into operational schemes of sustainable forest management.

We support the concept that SFM could be a very important strategy to conserve forest resources that are threatened by over-harvesting in unmanaged forest. For example, a proposal for managing the ornamental species *Zamia skinneri* a non-timber forest product (NTFP) which is in Appendix III of CITES, has been developed by Robles et al. (1997). In Peten, Guatemala, the Government has awarded forest concessions to communities resulting in less forest fires and forest degradation in those forests.

More efforts should be directed towards reinforcing the role that SFM could play to contribute to the conservation of tropical forests and its biodiversity. This role has to be seen along with other efforts to establish and properly manage protected areas and tree plantations. CATIE has conducted several studies aiming at improving the techniques to reduce the impact of forest operations in natural forests, while at the same time increasing the benefits to forest owners and local communities.

A great deal of tropical forests in Latin America are under private control, therefore innovative mechanisms should be developed in order to make forestry a competitive land use option for the landowner and the country. This requires a better use of the diversity of goods and services from these forest but also proper mechanisms for the owners to capture the benefits of managing these ecosystems in a sustainable manner. In this respect the payment to the forest owner of the environmental services provided by the sustainable management of forests could contribute significantly to the conservation of tropical biodiversity.

José Joaquín Campos A., Bryan Finegan and Róger Villalobos
Area of Management and Conservation of Forests and Biodiversity, CATIE 7170, Turrialba, Costa Rica.
E-mail: jcampos@catie.ac.cr

In the present paper, we examine three facets of neotropical forest biodiversity and the goods and services it provides, within the framework of what CATIE conceives as *diversified* forest management (Gálvez 1996, Robles et al. 1997; see Panayotou 1990 for independent conceptualization of this approach). The first two sections examine options for the generation of income to forest owners, through payments for environmental services and the sustainable harvesting of NTFPs. In the final section, we focus on what is conserved when forests are used as sources of timber, analysing the impact of timber harvesting on plant biological diversity and introducing the way in which these research results may underpin the conceptualization, communication and evaluation of sustainable forest management using Criteria and Indicators.

Diversification of forest uses in Mesoamerica: capturing the benefits of environmental services

It is well known that neotropical forests are complex terrestrial ecosystems with a very high diversity of timber and non-timber species. This diversity however, comes at the same time with a low abundance of most of these species, making it more difficult for these forests to be managed intensively for a particular product that could yield at the same time a substantial financial return. This is particularly true for low scale forestry operations as in Costa Rica, as has been shown by Quirós and Gómez (1998). Some larger scale operations that have being financially successful are integrated in a process of value added trough the processing of higher value products.

Several studies have shown that the management of tropical forests for timber purposes alone, yields in general low financial returns. According to studies in Costa Rica, the financial indicators are usually low (Mendez 1996; Quirós and Gómez 1998). Similar results are reported in other tropical regions by Pearce, Putz and Vanclay (1999). For small scale operations, a potential for SFM lies in a approach that could make use of the wide array of goods and services that neotropical forests provide, as has been shown by Mollinedo *et al.* (2001) in Peten, Guatemala. These authors showed that the financial benefits of community forestry operations in Peten increases by integrating the production of timber and non-timber forest products.

SFM means several restrictions on the harvesting intensity and therefore a substantial reduction in its income. For example in Costa Rica the standard for SFM includes (CNCF 1999):

- protection zones where no logging is allowed along water courses and steep slopes;
- a minimum diameter for cutting is established in 60 cm;
- only a maximum of 60% of commercial individuals per species could be harvested;
- low abundant tree species (less than 0.3 trees per ha) are not allowed for logging;
- 18 species are banned from any logging.

These restrictions contribute to reducing the financial feasibility of SFM, therefore its promotion requires another sort of income to make this activity competitive against other land uses; in this respect the payment of environmental services plays a significant role.

One of the most important innovations of the Costa Rican Forestry Law of 1996 has been the decision to compensate forest owners for the environmental services their forest provide to society. This program is known as the Payment for Environmental Services (PES) and has been financially supported by a tax on fossil fuels that internalises, at least partially, the cost of environmental degradation. New proposals have also been developed involving the private sector, such as, including the cost of protecting watersheds for electricity generation and drinking water production (Table 2).

These type of efforts reinforce the multifunctional value of forests, where tropical biodiversity plays a very important role. The underlying hypothesis is that forests would be better maintained and protected if forest owners were compensated for the services provided by their forests to society. One of the problems in implementing sustainable management practices is that, although society benefits from it, forest owners usually do not capture these benefits; in this respect, the payment of environmental services is an effective way for internalising these benefits to those people responsible to implement in the field sustainable practices that contribute to conserve tropical forests.

The four environmental services recognized by the Forest Law No. 7575

1. mitigation of greenhouse gases
2. protection of watersources for urban, rural and hydroelectric uses
3. protection of biodiversity for its conservation and sustainable uses, including scientific, pharmaceutical and genetic improvement
4. protection of ecosystems, forms of life and natural scenic beauty for tourist and scientific uses.

Different forestry land use types are entitled to receive payment for environmental services in the Costa Rican PES Program, however, the payment and the commitment period varies according to the land use type as is shown in Table 1.

Since 1996 Costa Rica is working to establish an institutional structure with credibility and operative capacity to manage this Program, including the National Fund for Forestry Finance (FONAFIFO), responsible for managing and financing projects, the Costa Rican Office for Joint Implementation (OCIC), responsible for marketing the environmental services in the international market, and the National System of Conservation Areas (SINAC), state agency that manages all protected areas and facilitates the development of the private sector.

An important debate has taken place around the amount of money that should be paid and how they should vary according to the forest type. For example, the Tropical Science Centre estimated an average payment of US$50 ha^{-1} yr^{-1} as a starting point (Watson et al 1998). However, earlier in 1992 a private initiative between the Neotropica Foundation and forest owners agreed on a payment of only US$24 ha^{-1} yr^{-1} for the conservation and sustainable management of the biodiversity rich forests of the Osa Peninsula. The amount paid should bear in mind the opportunity cost of the land for the owner (either private or public). There are several efforts towards estimating the value of the ES. However, in our opinion there is a need to develop proposals of mechanisms for forest owners, either private or public, to capture the benefits of SFM.

Table 1:

Amount paid for environmental services and commitment period for each forestry land use type in the Payment of Environmental Services in Costa Rica (October 2001. 1US$=329 colones).

Land use type	Total amount paid[1] over a five year period (US$ ha^{-1})	Annual payments as percentage of total for years 1-5					Commitment period[2] (years)
		1	2	3	4	5	
Reforestation	565	50	20	15	10	5	15
Natural Forest Management	344	50	20	10	10	10	5
Natural Forest Preservation or Regeneration	221	20	20	20	20	20	10

[1] The payment is modified every year according to inflation (approx. 10%) but affect only new contracts.
[2] Period when the forest owner transfers to the Costa Rican Government the rights to market the environmental services from the forest or tree plantation receiving the PES.

In 1997 US$14 million were invested in the payment for environmental services in Costa Rica, which resulted in the reforestation of 6 500 ha, the sustainable management of 10 000 ha of natural forests and the preservation of 79 000 ha of private natural forests. 80% of this funding originated nationally from the tax on fossil fuels; the other 20% came from the international sale of carbon from public protected areas which contributed with US$2 million dollars. More recently, several organisations from the public and private sector have signed agreements with FONAFIFO for the protection of natural forests in critical watersheds or lands of value for its role as biological corridors. Table 2 shows the different sources of funding to the PES in Costa Rica. It should be mentioned that all of this funding is directed only to natural forest protection and regeneration; similar agreements should then be found in order to promote SFM which also has the potential to provide these environmental services. In this respect, there is a negotiation in progress with the German Bank KFW, that would bring approximately US$11 million to PES in order to support SFM and reforestation.

In 2001 a new law was approved to simplify the collection of all type of taxes in Costa Rica; the tax on fossil fuels was then replaced by an annually indexed budget of approx. US$7 million that is committed from the national budget to finance this program and particularly the services of mitigation of greenhouse gases and protection of biodiversity.

Recently, the World Bank provided a US$32.6 million loan to Costa Rica to fund the PES trough a Project called “Ecomarkets”. It came along with a grant from the Global Environment Facility (GEF) of approx. US$8 million; US$5.6 million will be invested in PES for private lands critical for their role as biological corridors previously identified by SINAC and the Mesoamerican Biological Corridor. The target with this project is to protect 100.000 ha of natural forests (Table 2). This is the first time the PES receives a compensation for the environmental service of biodiversity protection.

Table 2:

Other sources of funding to the Payment of Environmental Services from forests in Costa Rica.

Enterprise or Organisation	Watershed or region target	Total area funded (ha)	Amount contributed (US$ $ha^{-1}yr^{-1}$)
Energía Global	Volcán River San Fernando River	2.493 1.818	10 10
Hidroeléctrica Platanar	Platanar River	1.400	• 15 for lands with title • 30 for lands with no title plus regent costs and 5% for FONAFIFO
Compañía Nac. Fuerza y Luz	Aranjuez River Balsa River Cote Lake	11.900	53 (40 for forest owner rest to cover costs of regent and FONAFIFO)
GEF	Biological corridors identified	100.000	10
Cervecería Costa Rica	Segundo Río	1.000	45 plus regent costs and 5% for FONAFIFO

Source: FONAFIFO. October, 2001

The demand for PES is much higher than the funding available: it is estimated that the funding available could only cover between 15-30% of the demand. For example, in 2000 the demand was approximately 175.000 ha, but the PES could only fund 21.000 ha, while in 2001 the demand was 97.000 ha but only 28.000 ha will be funded. This could somehow indicate that forest owners might be in agreement with the amount paid for the ES provided by their forests.

A priority has generally been given to fund protection of natural forests against SFM and tree plantations. In this respect, some studies have shown that most of the Costa Rican society is willing to internalise the costs to maintain the ecological functions and environmental services from forest ecosystems. Ortiz and Campos (in press) found that most Costa Ricans agree to pay for ES provided by forests. The same study shows that the ES that Costa Rican value most is water protection, followed by biodiversity protection, and mitigation of GHG and scenic beauty (35%, 25%, 20% and 20% respectively). At the same time they considered water protection as a environmental service that directly benefit them, while the other ES as indirect benefits. In that respect they prefer the conservation of natural forests against tree plantations, because it is directly correlated to its contribution to biodiversity conservation and the conservation of other ecological functions. These results are in agreement with Table 2, that shows a great deal of support for funding protection of water sources by preservation of natural forests.

Tourism also brings opportunities for conserving tropical forests; one million tourists visited Costa Rica in 2000 and 70% are interested in nature. 250.000 ha (5% of the country) are part of an organisation of private forest reserves; some of these private reserves are in the business of ecotourism. A private hotel consortium is applying a voluntary charge of one dollar per guest. The funding collected goes to support conservation efforts in public protected areas in one of the eleven conservation areas of Costa Rica. Initiatives like this one should also be promoted in order to fund conservation efforts in private forests like those supported by FONAFIFO.

Diversification of forest uses in Mesoamerica: management of non-timber forest products

Two extreme positions about NTFP production exist: one advocating that it is not possible to base a sustainable productive system on a natural population in a tropical forest (Homma 1992), and the other, that extractive reserves from which NTFPs are harvested are prime examples of sustainability (Nepstad and Schwartzman, 1992; Kiernan *et al.* 1992). Between these two extreme positions there are relatively few efforts to determine which cases could be improved to assure their sustainability and which should be changed for domestication or plantation systems. In addition, although there are many case studies reporting the economic significance of NTFP, there is still a pressing need for research that would result in the development of technical approaches for the sustainable management of natural populations of NTFP species. That harvesting of NTFPs is sometimes an activity of fundamental importance to sustainable livelihoods in Mesoamerica is undeniable. A study carried out by CATIE in two community forestry operations in Peten, Guatemala (Mollinedo 2001), for example, found that all of the productive systems include harvesting of NTFPs. In the Carmelita Concession 92% of the people depended on some NTFP for subsistence, in particular xate (*Chamaedorea* spp.), chicle (*Manilkara zapota*) or allspice (*Pimenta dioica*); those products represented about 50% of the economic benefits, very similar to the benefits from timber production. An important issue that has to be resolved in order to improve the economic and social benefits of NTFP management is the distribution of benefits between market intermediaries and NTFP producers. In the case of *xate*, 78% of economic benefit went to the intermediary while only 22% for the producer; in the case of chicle the distribution was 81% and 19% respectively, and for allspice 79 % and 21% respectively. As the history of tropical forestry shows, however, the development of management criteria is crucial in the determination of sustainable harvest rates of any biotic resource and the identification of silvicultural tools to ensure and increase this harvest. Besides, despite the value and significance of traditional ecological knowledge, the history of NTFP shows that traditional harvest systems cannot ensure sustainable production if the product is included in a growing global market. This has been the case for products obtained from forest during generations by indigenous populations that were later included in intercontinental markets during the 19th century (Domínguez and Gómez 1990) and more recently, in response to unexpected new and growing tourist markets for handicrafts (Villalobos and Ocampo 1997).

One of the first approaches to systematise concepts through silviculture of NTFP is that set out by Peters (1996), which describes in a very general way the steps for a sustainable management system for natural populations. In CATIE, we have developed a more detailed methodological process, based on our experiences with NTFP from Mesoamerican forests, representing a wide range of growth habits, ecological niches and kinds of products and markets (Marmillod et al. 1998).

According to CATIE´s proposal, the sustainable management of NTFP from wild population should include indicators such as: quantity of product to harvest in the management unit; harvesting cycles by species; the effect of different types of human intervention, as well as environmental factors, on the wild population and the harvesting cycle; and population dynamics. The forest management plan should be the instrument in which this information is integrated in practice.

Theoretically, the management plan may be diversified (for various species or various kinds of product from the same management unit); in any case criteria for silvicultural management of the different species included in the management plan are required. In the case of NTFP, the wide range of situations derived from market – product – growth pattern combinations represent a critical issue to be considered.

The same kind of product (*e.g.* a medicine) may be obtained from:

- a similar kind of vegetative organ but from plants with different growth habits (*e.g.* the bark of *Simarouba amara* trees, or the bark of the vine *Uncaria tomentosa*);
- plants with the same growth habit but from different organs (the stem of the vine *Bauhinia guianensis* or the root of the vine *Smilax chiriquensis*);
- different organs of plants with different growth habit (the fruits of the herb *Solanum mamosum* or the branches of the shrub *Quassia amara*) (Villalobos 2001).

Several lessons have been learnt from the analysis of this problem:

- although the general principles for the management of a particular plant are the same, the specific tools for implementation must be developed for each species individually;
- the development of those tools requires some investment;
- the management tools depend on the definition of the kind of product to obtain from the forest;
- in most cases the needs of people mean that harvesting can not be put off, so the silvicultural tools must be developed in an adaptive fashion as a part of the management and production process;
- to reduce the investment risk it is important to guarantee an adequate selection of the species to include in the diversified management plan

The first step to develop management criteria for a NTFP species, according to the CATIE approach, is the definition of the product, since a basic sustainability principle is to avoid unnecessary extraction or waste of the species being harvested. There are several examples of enterprises that have collapsed due to the lack of quality control of the product (the goal should be to guarantee the maximum sustainable supply of the product required by the market).

Product definition depends on the industry or market goal (fibre quality, active chemical principles, nutritional quality, appearance). A productive individual is one capable to provide the product required for the market; the forest manager should determine if the product required by the market is possible to produce in a particular management unit.

The subsequent step, developing the management criteria, corresponds to the definition of the production system, and for this the definition of silvicultural tools is necessary. These tools should allow the identification of the productive individuals, the measurement of how much product could be obtained from one individual or group of individuals, the definition of growth and development categories for the species and the differentiation of kinds of individuals with respect to maturity and productivity and the ecological factors related to these growth and development categories.

Basic knowledge which is required includes that on ethnobotany, biology and economy related to the species and its products. With regard to management, the determination of variables which differentiate growth stages, and the biological factors affecting these variables that should be studied during the development of management criteria, should be attempted.

The analysis of population productive potential, as a function of its demographic structure, requires the development of variables for population characterisation, these should allow a reasonable and sufficient description of growth and development stages and be practical to measure or to observe in the field.

The quantity of harvestable product in a management unit is determined through census or inventories, but these only are technically and economically reasonable if practical variables for population characterization exist, to obtain a reliable and precise information about productivity. So, it is necessary to determine practical field variables, the quantitative relationship between data from measures and the estimated product quantity and its degree of variability.

Once these tools have been developed it is possible to set out a silvicultural management system. The tools for characterisation of the population of interest permit the determination of optimal conditions for species growth and production, and the distribution of the species in relation to the main environmental gradients in the management unit. The main factors to be studied, with respect to the behaviour of an NTFP species in tropical forests, include requirements regarding environmental resources, particularly light and water, phenology, the optimal harvesting regime to obtain a good product without a reduction in population productive capability, species response to silvicultural interventions and annual species production in the proposed silvicultural system

The culmination of this process is the design of a sustainable plan for the management unit, which should determine:

- the location and extension of areas where the species is productive;
- the quantity of harvestable product in each area;
- harvesting cycles and the project quantity of harvestable product; and,
- silvicultural interventions needed for each area

Based on the previously described process, a management plan was developed for a natural population of *Quassia amara*, a natural insecticide and medicinal shrub, located in the Kéköldi Indian Reserve on the Atlantic Coast of Costa Rica. The methodology allowed us to determine the sustainable management recommendations and at the same time to learn about the ecological behaviour of the species. Prior to the development of this management plan, one company offered to buy 500 kg of *Q*. amara branches each month from the Kéköldi people. However, our sustainable management analysis and estimates showed that the Kéköld *Q*. amara population has a sustainable production capacity of just 2000 kg a year. Product sales to meet the entire market demand had produced serious damage to this natural population (Villalobos et al. 1998). Further research is being conducted to revise and improve our recommendations for *Q*. amara management, based on its growth over several years, in different environments and in response to different harvest practices (Guzmán *et al*. 2000, Leigue et al. 1999, Villalobos *et al*. 1999).

The development of scientifically based techniques for forest management has been biased in favour of wood production; however, the traditional use of forests by humans has always been diversified. In general terms, diversified forest management, related to the production of vegetative goods, consists of determining whether or not the environmental requirements and responses of different species to the silvicultural actions are antagonistic or complementary, in order to establish integrated management systems for the whole management unit, based on these factors and on economic priorities for the species.

The definition of tools to characterise NTFP populations, explained above, led us to study the response of several species to different interventions in the forest. Our research shows that several NTFP species increase their growth and productivity in response to the opening of canopy gaps (Gálvez 1996; Marmillod and Gálvez 1998; Guzmán *et al.* 2000; Leigue et al. 1999; Villalobos *et al.* 1999). These gaps are typical in logging operations. From a biological approach, for many economically useful species, diversified forest management is not therefore an utopia, but the most logical adaptation to the forest ecology.

Once the variables for species characterisation have been defined, dedicated research helps to define the optimal forest inventory techniques, including plot size, shape and distribution. Based on the CATIE approach to define useful variables, Pineda *et al.* (1998) developed a case of inventory design and application in Petén, Guatemala, including in the same inventory process five NTFP species and all the commercial timber species. The objectives included: estimation of wood volume from commercial species, with a margin of error accepted by the owner, estimation of wood volume from all tree species with the legal margin of error (15%), regeneration analysis of commercial tree species through the diagnostic sampling methodology (Hutchinson 1993) and estimation of stocking of NTFPs. Those authors found that classical tree sampling techniques used in this area had a cost of US\$0.24 ha^{-1}. The total costs to inventory the timber and non-timber components separately was US\$0.69 ha^{-1}, while the cost of the integrated inventory for diversified management was only US\$0.39 ha^{-1}. So, integrative processes are the more logical way (in ecological and economical senses) to develop criteria for diversified forest management.

CATIE is carrying out research on the use of this kind of diversified management criteria, in a participatory approach with a community in the National Forest of Tapajos in the Brazilian Amazon. The traditional inhabitants of this area, the caboclos, descendents of Spanish and indigenous people, practice extractivism of timber and non timber forest products, slash and burn agriculture, fishing and livestock. The study integrates social, silvicultural, and ecological issues of traditional forest use, in order to develop a diversified forest management model.

Although the traditional use of forest means the harvest and hunting of several species, our research is based on the management of wood, and oil from the tree species *Carapa guianensis* (*andiroba* oil) and *Copaifera sp* (*copaiba* oil). In this participatory approach, local people have selected in their concession area, zones for timber production and zones for the non-timber selected species production. In the case of copaiba they preferred to select productive individuals instead of zones; this seems to be a practical approach common for several non-timber species. The local people participated in designing and developing a process for the diversified inventory , census and diagnostic sampling.

What can timber production forests contribute to the conservation of biodiversity?

The conservation of much of the world's biological diversity depends, or should depend, on the way in which timber production forests are managed. This axiom of modern approaches to forest management is encapsulated by the Forest Stewardship Council's Principles and Criteria for Forest Stewardship, which require that forest management maintain intact, enhance or restore biodiversity at all its levels. Knowledge of biodiversity conservation in managed natural tropical forests has recently been thoroughly reviewed by Putz *et al.* (2000). Pointing out and discussing the fact that the seemingly simple terms "logging" and "biodiversity" both embrace great complexity, they conclude that while timber production forests will not replace protected areas as storehouses of biodiversity, they can and should become a component of an integrated conservation strategy which will potentially cover much greater land areas than are likely to be assigned to strict protection. Two main routes towards capacity to attain biodiversity conservation objectives in timber production forests may be envisaged. One, which may be implemented immediately - as is happening in the neotropics through the rapid growth of forest certification in the region – is essentially precautionary and relies on tactics such as reduced-impact logging and the strict protection of areas of each forest type within the forest management unit (fmu). The other would be based on more complete information on the response of the different levels of forest biodiversity to management interventions and would be adaptive (Holling and Meffe 1996), with learning through monitoring an integral part of the management process. In such a framework, opportunity costs incurred by forest managers under a precautionary approach – for example, when harvesting intensities are reduced – could be avoided if it is shown that intervention may be more intensive without significant additional costs for biodiversity, and the consequences of intervention are monitored in any case. The general principle that management can only be sustainable if it is adaptive is applicable to both the preceding scenarios, of course, though it is currently seriously underemphasized in the former (Finegan *et al.* in press).

Recent research and development work being carried out by CATIE and its national partners in natural Central American timber production forests has the goals of increasing knowledge of forest management effects on biodiversity – with emphasis on the surprisingly poorly-documented area of species- and genetic-level diversity of tree communities and populations – and on the development of adaptive ecological components of national standards for sustainable forest management at the fmu level. This work, possibly uniquely in the tropics, takes into account that Central American production forests are also, increasingly, fragmented forests. Work towards the twin goals is closely integrated. The focus is on two moist forest ecoregions as defined by Dinerstein et al. (1995): the Central American Atlantic forest and the Tehuantepec forest. Besides embracing some of the largest remnant forest areas of Central America, these ecoregions are major sources of forest products and are a key component of the area of the Mesoamerican Biological Corridor, a major conservation strategy currently being implemented with support from governments and international organizations. We emphasize that this research focuses on managed forests, not on forests subjected to conventional logging.

Taxonomic biodiversity at the species level is usefully characterized in terms of both the species diversity and the species *composition* of the forest community and our work is carried out in permanent sample plots with planning for the long term. As a large proportion of the plant diversity of tropical rain forests is found among life forms other than large trees, this characterization should embrace a broader spectrum of the community than is the case in traditional permanent sample plot studies. CATIE has introduced methodological innovations to take this latter necessity into account, sampling the forest understorey as well as individuals ≥ 10 cm dbh.

For the analysis of management effects on plant taxonomic biodiversity, our results show that in general, it is convenient to identify both direct and indirect effects. *Direct* effects are immediate consequences of management operations and occur simply because some plants in sample plots are killed by those operations. *Indirect* effects of management operations on plant biodiversity may occur as consequences of management-induced changes in forest environmental conditions or in ecological processes such as pollination or seed dispersal. These effects will evolve over time and may be long-lasting.

Direct effects of management on plant species richness are relatively simple to demonstrate. Species-abundance distributions in our permanent sample plots are typical of those for tropical forests in that they show large numbers of species represented by few or single individuals. Some of these individuals are killed when forests are logged or silvicultural treatments applied, these deaths bringing about immediate reductions in the species-richness and diversity of the vegetation in the plot. It is important to point out that such reductions of diversity are to an extent artefacts of the permanent sample plot techniques used and by their very nature, certainly do not mean that species are being locally extinguished. Indirect effects require demonstration by more detailed studies, though it may be inferred that such changes are taking place especially if appropriate methodologies for the study of mortality are used. In intensive research in three different floristic types of production forest in the Central American Atlantic moist forest CATIE has found, however, that in spite of the array of factors which may influence it in timber production forests, plant species diversity is not reduced during the first decade of management. This conclusion applies over a range of harvesting intensities from 10 – 30 m^3 ha^{-1} and to forest stands where silvicultural treatment has produced major changes in forest structure and marked increases in the growth of potential crop trees. Two hundred-year simulations using *Gavilán*, an individual-tree computer model developed at CATIE (Sitoe 2000), further support the tentative conclusion that plant species diversity is a robust forest characteristic in the context of management interventions typical of Central American production forests, and that sustainable production and the conservation of a large proportion of the original plant taxonomic biodiversity are compatible.

Forest composition and forest diversity may vary independently (Finegan 1996) and it remains a possibility that compositional change occurs, for example if populations of plant species typical of the original forest decline or are locally extinguished under management, even if forest diversity is maintained. Species-abundance distributions again rear their heads in the analysis of compositional change using permanent sample plot data, as changes in relative abundance can only be reliably identified for that minority of species which are, or become, relatively common. Our results for such species show that as may be expected, forest composition is changed directly by management as the sizes and structures of populations of commercial species, or non-commercial species which compete with potential crop trees in silviculturally treated forests, are modified by intervention (Finegan *et al.* in press). Marked increases in the abundances of light-demanding species occur only patchily in the forests.

The apparent robustness of plant diversity in the managed forests studied suggests that the taxonomy-intensive monitoring of this parameter is not of high priority in sustainability assessments using Criteria and Indicators (C&I) (Finegan *et al.* in press). With respect to that majority of species that occur at low densities, and those species whose populations are "targeted" by management, such as those of commercial value, CATIE is now pursuing the suggestion by Finegan *et al.* (in press) that a focal species approach (Noss 1999) can be usefully adapted for research and monitoring of management effects. These latter suggestions are being fed into proposals for adaptive C & I sets for the assessment of ecological sustainability (McGinley and Finegan in press), where it is considered that the openness of regional expert groups to the concept of adaptive management (McGinley and Finegan in press) must be matched by objective input from research organisations such as CATIE regarding the what, how and why of biological monitoring for forest management (Finegan *et al.* in press).

References

Ammour, T.; Ocampo, R.; Robles,G. 1994. Caracterización de los sectores asociados a la producción, comercialización y transformación de plantas medicinales en Costa Rica. Turrialba, Costa Rica, CATIE/Proyecto Olafo. Documento de trabajo N 3. 36 p.

Comisión Nacional de Certificación Forestal. 1999. Estándares y procedimientos para el manejo sostenible y la certificación forestal en Costa Rica. CNCF. San José, Costa Rica. 54 pp.

Dinerstein, E., Olson, D.M., Graham, D.J., Webster, A.L., Primm, S.A., Bookbinder, M.P. and Ledec, G. (1995) *A Conservation Assessment of the Terrestrial Ecoregions of Latin America and the Caribbean.* The World Bank, Washington, D.C., 129pp.

Dominguez, D.; Gomez, A. 1990. La economía extractiva en la Amazonía Colombiana 1850-1930. TROPENBOS - Corporación colombiana para la Amazonía Araracuara. 279 p.

FAO. 1996. Forest resource assessment 1990. FAO Forestry Paper 130. Roma. 152 p.

FAO. 1997; *State of the World's Forests 1997*, Food and Agriculture Organization of the United Nations, Rome, Italy, 200 p.

FAO. 2000. Global forest resources assessment. FAO Forestry paper 140. Food and Agriculture Organization of the United Nations, Rome, Italy, 357 p.

Finegan, B. (1996). Pattern and process in neotropical secondary rain forests: the first hundred years of succession. *Trends in Ecology and Evolution* 11, 119-124.

Finegan, B., Delgado, D., Camacho, M. and Zamora, N. In press. Timber production and plant biodiversity conservation in a Costa Rican rain forest: an experimental study and its lessons for adaptive sustainability assessment. In A. Franc (Editor), *Proceedings of the Conference/Workshop on Indicators for Sustainable Forest Management at the Forest Management Unit Level*. Nancy, France, March 21-24 2000. European Forestry Institute.

Gálvez, J. 1996. Elementos técnicos para el manejo forestal diversificado de bosques naturales tropicales en San Miguel, Petén, Guatemala. Tesis M.Sc., CATIE, Turrialba. 163 p.

Guevara, M., Villamizar, F. 2001. Estadísticas del sector agropecuario de Centroamérica y Belice 1989-1998"; RUTA, Documento de Trabajo No. 4.

Guzmán, V., Villalobos, R., Marmillod, D., Campos, J.J. 2000. Capacidad de rebrote de *Quassia amara* bajo diferentes condiciones de aprovechamiento en Costa Rica. In: IV Congreso Forestal Centroamericano. Resumenes de ponencias. Mesa de Trabajo Aprovechamiento e industrialización de los recursos forestales. Montelimar, Nicaragua 15-17 noviembre 2000. S.p.

Holling, C.S. and Meffe, G.K. 1996. Command and control and the pathology of natural resource management. Conservation Biology 10 (2): 328-337.

Homma, A.K.O. 1996. Modernisation and Technological dualism in the extractive economy in Amazonia. In: Ruiz, M.; Arnold, J.E.M. (eds.). Current issues in non-timber forest products research. Proceedings of the workshop "Research on NTPF", 28 August - 2 September 1995, Hot Springs, Zimbabwe. Bogor, Indonesia, Center for International Forestry Research. Pp. 59-82.

Kiernan, M.; Perl, M.; Mccaffrey, D.; Buschbacher, R.; Batmanian, G. 1992. La ordenación de los bosques naturales en América Latina: enseñanzas y ejemplos. Unasylva 43(169):16-23.

Leigue, L.; Marmillod, D.; Villalobos, R.; Finegan, B. 1999. Elementos fenológicos para la silvicultura de *Quassia amara* en Talamanca, Costa Rica. *In* Centro Agronómico Tropical de Investigación y Enseñanza. Actas de la IV Semana Científica. Logros de la investigación para el nuevo milenio. Turrialba, Costa Rica, 6 al 9 abril, 1999. p.307-311.

Marmillod, D.; Gálvez, J. 1998. Efecto del aprovechamiento maderero sobre la población de bayal, una especie no maderable del bosque petenero. In: BOLFOR; CIFOR; IUFRO. Memorias del Simposio internacional sobre Posibilidades de manejo forestal sostenible en América Tropical. Santa Cruz, Bolivia, Proyecto de Manejo Forestal Sostenible. Pp. 71-79.

Marmillod, D.; Villalobos, R.; Robles, G. 1998. Hacia el manejo sostenible de especies vegetales del bosque con productos no maderables: las experiencias de CATIE en esta década [disco compacto]. *In:* Congreso Latinoamericano IUFRO (1., 1998, Valdivia, Chile). El manejo sustentable de los recursos forstales, desafío del siglo XXI. Valdivia, CONAF/IUFRO.

Mollinedo, A. 2000. Beneficios y rentabilidad del manejo forestal comunitario en dos áreas de la reserva de la biosfera Maya, Petén, Guatemala. Tesis M.Sc. Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba. 99 p.

Mollinedo, A., Campos, J.J., Kanninen, M. And Gómez, M. Beneficios sociales y económicos del bosque en la Reserva de Biósfera Maya, Petén, Guatemala. Revista Forestal Centroamericana. CATIE. No. 34. 57-60.

McGinley, K. and Finegan, B. in press. Evaluations for sustainable forest management: Towards an adaptive standard for the evaluation of the ecological sustainability of forest management in Costa Rica. CATIE, Turrialba, Costa Rica and CIFOR, Bogor, Indonesia.

Méndez, J.A. 1996. Determinación de la rentabilidad financiera del manejo del bosque natural en la Zona Norte de Costa Rica, en fincas de propiedad de asociados de CODEFORSA. Thesis M.Sc. CATIE. Turrialba, Costa Rica. 89 pp.

Nepstad, D.; Schwartzman, S. 1992. Non timber product extraction from tropical forests. Evaluation of a conservation and development strategy. Advances in Economic Botany 9:vii-xii.

Noss, R.F. 1999. Assessing and monitoring forest biodiversity: a suggested framework and indicators. Forest Ecology and Management 115, 135-146.

Panayotou, T. 1990. Introduction: multiproduct forest management - A key to sustainability? In: Status and potential of non-timber products in the sustainable development of tropical forest. Proceedings of the international seminar. ITTO. Kamakura, Japan, 17 November 1990. Pp. 3-8.

Pearce, D., Putz, F. and Vanclay, J. 1999. A sustainable forest future. CSERGE Working Paper GEC 99-15. Centre for Social and Economic Research on the Global Environment University College London. London. 67 pp.

Peters, C. 1996. Observations on the sustainable exploitation of non-timber tropical forest products. An ecologist's perspective. In: Ruiz, M.; Arnold, J.E.M. (eds.). Current issues in non-timber forest products research. Proceedings of the workshop "Research on NTPF", 28 August - 2 September 1995, Hot Springs, Zimbabwe. Bogor, Indonesia, Center for International Forestry Research. Pp. 19-39.

Pineda, P.; Marmillod, D.; Ferreira, P. 1998. Diseño y aplicación de un inventario forestal diversificado (productos maderables y no maderables) en Petén, Guatemala. In: BOLFOR; CIFOR; IUFRO. Memorias del Simposio internacional sobre Posibilidades de manejo forestal sostenible en América Tropical. Santa Cruz, Bolivia, Proyecto de Manejo Forestal Sostenible. Pp. 264-269.

Poore, D. (ed.) (1989). No timber without trees. Sustainability in the tropical forest. London, UK, Earthscan Publications, 252 pp.

Putz, F.E., Redford, K.H., Robinson, J.G., Finbel, R. and Blate, G.M. 2000. Biodiversity Conservation in the context of tropical forest management. Environmental Department Papers, Biodiversity Series – Impact Studies. Paper no. 75. World Bank, Washington D.C. 80 pp.

Quirós, D. and Gómez, M. 1998. Manejo sustentable de un bosque primario intervenido en la Zona Atlántica Norte de Costa Rica. Análisis financiero. Serie Técnica. Informe Técnico No. 303. Colección Manejo Diversificado de Bosques Naturales. Publicación No. 13. CATIE. Turrialba, Costa Rica. 22 pp.

Robles, G.; Ocampo, R.; Marmillod, D. 1997. Incorporación de una especie no maderable en un sistema silvicultural diversificado: el caso de *Zamia skinneri.* In: CATIE. Actas de la tercera semana científica. Turrialba, Costa Rica. Pp. 133-138.

Ruiz, M.; Arnold, J. (eds.). 1996. Current issues in non-timber forest products research. Proceedings of the workshop "Research on NTPF", 28 August - 2 September 1995, Hot Springs, Zimbabwe. Bogor, Indonesia, Center for International Forestry Research. 264 p.

Sitoe, A.A. 2000. A patch-model for managed tropical lowland rain forests in Costa Rica. Ph.D. Dissertation, CATIE, Turrialba, Costa Rica. 157 pp.

Villalobos, R. 2001. Silvicultura para el aprovechamiento de plantas medicinales a partir del bosque tropical. Experiencias del CATIE [Disco Compacto]. In Memorias Primer Congreso Internacional De Plantas Medicinales Y Aromaticas (1, 2001, Cali, Colombia). Desarrollo agroindustrial, conservacion y aprovechamiento como instrumentos para el desarrollo sostenible. Universidad de San Buenaventura , Facultad De Ingenieria Agroindustrial. Del 13 Al 15 de agosto de 2.001. p. 587-600.

Villalobos, R.; Chang, Y.; Marmillod, D.; Bedoya, R.; Leigue, L. 1998. Desarrollo de criterios silviculturales para el manejo de *Quassia amara*, un producto no maderable del bosque tropical. In Memoria del Simposio Internacional sobre posibilidades de manejo forestal sostenible en América Tropical. BOLFOR, CIFOR, IUFRO. Santa Cruz de la Sierra, Bolivia, 15-20 de julio de 1997. P. 64-70.

Villalobos, R.; Marmillod, D.; Ocampo, R.; Mora, G.; Rojas, C. 1999. Variations in the quassin and neoquassin content in *Quassia amara* (Simaroubaceae) in Costa Rica: ecological and management implications. Acta Horticulturae 502:369-376. (Presentado en: World Congress on Medicinal and Aromatic Plants (2, 1997, Mendoza, Argentina)

Villalobos, R.; Ocampo, R. (eds.). 1997. Productos no maderables del bosque en Centroamérica y El Caribe. Actas de la consulta sobre la situación de los productos forestales no madereros, 17 al 21 de julio de 1995. Turrialba, Costa Rica, CATIE. Serie técnica, eventos especiales No. 1. 103 p.

Watson, V., Cervantes, S., Castro, C., Mora, L., Solís, M., Porras, I. And Cornejo, B. Abriendo espacio para una mejor política forestal. Estudio de Costa Rica. San José, Costa Rica: Proyecto Políticas Exitosas para los Bosques y Gente. Tropical Science Center and Institute for Environment and Development. 136 pp.Wickens, G. 1991. El desarrollo de los productos forestales no madereros: principios de ordenación. Unasylva, 42(165): 3-8.

HARVESTING OF NON-TIMBER FOREST PRODUCTS: IS SUSTAINABILITY ACHIEVABLE?

What are non-timber forest products?

The term "non-timber forest products" (NTFPs) refer to natural resources collected from forests apart from sawn timber. Wickens (1991), for example, considered non-timber forest products to be "all the biological material (other than industrial round wood and derived sawn timber, wood chips, wood-based panel and pulp) that may be extracted from natural ecosystems, managed plantations, etc. and be utilised within the household, be marketed, or have social, cultural or religious significance". Though not explicitly stated, wildlife (mammals, birds, reptiles, fishes, insects, land snails, etc) is part of NTFPs.

The diversity and importance of NTFPs

Diversity

In the Peruvian Amazon, Vasquez and Gentry (1990) recorded over 57 wild-collected fruit species being sold by Iquitos Indian. In Indonesia (Sswoyo et al. 1994), 1260 species of medicinal plants, many wild-collected species are sold. In South Africa, 400-500 species are sold for traditional medicines, 99% are wild harvested (Cunningham 1991; Williams, 1996). In Germany, Lange & Schippmann (1997) have documented 1543 medicinal plant species comprising 854 genera in 223 families in import or export trade, 70-90% of which are primarily harvested from the wild. According to Farnsworth & Morris (1976), 25 percent of all prescription drugs dispensed in the United States over the last several decades have contained active ingredients extracted from higher order plants. At least 175 plant species native to North America are found in the non-prescription medicinal market in the United States and more than 140 medicinal plants native to North America are in international markets (TRAFFIC North America 1999). In Sarawak, Malaysia, three ungulate species, bearded pig and two barking deer species, comprised 80% of biomass hunted (Robinson & Bennett 2000) although at least 26 mammal species, 12 bird species and 5 reptile species are regularly eaten. In Colombia, Maracá Indians killed at least 51 bird species, including 10 hummingbird species (Ruddle, 1970) and the Sirionó Indians of Bolivia hunt 23 mammals species, 33 bird species and 9 reptile species. In the Central African Republic, hunters using snares capture 33 mammal species, 7 reptile species and 3 bird species and in the Lobéké area of Cameroon, hunters took at least 36 animal species (Robinson & Bennett 2000).

Importance

Access to NTFP helps rural households diversify their livelihood base and reduce their exposure to risk. Rural people, moving from a subsistence lifestyle to a cash economy, have relatively few options for generating income. They can sell agricultural produce, work for a cash wage, or sell retail goods in local or regional marketplaces. For the landless rural poor, harvesting of NTFP is a common option. NTFP provide a safety net, a sort of "green social security" to billions of people in the form of low cost building materials, income, fuel, food supplements and traditional medicines (van Andel, 2000). In several tropical countries, bushmeat represents up to 80% of the household protein intake, with little or no replacement available (Robinson & Bennett 2000). The economic value of NTFP is rarely taken into account in assessing Gross Domestic Product. Still their international trade involve global networks and huge amount of money (Table 1).

Robert Nasi
CIFOR, Center for International Forestry Research Situ gede, Sidang Barrang, Bagar Barot 16680 Indonesia
E-mail: R.nasi@cgiar.org

Table 1:
Some examples of NTFP international trade values[1]

Products from NTFP	World's import (million US$)	Notes
Natural rubber	4,221.8	Tropical moist forest regions, from intensively managed plantations, agroforestry systems and natural stands (extractive reserves) of *Hevea brasiliensis*
Ginseng roots	389.3	Tropical or subtropical, both from wild and plantations
Essential oils	319.4	Various regions, both from wild and cultivated resources
Cork	310.7	Mediterranean regions from managed natural stands and plantations of *Quercus suber*
Honey	268.2	Worldwide product from intensively or extensively managed and wild resources
Walnut	215.9	Temperate from cultivated populations of *Juglans spp.*
Mushrooms	206.5	Temperate and sub-tropical both from wild and cultivated populations
Rattan	119,0	Tropical rainforests, mostly from natural stands, few plantations in Asia
Gum Arabic	101.3	Tropical arid regions, mostly from wild or extensively managed natural stands of *Acacia senegal* and *A. seyal*
Brazil nuts	44.3	Amazonian rainforests, from wild or semi-intensively managed natural stands of *Bertholetia excelsa*
TOTAL NTFP	**11,108.7**	

[1] modified from FAO (1995b) – original data from UNCTAD database

NTFPs, the changing paradigm

In the past, plant and bush-meat use values to people have either been disregarded, or if taken into account, then the emphasis has either been on the values of plants or wildlife, rather than both together. In the developed world, little attention has been paid to NTFP for decades. The names used to characterize these products gives an idea of their relative ranking compared to timber in the minds of the developed world managers. Decision makers and forest managers were then talking about secondary, minor, special, specialty non-wood or non-traditional forest products. For various reasons, the most prominent one being probably the need to find alternative sources of incomes to populations deprived of their land (e.g. for conservation purposes) or of its most valuable resources (e.g. timber), NTFP have now come out of the 'shadow' and are no longer considered to be minor products. Nowadays, they are often presented as the possible miracle solution to reconcile poverty alleviation and conservation. Some studies have shown that potential income from NTFP can match incomes from logging or other forest degrading activities. The idea that higher income from NTFP (and other activities) is will reduce farmer's need to encroach upon protected areas is the 'new' policy paradigm that underlies many Integrated Conservation and Development Projects (Angelsen & Kaimowtiz 2001). Unfortunately available experience shows that when a forest product becomes commercially attractive (either locally or internationally) then harvesting is often unsustainable, undermining the primary goal of any protected area: maintenance of habitat and species diversity.

Why is harvesting not sustainable?

This general pattern of over-exploitation is due to several biological and socio-cultural factors that are generally not sufficiently taken into consideration:

- Differences in climate, soil and vegetation type result in significant differences in the availability and possible use of NTFPs across tropical and temperate climates (Cunningham 2001). The assumption that income from NTFPs can match those from logging is often false. It certainly applies to natural stands like the "oligarchic" forests dominated by fruit bearing trees (e.g. *Myricaria dubia*) or palms (eg: *Euterpe oleracea*), but in most cases it does not apply.
- Vulnerability or resilience to harvesting is influenced by biological characteristics: life form (plants) or body size (animals), growth rate, reproductive biology, geographic distribution, habitat specificity, population density, etc. (Peters, 1994).
- The potential yield from wild stocks of many species is frequently overestimated. As a result, commercial harvesting ventures based on wild populations is characterised by a "boom and bust" situation where initial plentiful harvests are followed by declining resource availability.
- The new 'policy' paradigm on NTFP is probably based on several false assumptions. Most rural people do not exhibit the 'full belly' preferences that the hypothesis assumes (Angelsen & Kaimowitz 2001).

The way forward

If sustainable management of non-timber forest product (NTFP) is to be implemented successfully, then recognition that there is no "one size fits all" policy is essential. Policies and their implementation practice have to be tailored to local ecological, economic, cultural and political circumstances.

Preliminary results of a multi-case comparative study (more than 60 cases covering several countries and NTFPs) by CIFOR and partners show that it is possible to predict if, when and under which ecological and social conditions a given NTFP can be effectively sustainably managed. This should open the way to a more rational approach on conservation and sustainable use of NTFP by defining the actual range of conditions under a product can be sustainably harvested. Several important NTFP come from domesticated or semi-domesticated plants or animals: cork, ginseng, khat leaves, silk, taxol, etc. The same domestication process is possible for several other NTFP under such conditions and wild harvest is not necessarily the [only, rather than "right"] answer.

Awareness, communication and participation are also important. A recent meeting on 'bushmeat and logging concession in Central Africa' showed that it is possible to significantly reduce the negative impact of logging on wildlife and that most stakeholders are willing to contribute to this effort. Actual pilot activities have demonstrated that collaboration between the private sector and conservation NGOs is possible and that practical options do exist for reducing the impact of timber exploitation on wildlife (Tutin et al. 2001). Certification of NTFP might also open some avenues in specific cases for better management by raising buyers' awareness thus opening greater market share for fair trade in sustainably harvested products which provides an incentive for resource management (Shanley et al. in press). Just as there is no "one size fits all" policy, so there is no single, definitive path to linking local livelihoods and NTFP use in a sustainable way: what is essential, however, is that policy development is enriched and adequately informed through "scaling up" from the field level studies to the policy level. This paper is intended as a contribution to this goal.

References

Andel, T.R. van. 2000. *Non-timber forest products of the North-West district of Guyana.* Tropenbos Guyana Series 8. Tropenbos Guyana Programme, Georgetown, Guyana.

Angelsen, A., & D. Kaimowitz (eds.) 2001. *Agricultural Technologies and Tropical Deforestation.* CAB International, London and CIFOR, Bogor.

Cunningham, A.B. 1991. *Development of a conservation policy on commercially exploited medicinal plants: a case study from southern Africa* pp. 337-358 In Heywood, V., H. Synge & O. Akerele (eds.) *Conservation of medicinal plants.* Cambridge University Press, Cambridge.

Cunningham, A B. 2001. *Applied ethnobotany: people, wild plant use and conservation.* Earthscan, London.

FAO 1995. *Trade restrictions affecting international trade in non-wood forest products.* Non-wood Forest Products no 8, Food and Agricultural Organization of the United Nations, Rome.

Farnsworth, N. R., & R.W. Morris. 1976. Higher plants – the sleeping giant of drug development. *American Journal Pharmaceutical Education* 148:46-52.

Lange, D. & U. Schippmann. 1997. *Trade survey of Medicinal plants in Germany: a contribution to international plant species conservation.* Bundesamt fur Naturschutz, Bonn

Peters, C.M. 1992 . The ecology and economics of oligarchic forests. *Advances in Economic Botany* 9 : 15-22

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

Robinson, J.G., & E.L.Bennett (eds.) 2000. *Hunting for Sustainability in Tropical Forests.* Columbia University Press, New York.

Ruddle, K.1970. The Hunting Technology of the Maracá Indians. *Antropologica* 25:21-63.

Shanley, P., S. A. Laird, A. Pierce & A. Guillen (eds.) in press. *The management and marketing of non-timber forest products: certification as a tool to promote sustainability.* Earthscan, London.

Siswoyo, E.A.M. Zuhud & D. Sitepu 1994. *Research programme on and development of medicinal plants in Indonesia pp. 161-300 In* E.A.M. Zuhud & Haryanto (eds.) *Conservation and use of medicinal plants' diversity in Indonesia's tropical forests.* Jurusan Konservasi Sumberdaya Hutan Fakultas Kehutanan IPB & Lembaga Alam Tropika Indonesia (LATIN), Bogor.

TRAFFIC North America. 1999. *Medicine from U.S. Wildlands: An Assessment of Native Plant Species Harvested in the United States for Medicinal Use and Trade and Evaluation of the Conservation and Management Implications.* Unpublished report to the National Fish and Wildlife Foundation, TRAFFIC North America, World Wildlife Fund, Washington, DC.

Tutin, C., R. Nasi & D. Wilkie 2001.

Vasquez, R., & A.H. Gentry. 1990. Use and misuse of forest-harvested fruits in the Iquitos area. *Conservation Biology* 3(4): 350-361.

Wickens, G.E. 1991. Management issues for development of non-timber forest products. *Unasylva* 42(165): 3-8.

Williams, V L. 1996. The Witwaterrand multitrade. *Veld and Flora* 82: 12-14.

Assessment and Monitoring

1
VEGETATIVE DIVERSITY OF KARELIAN ISTHMUS FOREST ECOSYSTEMS AS INDICATOR OF THEIR ECOLOGICAL STATE

***A.S. Alexeev, **S.O. Grirorieva, ***G.L. Egorova, *A.A. Egorov, **V.N. Fedorchuk, *I.M. Chernov, ****C.Gauberville**
*Saint-Petersburg Forest Technical Academy
** Saint-Petersburg Forestry Institute
*** Saint-Petersburg Scientific Centre of the Russian Academy of Science
****Forest development Institute, Paris

Keywords: Biodiversity, forest ecosystems, forest types, normal distribution, diversity standard

Within the framework of the international project “Cape Biodiversity”, which is being designed by a group of scientists and specialists from the three countries: Russia, France, and Finland, supported by the European Programme “LIFE”, the research aimed at the study of Karelian Isthmus forest ecosystem vegetative diversity has been carried out. The purpose of the research is to develop methods of use of vegetative diversity indicators in order to evaluate en ecological state of forest ecosystems, to elaborate proposals concerning monitoring system organisation, and use them with the object of stable forest management.

Karelian Isthmus is of particular interest for its territory, is distinguished by unique flora and fauna, peculiar geological structure and relief. Karelian Isthmus is situated between the Gulf of Finland and Lake Ladoga bordering the Neva river in the south.

Vegetative communities of Karelian Isthmus are mainly represented by forests, which are the main equalising component of the landscape. Forests occupy a significant part of Karelian Isthmus – 65%. Diversity of the main forest species is typical for a subzone of southern taiga. There are a great variety of forest types, vegetation conditions, landscapes, and a quantity of rivers and lakes on Karelian Isthmus, which territory is relatively small (about 15,000 square kilometres). 9 types of natural landscapes have been determined on Karelian Isthmus.

Karelian Isthmus area has a unique variety of forest ecosystems. At the same time, it is situated very closely to Saint Petersburg and undergoes significant anthropogenic impact: industrial pollution of the atmosphere, soil, and waters, recreational pressure, and excessive exploitation of forest resources. In connection with this it is necessary to implement permanent effective control of forests’ conditions.

In order to collect the necessary material, during the summer season of 2000 the fieldwork has been carried out, as a result of which 178 permanent registration points (PRP) were founded according to 4x4 km coordination network. ?-diversity study was carried out in accordance with forest group types. The number of PRP organised in specific forest types corresponded to the representation of these types in the forest-covered area of Karelian Isthmus. Experimental data collection was performed according to the specially developed technique, the basis of which constituted the condition and vegetation presence registration technique in the American monitoring system of forest life condition.

α-diversity

After the statistical analysis the following indicators of forest vegetation cover α-diversity were obtained:

m=34 – the average number of species falling one on test area	v=40.3% - the species number variation factor on test areas from the average values.
σ=13.5 - the root-mean-square deviation of species number on test areas from the average value	P=71 fluctuation amplitude of specious diversity between the max (80 species) and min (9 species) values.

The maximum species diversity corresponds to the oxalis, the most optimal forest type group as to the conditions of growth, the minimal species diversity corresponds to the lichen forest type group. However, on the whole, the test areas number distribution according to the gradation of species diversity is well described by a standard curve of normal distribution. On the whole, species diversity of Karelian Isthmus vegetation cover is not relatively rich, it numbers from 21 to 50 species in 70% cases which is characteristic of the southern taiga territory.

The calculated Simpson indexes for every forest phytocenosis level and for the whole community on average repeat the dependencies obtained for the indicator of species diversity.

As a result of the performed calculations, statistically reliable dependencies of spatial distribution of species diversity indicator on the territory under investigation were obtained. The prognoses of the species diversity value for those points on the investigated territory, for which the experimental data is lacking, is possible with the help of the equation obtained as a result of the calculations. The addition of a number of variables explaining the species diversity, such as prevailing breed and type of forest, can increase the reliability of the prognoses.

β-diversity

Beta-diversity characterises the richness of the number of species in the vegetation cover of elementary forest ecosystems classified according to prevalent ecological factors and gradients. Statistics obtained as a result of field observations allows evaluating beta-diversity indicator for each forest ecosystem belonging to different forest type groups, as basic units (Fig. 1).

Development of quantitative standards of forest ecosystems' vegetative diversity

The results of the analyses conducted during the project show that the most important factor influencing species diversity is a combination of ecological factors, which can be defined under a system of forest type groups exerting the greatest influence on forest cover species diversity. Average values of species diversity, as shown on the Figure 1, strongly differ according to forest type group. Besides, it turns out that the distribution of control points inside each forest type group based on species diversity is described by a curve of normal distribution, i.e. the number of control points having a species diversity bigger or less than the average value diminishes quickly along the normal curve.

$$y = 10/((2*\pi)^{\wedge}0.5*\sigma)*\exp(-(x-x_{cp.})/2*\sigma^{\wedge}2).$$

y – apportionment (number) of ecosystems belonging to a given forest type group with species diversity equal to x ,

$x_{cp.}$– average species diversity of a forest type group – standard of biodiversity,

σ – average quadratic declination.

As a result of this, an opportunity appears to calculate and determine quantitative standards of vegetative diversity according to forest type groups, and use them for evaluation of forest ecosystems. Test areas distribution according to species diversity for the bilberry forest type group is shown on the Fig. 2.

According to the results of work thematic maps of Karelian Isthmus were drawn.

Figure 1.

Shares of sample plots with different alpha biodiversity in Bilberry (Myrtillosa) forest type group. y=(10/(((2*3.14)^0.5)*11))*exp(-(x-33)^2)/(2*11^2))

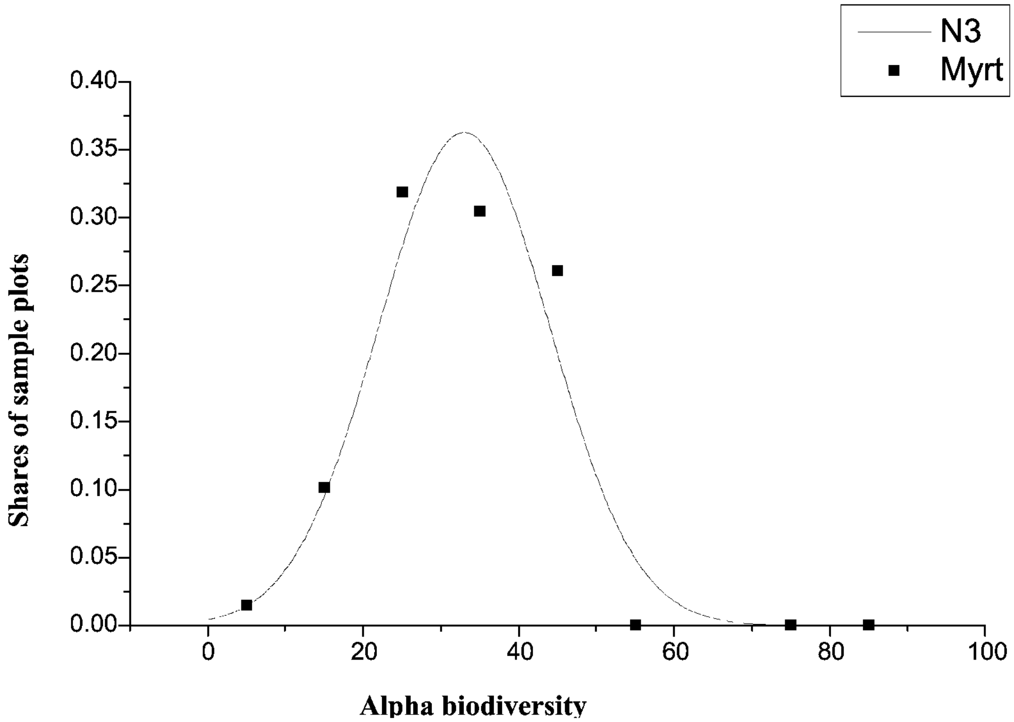
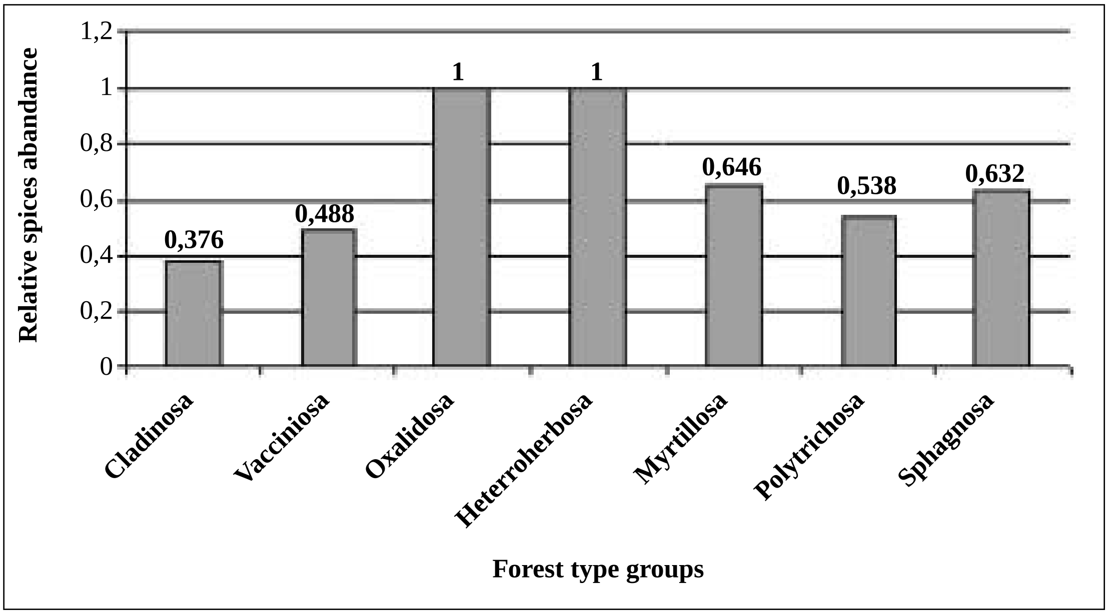


Figure 2.

Beta-diversity of the forest vegetation cover on Karelian Isthmus



2
INDIAN LANDS AS A KEY ELEMENT IN THE BIODIVERSITY CONSERVATION OF THE BRAZILIAN AMAZON

João Paulo Capobianco, Nurit Bensusan*, Adriana Ramos and Alicia Rolla
Instituto Socioambiental
Av. Higienópolis 901
01238-001 São Paulo – SP
Brazil

Keywords: biodiversity conservation, forests, Indian lands, Amazon, protected areas

Background

The identification and definition of important areas for biodiversity conservation in a region as vast as the Amazon has been a challenge for researchers and policy makers for years. From 1970, the search for a method beyond opportunism lead to the proposals of many methodologies for the selection areas in order to protect the greatest biodiversity (Pressey *et al.*, 1993). Some of them were applied in the Brazilian Amazon. The first experience of selecting areas for conservation was made by the land use component of RadamBrasil, a programme for mapping the Brazilian Amazon developed between 1973 and 1983. The identification of the areas was based on their geological and geomorphologic characteristics, but it also included areas without any specific use.

The second experience was based on the occurrence of centres of endemism in the Brazilian Amazon (Wetterberg et al., 1976). At this time 30 areas were identified as priority. The third effort was, in 1990, the so called Workshop 90. The selection of the areas was based on biogegographical analysis of endemism and species richness. The results pointed to 57 priority areas (Rylands 1991). After some years, Rylands and Pinto (1998) highlighted that many other areas were not included due to lack of information and argued that the final map of Workshop 90 reflected only the limited knowledge we have about the Brazilian Amazon.

Because of the limitations of species-based identification of areas, suggestions of landscape and ecosystem related approaches were put forward and, in 1999 as a part of the National Programme on Biodiversity six non-governmental organisations co-ordinated by Instituto Socioambiental, promoted a workshop on evaluation and identification of priority areas and activities in the Brazilian Amazon. This workshop, called "Seminar on Evaluation and Identification of Priority Activities for Conservation, Sustainable Use and Benefit Sharing of the Brazilian Amazon Biodiversity", gathered the greatest number of data on the Brazilian Amazon ever, and selected 86 new areas to be protected.

On the other hand, Indian lands have been established considering their traditional occupation of the land, without taking in to account the biodiversity status of these areas. In the Brazilian Amazon, an area of 500.631.680 hectares, there are 370 Indian lands, encompassing 102.278.338 hectares, representing 20,43% of the Amazon region.

Methods

The Seminar on Evaluation and Identification of Priority Activities for Conservation, Sustainable Use and Benefit Sharing of the Brazilian Amazon Biodiversity developed its work on preliminary data including: a) maps of cattle distribution, main crops cultures, mining, population, land use pressure, deforestation, deforestation pattern, fire risk, hydro balance, fires in August 1999, ecoregions, phytophysiognomies, protected areas, Indian lands, land reform settlement, roads, centres of wood exploitation, hydrography and traditional knowledge; b) assessment of biological groups, such as plants, mammals, fishes and birds; and c) socio-economic analysis.

These documents were analysed first through a thematic approach and then through a regional approach, which divided the Brazilian Amazon in 7 regions. The 226 participants pointed out 379 priority areas, divided in 4 categories: extremely high priority, very high priority, high priority and unknown areas with strong possibility of biological relevance. For each area, recommendations were developed, including the establishment of protected areas.

Results

The results of the seminar, presented in figure 1 and table 1, show that an important part of the relevant areas for biodiversity conservation, 40,1% of the extremely high priority areas and 36,4% of the very priority areas, are located inside the Indian lands. These numbers are significantly higher than the percentage of relevant areas for biodiversity conservation located within protected areas; only 34% of the extremely high priority areas and 29,9% of the very priority areas It is difficult to point out an explanation for these results, but there are three main hypothesis: 1) Indians tend to concentrate where biodiversity is abundant; 2) these peoples have an important role in the ecological processes that generate and maintain biodiversity; and 3) a mix of the two previous hypothesis, Indians prefer lands with more biodiversity, but they are also a key element in the processes that create and maintain biodiversity.

These data highlight the relevance of the Indian lands to the conservation of the biodiversity in the Brazilian Amazon. However, Brazil is still lacking a programme for biodiversity conservation in those Indian lands.

References

Pressey R.L., C.J. Humphries, C.R. Margules, R. I. Vane-Wright, P.H. Williams. 1993. Beyond opportunism: key principles for systematics reserve selection. Tree 8: 124-128.

Rylands AB. 1991. The status of conservation areas in the Brazilian Amazon. Washington. World Wildlife Fund & The Conservation International.

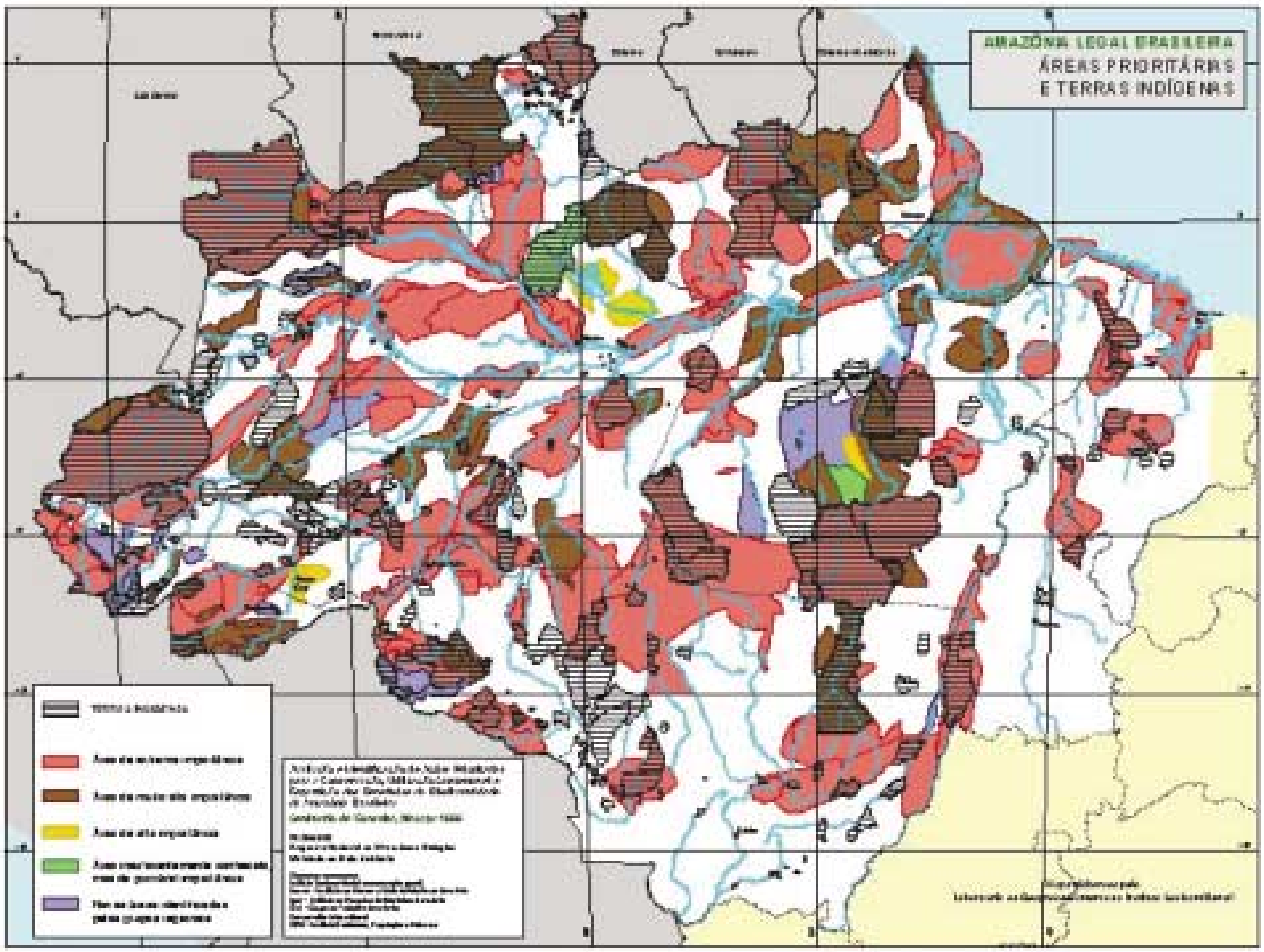
Rylands AB., Pinto LPS. 1998. Conservação da biodiversidade na Amazônia brasileira: uma análise do sistema de unidades de conservação. Cadernos FBDS 1: 1-65.

Wetterberger G.B., M.T.J Pádua., C.S Castro., J.M.C. Vasconcellos. 1976. Uma análise de prioridades em conservação da natureza na Amazônia. Projeto de Desenvolvimento e Pesquisa Florestal (PRODEPEF) PNUD/FAO/IBDF/BRA-45, Série Técnica 8: 1-63.

Table 1.
Percentage of priority areas included in protected areas and Indian lands

Level of priority	Protected Areas (%)	Indian lands (%)
Extremely high priority	34,0	40,1
Very high priority	29,9	36,4
High priority	0	25,0

Figure 1.
Final map of the results of the seminar on Evaluation and Identification of Priority Activities for Conservation, Sustainable Use and Benefit Sharing of the Brazilian Amazon Biodiversity, including Indian lands (hatched); priority areas (extremely high priority in red, very high priority in brown, high priority in yellow and unknown areas with strong possibility of biological relevance in green); and the new areas identified as relevant by other criteria than biological (in purple).



3
NHy - EMISSION DENSITY TRIGGERS DIVERSITY OF "TYPICAL" FOREST VASCULAR PLANTS

Hermann Ellenberg* and Tobias Nettels**
*Institute for World Forestry, Federal Research Centre for Forestry and Forest Products, Hamburg,Germany;
** MSc-thesis, Faculty for Biology, University of Hamburg, Germany.
E-mail: ellenberg@holz.uni-hamburg.de

Keywords: plant species diversity, sustainable forest management, management intensity, ammonia emission density, eutrophication, Northern Germany.

Introduction:

Eutrophicating and acidificating power of ammonia (NH3) and ammonium (NH_4^+)deposition from the air is well known scince the mid Eighties. It is considered one of the main causes for forest decline in Central Europe. Forests are "combing" these substances from the air and concentrating by this means the deposition load upon their areas. Trees and other plants are able to take up ammonia and ammonium directly from the air via their stomata and assimilate them into their leaves. Also, algae or lichens in the canopy assimilate these nitrogen compounds directly. Deposition and assimilation of NH_3 and NH_4^+ trigger eutrophication of the ecosystem with a nutrient that in the past has been in short supply at most places, naturally or as a consquence of unsustainable use. This eutrophication occurs via leaf and litter fall and by the decomposition of this organic material through the activities of soil organisms.

Question:

As forests are normally not/no longer supplied with nitrogen fertilizers, and as plant indicator species for poor nitrogen supply are known to be most intensly threatened – does there exist a correlation or even a causal connection between numbers of "typical" forest species (vascular plants: ELLENBERG 1998) and the emission density of NHy ?

Approach:

For 28 counties (Landkreise) in the Northern German Lowlands – a quite homogenous macro-landscape over hundreds of kilometres – emission densities of NH3 had been calculated from animal husbandry statistics and provided to the CORINE data sample of the European Community. These data could be taken at the Federal Agency for Nature Conservation in Bonn. – The number of "typical" forest vascular plant species have been counted from this Agency's data pool on the distribution of vascular plants in Germany. The species pool of "typical" forest vascular plants for each county was defined as the cumulative species numbers for four map sheets 1 : 25 000 (about 11 x 11 km, Messtischblatt). We concentrated on counties with approximately similar forest cover percentages (between 12 and 25 % forest cover).

Results:

There exists a clear correlation: high NHy – emission densities go parallel with low numbers of "typical" forest vascular plant species. This is especially evident for the counties on the poorer soils of the moraines of the last but one glaciation (see Figure). Possibly this result is only due to a lack of a similar steep gradient in emission densities for the counties in younger moraine landscapes. – This findings fit well with earlier published results on "eutrophication – the most serious problem in nature conservation" (ELLENBERG et al., 1989).

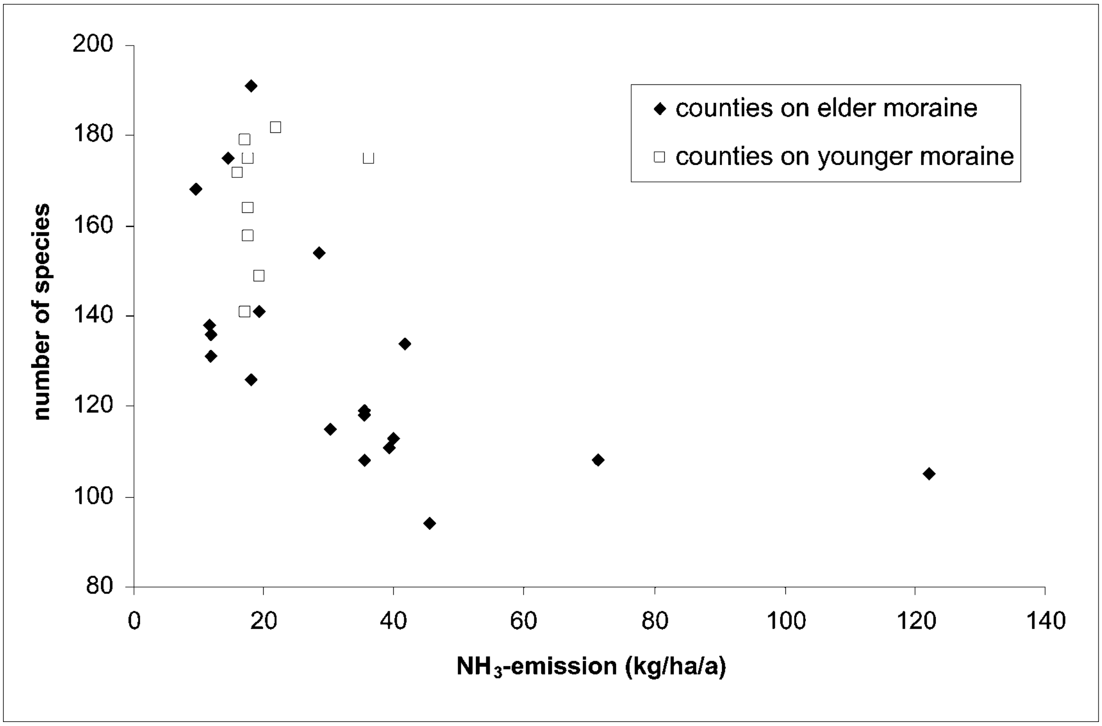
Literature:

ELLENBERG, H., RUEGER, A., VAUK, G. (editors), 1989: Eutrophierung – das gravierendste Problem im Naturschutz? (*Eutrophication – the most significant problem in nature conservation?*). – NNA-Berichte, 2. Jahrg., Heft 1 (Norddeutsche Naturschutzakademie, Hof Möhr, 3043 Schneverdingen, Germany). 70 p.

ELLENBERG, H., 1997: Biologische Vielfalt auf Art-Ebene und ihre Gefährdung als Kriterium und Indikation für ein Monitoring der Nachhaltigkeit von Waldbewirtschaftung. Ein Diskussionsbeitrag zum Helsinki-Prozess. (*Biological diversity on species level and it's threat as criteria and indication for a monitoring of sustainability in forest management – a discussion contribuition to the Helsinki Process*).– In: Schriftenreihe des BML (Federal Ministry for Agriculture, Germany) "Angewandte Wissenschaft", Heft 465, "Biologische Vielfalt in Ökosystemen", (1997), p 127 – 137.

Figure 1:

Number of "typical" forest vascular plant species in relation to emission densities for ammonia. - Plant species are counted per four map grids (1 : 25 000, a total of 484 km^2, grid mapping results for Germany, Federal Agency for Nature Conservation, Bonn) in 28 counties in the Northern German Lowlands. Emission density is calculated on the basis of husbandry animal statistics per county (data from the CORINE information base, as available in the Federal Agency for Nature Conservation in Bonn). - Black rhombs = counties in moraine landscapes of the last but one glaciation, rather poor soils. - Open squares = counties in moraine landscapes of the last glaciation, richer soils.



4
RARITY TYPES OF FOREST PLANTS IN NORTHERN GERMANY

Ellenberg*, H., von Oheimb, G., Kriebitzsch*, W.U.**
Institute for World Forestry, Federal Research Centre for Forestry and Forest Products, Hamburg, Germany; ** Institute for Ecology and Environmental Chemistry, University of Lueneburg, Germany

Keywords: rarity types, forest plants, sustainable forest management, Red data list, Germany

Introduction

Few species exist that can be found almost everywhere. Most species are rare somehow, id est irregular in occurrence in a larger area of distribution and often only with a few individuals per stand. Many species live only under special ecological conditions of climate, soil quality and/or water availability. – But rare species significantly shape species diversity in a landscape or region. – We define seven types of rarity. We take the example of “typical” forest vascular plants of the Northern German Lowlands.

Approach

In Germany exist about 2700 species (conservatively speaking) of vascular plants on 357 000 km^2. Some 560 of them are defined “typical” for forests (von Oheimb et al. 1999, Ellenberg 1997). North of a line passing the city of Berlin in an east-west direction, 297 „typical“ forest plants occur in former West Germany, and 315 of them in former East Germany, on 58 000 and 48 000 km^2, respectively. In our three research areas on rich, moderately rich, and poor soils, 227, 169 and 225 „typical“ forest species have been found on 484 km^2, each, over a time of more than 50 years. But on our research sites we met only 45 to 105 “typical” forest species, altogether, on approximately one hectare, cumulated from plenty of plots à 200 sq.m, each, scattered more or less systematically over the areas. From these latter species only very few may be considered rare. They grow but exceptionally on our systematically distributed plots.

Rarity – apart from distribution of populations in a larger area (**geographic** aspect) – has at least two more relevant aspects: the l**ocal population size** and the habitat requirements of the species, that may not be given everywhere (**habitat specificity**). Geographical distribution is measured as the percentage of map grids occupied (1 : 25 000; 120 km^2; Messtischblatt). Local population size is the number of individuals at a site of occurence, e.g. individuals per 100 m^2. Habitat specificity may be judged from the position of the species in the phyto-sociological system (based on geobotanical literature). For example: *Ulmus laevis*, an elm tree, almost exclusively occurs in river flood plains, whereas the oak, *Quercus robur*, lives in a wide spectrum of different forest types.

We typified the 297 respectively 315 “typical” forest vascular plant species of the western and eastern parts of Northern Germany according to the three criteria geographical distribution, single stand population size, and habitat specificity. This provides a matrix of eight categories with only one “really abundant” (widely distributed, always many individuals and often dominant in the vegetation, phyto-sociologically not very specific). Seven categories describe different types of somehow rare species, where at least one of the three criteria is considered restricted. Additionally we checked the Red data list status of these species in the eight categories of rarity.

Results

Common species with a geographically vast distribution, a broad or narrow habitat specificity, and large local population sizes, contribute to one third of the species considered. Examples are tree species such as *Fagus silvatica, Quercus robur, Fraxinus excelsior, Acer pseudoplatanus*, herb and grass species such as *Galeobdolon luteum, Poa nemoralis, Milium effusum*, or ferns such as Dryopteris filix-mas. There are very few Red data list species in this group. About 10 % of the species have to be put into two „transitional“ categories. More than

50 % of the “typical” forest vascular plant species are in three categories of “really rare plants”. They are distributed sporadically or peripherically, require specific habitats and have but small populations at a stand. Many of these species are on the Red data lists of the German states Niedersachsen (NS), Schleswig-Holstein (SH) or Mecklenburg-Vorpommern (MV), such as the tree species *Ulmus minor, Sorbus torminalis, Tilia platyphyllos, Malus sylvestris, Taxus baccata*.

Conclusions

By selection of the research area, the landscape and the sites of an investigation, a certain potential floristic diversity is already defined implicitly. Comparing species diversity from different investigations has to consider the comparability of the geographical scale; best to provide species-area-relations in every published results. In discussions about species protection and nature conservation, not only threat is a relevant criteria but also rarity is. Rarity has to be seen in the context of the types of geographical and ecological distribution as well as the population sizes. More than half of the „typical“ forest vascular plant species in the Northern German Lowlands is somehow rare. There exists little chance to hit them on (rather small) sample plots, even in case many of them are checked. Rare species have to be looked for with specialized knowledge and skill.

Rare species are to be specifically valued in sustainable forest management as well as sustainable forest development. Forest managers are not only responsible for the favourable conservation status of rare trees.

Table 1:

Seven types of rarity in “typical” forest vascular plant species in the Northwestern German Lowlands (297 species). Numbers of species are given. Number of Red data list species in brackets for two northern German Laender.

GEOGRAPHICAL DISTRIBUTION (more or less than 50% of the ca. 120 km² grids occupied)		**wide**		**restricted**	
HABITAT SPECIFICITY (according to the phyto-socio-logical status of the species)		**broad**	**narrow**	**broad**	**narrow**
LOCAL POPULATION SIZE	**large** +/- dominant	**28** (0/0)	**7** (1/0)	**10** (2/3)	**15** (8/3)
	small single to few individuals	**62** (4/0)	**25** (4/3)	**86** (60/42)	**64** (36/25)

Table 2:

ditto (see Tab.1) .... in the Northeastern German Lowlands (315 species). ....

GEOGRAPHICAL DISTRIBUTION		**wide**		**restricted**	
HABITAT SPECIFICITY		**broad**	**narrow**	**broad**	**narrow**
LOCAL POPULATION SIZE	**large**	**32** (0)	**10** (1)	**5** (0)	**12** (2)
	small	**79** (6)	**31** (0)	**75** (27)	**66** (30)

5
AN INTRODUCTION TO THE HOPE RIVER FOREST FRAGMENTATION PROJECT

Robert Ewers
Department of Zoology, University of Canterbury
Private Bag 4800, Christchurch, New Zealand

Keywords: Fragmentation; invertebrate communities; New Zealand

Background

Biodiversity models predict deforestation and forest fragmentation will be the primary factors causing species extinctions in the foreseeable future. Fragmentation causes species loss by reducing core habitat area and increasing edge effects. New Zealand has a diverse biota and has been identified as one of the 25 most important biodiversity hotspots in the world. However, 88% of New Zealand's forests have already been destroyed and much of what remains is heavily fragmented.

This paper introduces *The Hope River Forest Fragmentation Project*, a new initiative by the Canopy Research Group at the University of Canterbury to investigate the effects of forest fragmentation on invertebrate communities in the Hurunui District, South Island, New Zealand. Historic deforestation rates in this region range from 35 to 95% per 10¥10 km grid square.

The Hope River project is the largest scale study of its kind ever conducted, covering a far greater range of fragment sizes (14 forest remnants from 0.01 to 3,485 ha and a >50,000 ha forest control site), and far longer edge gradients (0, 2, 4, 8, 16, 32, 64, 128, 256, 512 and 1024 m from edges into forest interiors *and* from edges out into pasture). At the same time, I am comparing fragmentation effects on ground and canopy dwelling insects.

Methods

A total of 233 ground and 114 canopy flight interception traps were operated continuously from 30 November 2000 until 10 February 2001, for a total of 24,794 trap days sampling effort. Initial sample sorting (3,545 trap days) indicates an average invertebrate abundance of 11 individuals per canopy trap day and 57 individuals per ground trap day, for an expected total of 1.06 million invertebrates sampled.

Results

Initial sorting (3,545 trap days) has produced 105,863 specimens, with an average arthropod abundance of 11 individuals per canopy trap day and 57 individuals per ground trap day. Based on these figures, I expect a combined total of 1.06 million invertebrates sampled across all sites.

There is a clear difference in ordinal community composition between pasture ground, forest ground and forest canopy communities (Figure 3). For these preliminary data, no effects of edge distance (regression: $F(1,9) = 0.47$, $p > 0.05$) or fragment area (regression: $F(1,13) = 1.26$, $p > 0.05$) on the abundance of canopy-dwelling arthropods have been found.

6
OVERVIEW OF THE FOREST BIODIVERSITY IN BANGLADESH

M. K. Hossain
Institute of Forestry and Environmental Sciences,
Chittagong University,
Chittagong 4331, Bangladesh,
E-mail: ifescu@globalctg.net.

Keywords: Forest, biological diversity, conservation, flora and fauna, Bangladesh

Bangladesh possessed a rich biological heritage of flowering plants, mammals, birds, reptiles, amphibians, fishes etc. and it is a zone of high biodiversity. Bangladesh has an area of 143,998 sq. km. and lies in between 21°3' and 28°29' north latitude and 88°01' and 92°52' east longitude [Das, 1990]. It has an area of 2.46 million ha of forests distributed all over the country. The natural forests of Bangladesh were considered as one of the richest and biologically diverse forest resources due to its unique geo-physical location. These forests consist of three major vegetation types occurring on the three distinctly different land types [Hassan, 1994]. An estimated 5,700 species of angiosperms alone are available in the forests of Bangladesh of which some 2260 species are reported from the Chittagong region which falls between two major floristic regions of Asia [Anon, 1992]. The major forest types of Bangladesh with some important tree species are shown in Table 1.

Khan [1996] reported that there are about 86 species of timber plants, 130 species of fiber plants and 29 species of medicinal plants available in the country. Besides domesticated species, a total of about 932 species of amphibians and amniotes have so far been recorded, which include 23 species of amphibians, 154 species of reptiles, 632 species of birds (358 non-passerine and 274 passerine) and 132 species of mammals. However, the GOB [1992] reported the status of wildlife in Bangladesh. Another 260 species of fishes [Rahman, 1989], 12 exotic [Rahman, 1985] and 56 species of palaemonid and penaeid prawns are also reported in the freshwater, estuarine and marine waters [Kibria, 1983]. The aquatic fauna diversity is represented by variety of sponges (3), corals (11), crabs (15), lobsters (3), molluscs (327), echinoderms (4) and other invertebrates. The vertebrate species being 260 species of freshwater fishes, 475 species of marine fishes, 10 species of frogs, 28 species of turtles and tortoises, 2 species of crocodiles, 1 species of gharial, 24 species of snakes and 125 species of mammals [Khan, 1996]. Heinig [1925] discussed the annotated check list of all the plant species known for the Chittagong Collectorate and Hill Tracts. Khan and Afza [1968] briefly gave the preliminary floristic report on Teknaf forest. Khan *et al.* [1994] reported the keystone species of plants of ecological and socio-economic value in the Teknaf Game Reserve, which comprised of 290 species belonging to 212 genera under 65 families. Hossain *et al.* [1996] reported 85 tree species (≥10cm dbh) were found to occur in Bamu reserve forests of Coxs'Bazar Forest Division. Similarly, Nath *et al.* [1998] reported 85 tree (≥10cm dbh) species from a sampled area of 2 ha in Sitapahar reserve block of Chittagong Hill Tracts (South) Forest Division representing 68 genera and 36 families. Alam [1988] recorded about 790 woody taxa (excluding monocots and gymnosperms) under 95 families of which about 400 are tree species from Sylhet forests. In moist sal forests area, a record of woody taxa includes 260 species under 160 genera comprising of 56 families [Alam, 1995]. In comparison to the deciduous sal and evergreen and semi-evergreen hill forests, the flora of the mangroves does not show much heterogeneity in floral composition. A recent inventory enlisted 66 plant species in the Sundarbans [Chaffey *et al.*, 1985]. However, altogether about 5700 species of angiosperms and 1500 species of fauna have been believed to be available in the country but recent findings show that the population of some of the species have declined to about a half.

Bangladesh has 12 protected areas, including 4 national parks, 7 wildlife sanctuaries and one game reserve, all gazetted under the provision of the Bangladesh Wildlife (Preservation)(Amendment Act, 1974 [Anon, 1992]. These cover a total of 110,000 ha area, but do not represent the natural diversity of forest types of other important ecosystems in the country. The UNESCO has declared the Sundarbans of Bangladesh as its 522nd World Heritage Site on 6th December 1997. UNESCO determined about 1400 km2 of Sundarbans as world heritage site. The then Honourable Prime Minister of Bangladesh hoisted the flag of World Heritage Site and unveiled the plaque at Nilkamal (Hiron point) of the Sundarbans on 4th February 1999. However, the existing protected areas are inadequate to protect the biological diversity of the country even under proper management. Rashid [1995] pointed out some of the forest biodiversity "hot spots" in northeastern Bangladesh and mentioned 15 threatened or endangered wildlife species in this area.

References

Alam, M.K. 1988. *Annoted checklist of the woody flora of Sylhet forests.* Bull. 5, Plant Taxonomy Series, Bangladesh Forest Research Institute, Chittagong. 153 pp.

Alam, M.K. 1995. Diversity in the woody flora of sal (*Shorea robusta*) forests of Banngladesh. *Bangladesh J. For. Sci.*, **24(1)**:41-51.

Annonymous 1992. *Forestry Master Plan-Forest Institutions,* ADB (TA No. 1355-Ban), UNDP/FAO BGD 88/025, 191 pp.

Chaffey, D.R.,Miller, F.R. and Sandom, J.H. 1985. *A forest inventory of the Sundarbans, Bangladesh.* Main report, Project report No. 140, 196pp. Overseas Development Administration, London.

Das, D.K. 1990. *Forest types of Bangladesh.* Bulletin 6, Plant Taxonomy Series, Bangladesh Forest Research Institute, Chittagong. 9pp.

GOB (Government of Bangladesh) 1992. The Government of Bangladesh and the International Union for Conservation of Nature and Natural Resources-Towards Sustainable Development. *National Conservation Strategy of Bangladesh.* 214 pp.

Hassan, M.M. 1994. Forest soils of Bangladesh. *Bangladesh J. For. Sci.*, 23(2):1-11.

Heinig, R.L. 1925. List of plants of Chittagong Collectorate and Hill Tracts. Darjeeling, India. 84pp.

Hossain, M.K., Hossain, M. and Alam, M.K. 1996. Diversity and structural composition of trees in Bamu reserved forest of Cox's Bazar forest division, Bangladesh. *Bangladesh J. For. Sci.*, 26(1):31-42.

Khan, M.S. 1996. *National Obligations in the Implementation of the Convention on Biological Diversity: Bangladesh Perspective.* A key note paper presented at the workshop on the National Obligations in the Implementation of the Convention on Biological Diversity:Bangladesh Perspective on July 13, 1996 at IUCN Bangladesh Country Office, Dhaka.

Khan, M.S. and Afza, S.K. 1968. A taxonomic report on the angiospermic flora of Teknaf and St. Martin's Island. *The Dhaka University Studies,* **16(B)**:25-30.

Khan. M.S., Rahman, M.M.,Huq, A.M. and Mia, M.M.K. 1994. Assessment of biodiversity of Teknaf game reserve in Bangladesh focussing on economically and ecologically important plant species. *Bangladesh J. Plant Tax*., 1(1):21-33.

Kibria. G. 1983. Shrimp resources and shrimp farming in Bangladesh (in Bengali). Jahan Printing Press, Satkhira, Khulna.

Nath, T.K., Hossain, M.K. and Alam, M.K. 1998. Diversity and composition of trees in Sitapahar forest reserve of Chittagong Hill Tracts (South) forest division, Bangladesh. *Ann. For.*, 6(1):1-9.

Rahman, A.K.A. 1985. *Introduction of exotic fishes in Bangladesh*. Fishery Training and Research Centre, Chandpur, Bangladesh.

Rahman, A.K.A. 1989. *Fresh water fishes of Bangladesh*. The Zoological Society of Bangladesh, Dhaka.

Rashid, S.M.A. 1995. Forest Biodiversity "Hot Spots" in Northeastern Bangladesh. In: *Measuring and Monitoring Forest Biological Diversity*: The International Network of Biodiversity Plots, An International Symposium at Smithsonian Institution, Washington D.C. on May 23-25.

Table 1:

Major forest types of Bangladesh with some of their important tree species.

Forest Type	Location	Important Tree Species
Tropical wet evergreen and semi-evergreen forests	Sylhet, Chittagong, Chittagong Hill Tracts (Banderban, Khagrachari and Rangamati Hill districts) and Cox'sBazar districts	*Adina cordifolia, Albizia chinensis, A. lebbeck, A. procera, Alstonia scholaris, Anisoptera scaphula, Aphanamixis polystachya, Artocarpus chaplasha, A. lakoocha, Bombax ceiba, Callicarpa arborea, Calophyllum polyanthum, Castanopsis indica, Chukrasia tabularis, Daubanga grandiflora, Derris robusta, Dillenia pentagyna, Diospyros embryopteris, Dipterocarpus alatus, D. pilosus, D. turbinatus, Elaeocarpus robustus, Ficus spp., Garcinia spp., Garuga pinnata, Gmelina arborea, Holarrhena antidysenterica, Hopea odorata, Hydnocarpus kurzii, Lagerstroemia speciosa, Lannea coromandelica, Lophopetalum fimbriatum, Macaranga denticulata, Mangifera sylvatica, Mesua ferrea, Michelia champaca, Mitragyna parvifolia, Microcos paniculata, Quercus semiserrata, Palaquium polyanthum, Podocarpus nerifolia, Pterospermum acerifolium, Pterygota alata, Salmalia insignis, Saraca indica, Schima wallichii, Sterculia villosa, Stereospermum chelonoides, Swintonia floribunda, Syzygium grande, Syzygium spp., Terminalia bellirica, Tetrameles nudiflora, Toona ciliata, Vitex glabrata etc.*
Tropical moist deciduous forests	Northern & Eastern parts of Bangladesh, particularly in the districts of Dhaka, Mymensingh, Tangail, Sher pur, Dinajpur and Comilla	*Adina cordifolia, Albizia procera, Aphanamixis polystachya, Artocarpus chaplasha, Butea monosperma, Careya arborea, Cassia fistula, Dillenia pentagyna, Garuga pinnata, Holarrhena antidysenterica, Lagerstroemia parviflora, Litsea polyantha, Microcos paniculata, Miliusa velutina, Phyllanthus emblica, Schleichera oleosa,* Semecarpus *anacardium, Shorea robusta, Sterculia spp., Streblus asper, Terminalia bellirica, T. chebula etc.*
Tidal forests	Sundarbans in Khulna, Chakaria sunderbans and coastal plantations of all along the coastal areas of the country	*Amoora cuculata, Avicennia marina, A. officinalis, Bruguiera conjugata, Ceriops roxburgiana, Cynometra ramiflora, Excoecaria agallocha, Heritiera fomes, Hibiscus tiliaceus, Nipa fruticans, Phoenix paludosa, Rhizophora conjugata, Sonneratia apetala, Xylocarpus granatum, X. moluccensis, X. obovata etc.*

7
RELATIONSHIP BETWEEN BIODIVERSITY AND GLOBAL WARMING

Michal Kravcik, Jaroslav Tesliar, Jan Hronsky, Robert Zvara
Non profit organization People and Water
Prazska 4, 040 11 Kosice
Slovakia,
Tel./fax: 00421 95 6428 184
E-mail: mvolav@changenet.sk
http://www.peopleandwater.sk

Keywords: Global warming; Slovakia

Problem of the climate change is more difficult than so far known hypotheses about the greenhouse effect developed by the pollution in the atmosphere. We are offering you the following facts that may help you to understand coherence between the global warming and water in a nature. Sustainable ecosystems and balanced water in it is an necessary condition for variety and richness of fauna and flora species, e.g. for biodiversity. This relationship we have described, on the bases of knowing the connections of draining the Earth's surface by the influence of human activities on the landscape. On the base of knowing the period and space changes of hydrological cycle of Slovakia in the 20-th century we have described the algorithm of the space-time changes of hydrological cycle for global ecosystem of the Earth. By this we would like to offer unconventional look on the algorithm of the possible scenarios of global warming for the 21-th century and influencing that biodiversity.

The Slovak Example

The average rainfall in Slovakia gets up to 700-mm. The dry period in January and February and the wettest period is from May till August (graph no.1). In Slovakia falls a year about 34,5 mld. m3 water in the rain form per year. From Slovakia flows away at about 33% (11.5-mld. m^3 per year) of the water flows out from watersheds and 23,0 mld. m^3 stays in the country and is a part of small hydrological cycle. The total length of the rivers and streams in Slovakia is 48.000 km. The area of Slovakia is 49. 060 km2 with 5.3 million inhabitants. There is 41% of the forests, 57% of agricultural and other lands and 2% of urban areas in more than 2.800 villages and towns.

In the 20 century was a long time decrease of rainfall in Slovakia of 5.6%. The periods are extending without any rain. There is a long-term drop of volume of the rainfall of 3,5 mld. m^3 in the months from September to May every year. There is frequent appearance of extreme intensive rainfalls in the summer month (Jun – August) and also general trend growth of volume of the rainfall in the mentioned summer month of 1,5 mld. m^3. In the upland (mountains) areas now it rains more and in the valleys less than in the past. The general outflow of volume of water is also decreasing but not so intensively. A year fall of the outflow is 1,58 mld. m^3, while the year's fall of volume of the rainfall gets up to 2 mld. m^3. That means that Slovakia drying up.

A year's fall of water in the wetlands exceeds 1%. In the 20th century the decrease in water reached approximately 12 mld. m^3 (See table. 1). The fall of the water supplies in process of last 100 years, may logically reach 100%. As a result, the process of draining may cause complete drainage in the wetlands. This process was started soon after the World War Second. Result of the drainage process is that the long-term rainfalls are decreasing, but their intensity is increasing, very much like the periods with no rain that are extending. The baked out agricultural and urbanised country overheats faster with the result that differences between the temperatures of the Earth's surface between the valleys and mountain are raising. This increased difference of temperatures means that in mountain areas rains more and intensively in the valleys less. The periods with no rain are extending and also in the warm summer months rains more and in the other months less than in the past. At the regional level it results in an increase of extreme rainfalls with frequent occurrence in the no rain periods.

The period of liquidation of small hydrological cycle and the increase level of the oceans

The industrialisation of natural ecosystems causes permanent destruction of the fresh water from the continents and its accumulation in the oceans. There is also a decrease in water in the atmosphere that increases the intensity of sun emission. That means that the growth of temperature is functionally depend on the flat liquidation of water from the continents and also from the atmosphere. In the case of Slovakia there is a year decrease of 250. mil. m^3 of fresh water in the natural ecosystems. If the intensity of industrialisation of a country in the world relates to intensity of industrialisation of Slovakia, then approximately 1800 mld. m^3 of the fresh water each year disappears from the continents. 100 years of drainage of the continents in the mentioned intensity would causes the liquidation of approximately 180.000 mld. m^3 of fresh water from continents of Earth.

The drying of the continents causes the increase of the oceans levels. If we completely drained the continents we would cause the increase of the oceans level of approximately 0,5 m. The extent of drying in the final result causes overheating of the Earth, which starts melting the icebergs, with the subsequent uncontrolled increase of the oceans level. Out of a simple thought results that we have in the last 100 years it resulted in an increase of the ocean levels by approximately 10 cm. The critical growth of the oceans level occurred after the World War Second. If we continue the drying at this rate, the level will increase by approximately 40 cm in the following 50 years. According to a panel board about the climate changes from January 2001 (Shanghai) adjusted scenarios of the increasing levels of the oceans move in the intervals 40-90 cm.

Considerations about the possible solutions

From the algorithm of liquidation of hydrological cycle we may deduce that water is drained as a result of use of the Earth's surface, which destroy the areas of water from the wetlands in a long-terms. That means if we destroy the water from the open surfaces, it needs to be recovered in the wetlands. Until now all around the world people do it the other way. We destroy the water supplies in a nature and we artificially renew it in the water tanks that are provisional tenable short term solutions. This means, that we need to initiate a renewal of surface water in the natural ecosystems on all the continents, and through this we have a chance to renew our original hydrological cycle for the whole global ecosystem - the Earth. Thus we will have a large stock of water for the nature, food and human beings. Therefore we recommend to start up with revitalization all over the world, where the hydrological cycles were destroyed, and reach in that way healthy, stabile ecosystems, naturally diverse.

Further reading:

[1] Robert D. Jarrett, Paleohydrology and its Value in Analysing Floods and Droughts, in Paulson, R.W., Chase, E.B., Roberts, R. S., and Moody, D.W., Compilers, National Water Summary 1988-89—Hydrologic Events and Floods and Droughts: U.S. Geological Survey Water-Supply Paper 2375, p. 105-116, U.S. Geological Survey, 1991

[2] Church, Michael,1998, Floods in cold climates, in Baker, V.R., Kochel, R.C., and Patton, P.C., eds, Flood geomorphology, New York, John Wiley, p. 205-229

[3] Ronald L. Hanson, Evapotranspiration and Droughts, in Paulson, R.W., Chase, E.B., Roberts, R.S., and Moody, D.W., Compilers, National Water Summary 1988-89—Hydrologic Events and Floods and Droughts: U.S. Geological Survey Water-Supply Paper 2375, p. 99-104.. U. S. Geological Survey, 1991

[4] Kravcik, M., Water for the third Millenium, People and water, Kosice, 2000

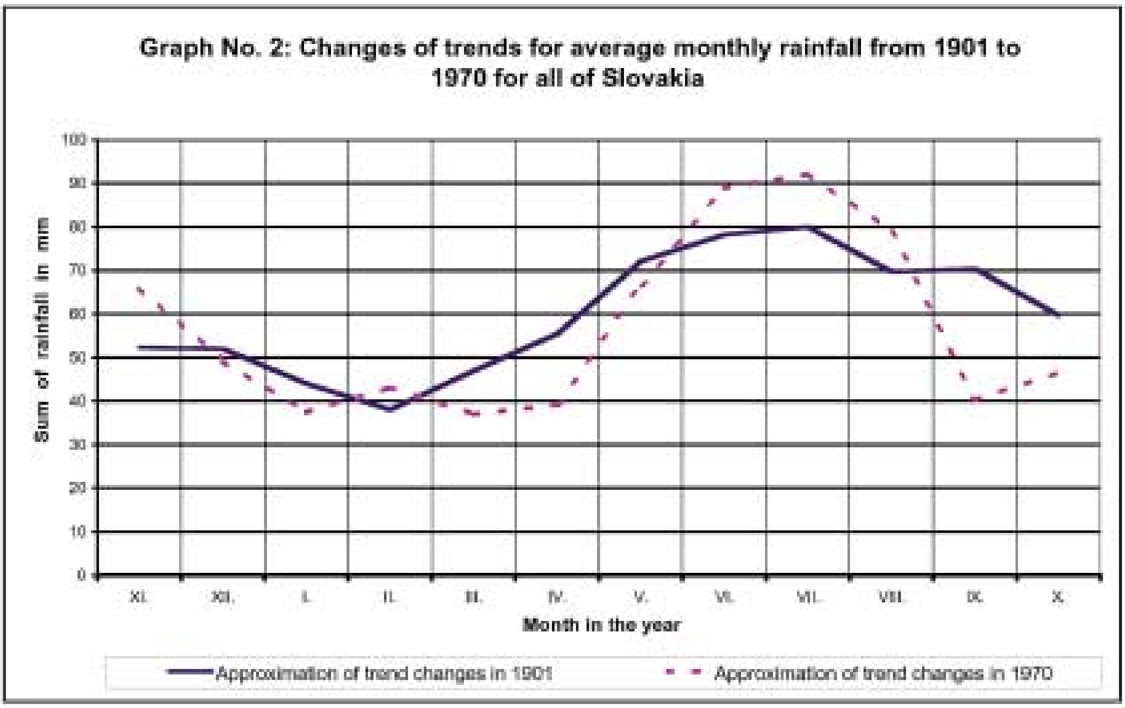
[5] Kravcik, M., Zvara, R.: How we "make it hot for ourselves" globaly, Aquapress, 02/2000, Wienna

[6] Kravcik, M., Hronsky, J., Tesliar, J., Zvara, R.: New Theory of Global Warming, Sustainable Development International, London, SDI5-15/1, 2001

[7] Barlow, M.: Blue Gold, The Global Water Crisis and the commodification of World´s water supply, International Forum on Globalisation, San Francisco, 1999

[8] Barlow, M.: Blue Gold, The Global Water Crisis and the commodification of World´s water supply, International Forum on Globalisation, San Francisco, 1999

[9] Shiklomanov, I.A.: Climate of indeterminatess, UNESCO Reviu, New York, 1993


Graph No. 2: Changes of trends for average monthly rainfall from 1901 to 1970 for all of Slovakia
Sum of rainfall in mm
100
90
80
70
60
50
40
30
20
10
0
XI.
XII.
I.
II.
III.
IV.
V.
VI.
VII.
VIII.
IX.
X.
Month in the year
Approximation of trend changes in 1901
Approximation of trend changes in 1970

8
BIODIVERSITY INDICATORS AS A TOOL FOR BIODIVERSITY CONSERVATION IN SUSTAINABLE FOREST MANAGEMENT – A CASE STUDY ON BORNEO

Jelle B. Maas
Tropenbos International
P.O. Box 232, 6700 AE, Wageningen, the Netherlands
E-mail: Tropenbos@tropenbos.agro.nl
www.tropenbos.nl

Keywords: Biodiversity, indicators, sustainable forest management, Borneo

Introduction

Sustainably managed forest areas will not replace protected areas as storehouses for biodiversity, but they can be an integral component of a conservation strategy that encompasses a larger portion of the landscape than is likely to be set aside for strict protection.

Therefore the assessment of biological diversity becomes increasingly important in the sustainable management and conservation of tropical forests. It is recognised that in practice still very few forest concessions possess operational systems for direct biodiversity monitoring. Most certified timber concessions limit biodiversity conservation to protective measures such as the establishment of sanctuary zones and buffer strips or the specific protection of Red List species.

It is recognised that research on biodiversity indicators has not yet led to globally valid assessment methodologies. Often there is a tendency to delay the commencement of biodiversity monitoring until baseline studies have been completed. As stated in the Preamble of the Convention on Biological Diversity, lack of full certainty should not be used as a reason for postponing measures to avoid or minimise the threat of significant reduction or loss of biological diversity.

Biodiversity indicators, as part of the different sets of standards to conceptualise and evaluate Sustainable Forest Management (SFM), have as yet contributed little to sustainable forest management, but may become useful tools to monitor the state of forest ecosystems.

Conceptual framework

A clear understanding of the concept of indicators is a prerequisite for the development and implementation of biodiversity indicators. In the Hierarchical framework for the formulation of sustainable forest management standards (Lammerts van Bueren and Blom, 1997) indicators are defined as 'quantitative or qualitative parameters, which can be assessed in relation to a criterion'. Generally, two categories of indicators are distinguished:

- Pressure (Stork, 1997) or performance indicators (**World Bank,** 1998) defining what is happening and what are the project inputs and outputs;
- State of response (Stork, 1997) or impact indicators (**World Bank,** 1998) defining the consequences and the project impact on biodiversity.

The most frequently discussed biodiversity indicators to describe the impact of human interventions (silvicultural treatments or other activities) on the forest-ecosystem, are keystone species, threatened species, and species assemblages (functional groups or guilds, and taxonomic groups), of which functional groups or guilds qualify best (Hoeven et al, 2000).

The World Bank (1998) and ITTO (1993) describe desirable characteristics of indicators such as cost effectiveness, measurability and consistency (identifying trends). Stork *et al* (1997) created a first set of bio-diversity indicators and verifiers, indicating specification and field-testing is required. Putz *et al* (2000) provide a framework in which literature is evaluated on the impact of the wide range of activities subsumed under the term 'logging' on the different components (landscapes, ecosystems, communities, species / populations, and genes) of biological diversity.

The case of Borneo

A literature review on fauna indicators for monitoring the impact of human intervention in forests on the island of Borneo concluded that functional groups or guilds qualify best as potential bio-indicators for human disturbance in the forest. The avian guilds are considered the most useful of the guilds, as there are extensive databases on birds, some are easy to observe and they can be identified from their vocalisations. Of the avian guilds, understory insectivorous birds seem to be most consistent in estimating the level of disturbance in Bornean forests. From the study it was also concluded that survey methods are critical and determine the reliability of monitoring and assessment surveys. (Hoeven *et al*, 2000).

Another study used the plant species of the genera *Macaranga* and *Mallotus* (Euphorbiaceae) for a rapid assessment method for determining the level of disturbance in burnt and selectively logged forests (Slik, 2001). Using multiple regression analysis, combinations of *Macaranga* and *Mallotus* species could be formed which can be used to predict the separate forest structure parameters and the general level of disturbance of a forest. An illustrated key of the known species is given to enhance rapid assessment.

Other studies in the framework of the NWO programme 'biodiversity in disturbed ecosystems' and the programmes of Tropenbos International provide additional data on the relationships between the different components of biological diversity and human activities. The association between a single indicator species and the environmental variable of interest can be problematic since the presence of the indicator can give information on the variable but the absence of the indicator does not necessarily do so (Lindenmayer *et al*, 2000). Therefore these data are incorporated in models that combine several indicator species with similar and overlapping responses to the studied variable.

References

Hoeven, C.A. van der, Iongh, H.H. de, Nijman, V. and Balen, B. van (2000). Biodiversity in disturbed ecosystems. A literature review of the use of fauna indicators for the assessment and monitoring of the levels of human disturbance in Bornean Tropical lowland Forests. Tropenbos Documents 16. Tropenbos International, Wageningen, the Netherlands

ITTO (1993). ITTO guidelines on the conservation of biological diversity in tropical production forests. ITTO policy development Series 5. ITTO, Yokohama, Japan

Lammerts van Bueren, E.M. and Blom, E.M. (1997). Hierarchical framework for the formulation of sustainable forest management standards. Tropenbos International, Wageningen, the Netherlands

Lindemayer, D.B., Margules, C.R., and Botkin, D.B. (2000). Indicators of Biodiversity for Ecologically Sustainable Forest Management. *Conservation Biology 14: 941-950*

Putz, F.E., Redford, K.H., Robinson, J.G., Fimbel, R. and Blate, G.M. (2000). Biodiversity conservation in the context of tropical forest management. *World Bank Biodiversity series – impact studies. Paper 75.*

Slik, J.W.F. (2001). Macaranga and Mallotus (Euphorbiaceae) as indicators for disturbance in the lowland Dipterocarp forest of East Kalimantan, Indonesia. Tropenbos-Kalimantan Series 4. The MOF-Tropenbos-Kalimantan project, Balikpapan, Indonesia

Stork, N.E., Boyle, T.J.B., Dale, V., Eeley, H., Finegan, B., Lawes, M., Manokaran, N., Prabhu, R. and Soberon, J. (1997) *Criteria and Indicators for Assessing the Sustainability of Forest Management: Conservation of Biodiversity*. CIFOR working paper 17. CIFOR, Bogor, Indonesia

World Bank (1998). Guidelines for monitoring and evaluation for biodiversity projects. *Environment Department Papers 65*

9
ASSESSMENT OF TREE SPECIES DIVERSITY IN NARSINGDI DISTRICT, BANGLADESH

Md. Danesh Miah* and M. K. Hossain
Institute of Forestry and Environmental Sciences
University of Chittagong
Chittagong 4331
Bangladesh
E-mail: dansmiah@yahoo.com md_miah@hotmail.com

Keywords: homestead forestry, tree species composition, diversity index, Narsingdi, Bangladesh

Introduction

The homesteads grow trees and other crops under an intensive and efficient system of agroforestry, through the traditional knowledge, combining multipurpose trees, food and forage plants, bamboo, palms, medicinal plants, and spices, which shows a productivity level 15 to 25 times greater than governmental forest lands in Bangladesh (ADB 1993). Today, homestead forests are the most important source of wood, bamboo and other nonwood forest products in the country. But, there is no program to improve the overall productivity of homestead forests, nor to produce yield-increasing technology. Systematic research in these fields is a pressing need, as these would enable us to evaluate the role of this system with other modern production systems and to assess the sustainability of the system. Millat-e-Mustafa *et al.* (2000) concluded that further study regarding homestead tree composition in the specific area of Bangladesh is necessary, which can be an important tool in sustainable homestead forestry. Since the ethical, aesthetic and cultural values of biodiversity are increasingly recognized (Kemp and Chai 1993), it is felt necessary to investigate the tree resources of various geographic location successively. Most of the previous studies provide information on homestead tree species resources only. Very few studies was found to investigate the tree resources in the district as a whole considering all factors which can lead the realistic figure on the tree species composition and structure. Thus, the present study aims at to identify the tree species composition, tree species diversity, tree species dominance in the homesteads, Government and Semi-government organizations, Educational institutions, Marginal/waste lands of all the representative locations of Narsingdi district.

Methods

Study was carried out in all six thanas (sub-district) of Narsingdi District. The district lies between 23°46′ and 24°15′ N latitudes and between 90°34′ and 90°59′ E longitudes. Based on preliminary investigation of map and information, a multistage random sampling technique was employed in all the six thanas (sub-district) of Narsingdi district to record tree species variability and their presence. The following sites were chosen for sampling, i.e., homesteads, academic institutes (school, college, madrasha), waste land and marginal land (highway, roads, canal bank, river bank) and in government and semi-government organizations (hospital, offices, government and private mills). From the district, a total of 125 homesteads, 30 schools, 8 colleges, 15 *madrashas* (institute for Arabic study), 6 governmental hospitals, 15 government and semi-government offices and 12 semi-government and private mills/factory, 10 km highways, 25 km feeder roads, 10 km Canal banks and 22 km river banks were randomly selected. Then a tree use matrix exercise was conducted to explore the uses of the species. The study only enumerated the use as timber, fuelwood, fruit and aesthetic/avenue. From this analysis, ten species for each purpose was undertaken for significancy test using LSD (Least Significant Difference) at 0.05 and 0.01 level. Species dominance and tree species diversity were calculated using the formula of Importance Value Index (Shukla and Chandel 1980) and Shanon's Diversity Index (Fowler and Cohen 1992). The fieldwork was carried out from November 1999 to March 2000.

Results

A total of 102 different tree species were identified with the diversity index 0.379 (0.245-0.638) throughout the whole district (Figure 1). Among the species 36, 31, 19 tree species were identified as timber, fruit and fuelwood respectively. Out of 41 families identified, Leguminosae possessed the highest numbers of species (21) followed by Myrtaceae (8), Moraceae (7), Rutaceae (6), Palmae (6) and Meliaceae (5), whereas 26 other families represent single species only. 29 tree species were recorded from the campus of schools, 22 from colleges and 16 from *madrashas*. Though the available land of the organizations vary from each other, the presence of 31 tree species were observed in the campus of hospital, 47 in offices and 45 in the mills/factories. 42 different tree species were observed in highways, 39 in feeder roads, 26 in canal banks and 15 in the riverbanks. *Artocarpus heterophyllus* was the dominant tree species throughout the whole homesteads sampled, whereas *Swietenia mahagoni* was the governing species in all institutions, organizations, mills and waste/marginal lands of the district.

References

ADB (Asian Development Bank). (1993). *Forestry Master Plan. Main Plan-1993/2012. Volume 1*. Ministry of Environment and Forests. Dhaka. Bangladesh.

Fowler, J. and Cohen, L. (1992). *Practical Statistics for Field Biology*. John Wiley and Sons, New York.

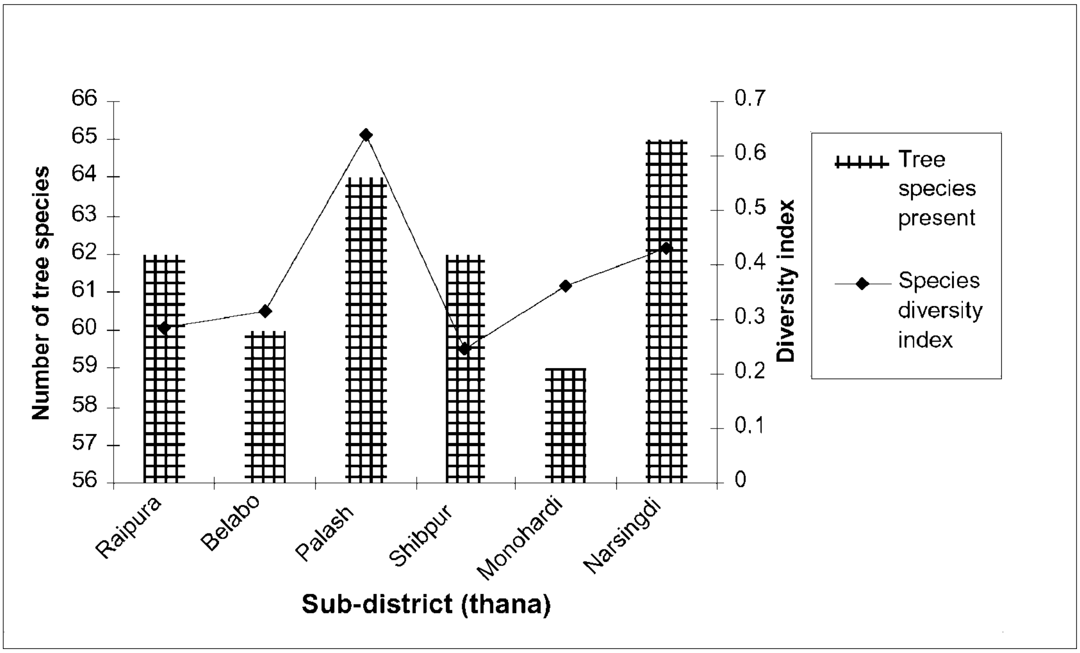
Kemp, R.H. and Chai, L. (1993). Conservation and implications of loss of biological diversity with particular reference to forest management. In Thang Hooi Chiew *et al.* (eds.) *People, the environment and forestry-conflict and harmony: proceedings of the 14th Commonwealth Forestry Conference,* Kuala Lumpur, Malaysia. pp. 247-254.

Millat-e-Mustafa, M., Khan, N.A., Haruni, A.K.O. and Shamim, M.S. (2000). Research on Homegardens in Bangladesh: Present Status and Priorities for the New Millenium. In N.A. Khan (ed.), *Of Popular Wisdom: Indigenous Knowledge and Practices in Bangladesh.* BARCIK, Dhaka, Bangladesh. pp. 107-117.

Shukla, R.S. and Chandel, P.S. (1980). Plant Ecology. S. Chand & Company ltd. New Delhi, India. 197pp.

Figure 1.

Tree species diversity indices in Narsingdi district



10
THE GLOBAL CANOPY PROGRAM – A NEW ALLIANCE FOR INVESTIGATING THE ROLE OF FOREST CANOPIES IN MAINTAINING A STABLE PLANET

Andrew W. Mitchell
Director, ICAN-Global Canopy Program,
Halifax House, University of Oxford,
6-8 South Parks Road, Oxford OX1 3UB,
United Kingdom
E-mail: k.secoy@global canopy.org

Keywords: Forest, canopy, Carbon, Biodiversity, Collaboration

The forest canopy is often popularly described as nature's last biological frontier. The amount of biodiversity contained there represents one of the greatest concentrations of life on earth. In addition, the canopy is where 'life meets the atmosphere'. The fluxes of gases which occur at this interface are increasingly thought to play a significant role in maintaining the earth's climate. A challenge for science here is that little is known of the structure/function relationships that occur in forest canopies. We do not even know the true extent of the biodiversity there. Further the precise mechanism and extent of the exchange of gasses across the leaf atmosphere boundary including the uptake of carbon in the canopy and its transfer to the soil, is also largely unknown.

Why is this important?

First, current human induced biodiversity loss is the 6th Earth extinction event which will dramatically alter future evolution on the planet. Second, the extent of our ignorance about biodiversity in forest canopies is both an economic threat through lost commercial opportunity and its value is therefore underestimated by governments, who cannot plan on an evolutionary time scale, and discount the value of biodiversity. Third, our almost complete lack of understanding of structure-function relationships in forest canopies and their impact on maintaining global environmental conditions is a major threat to human welfare in many countries at the local and regional level. Fourth, a lack of understanding at all levels of the role of forests in climate change, especially as sequesters of carbon, has led to a major breakdown in the implementation of the one treaty which is designed to fix the problem - namely the Kyoto protocol.

Why is our understanding so poor?

First we lack the scientific data on which to make sound predictions. Essentially this is because of the difficulty of access in forest canopies which has delayed the implementation of experiments other than those which ask: 'what is there?' as opposed to manipulative investigations asking 'how does it work?' or 'how will it change?' Canopy science has now emerged from the pioneering days of 30 years ago using monkeys or climbing ropes to access the crowns of tall trees to the large scale operations of today using canopy cranes, dirigibles, towers and other techniques which enable repeatable access with ease but often at considerable expense.

Second, the natural sciences have not been able to corner the market in major funding for projects in its field in the way that the physical sciences have. Table 1 is a comparison between the recent funding priorities for the major physical projects and canopy science under consideration and by the European Science Foundation. Projects on forest canopies have not attracted the support of Governmental science funding bodies at a level commensurate with either the scale or urgency of the problem to be addressed. Part of the reason for this may be that no such program has been presented with international support which addresses the scientific questions at the right scale and that can dramatically capture the attention of the political aspects of the fundraising process which could benefit from the results and from the positive public attention the program could generate in terms of education and conservation.

The Global Canopy Program

Following the Tropical Rainforest Canopies: Ecology and Management international conference at Oxford in 1998, a number of participants, including the author, convened a workshop under the auspices of the International Canopy Network (ICAN) and funded by European Science Foundation and the National Science Foundation, to address these issues. The outcome of that meeting was a Forest Canopy Planning Workshop Report (Nadkarni et al., 2000) at which the following resolution was agreed by 29 experts present from 9 countries:

"We propose an integrated, coordinated study of canopies across major environmental and management gradients to investigate the role of forest canopies in maintaining global biodiversity, global environmental conditions, and the sustainability of forests."

A year later in November 2000, with funding from two UK foundations the Global Canopy Program (GCP) Secretariat Office, working in close partnership with ICAN was established in Oxford. Its mission is as follows:

1. To seek to create the international framework for implementing the central research vision and goals of the Global Canopy Program as conceived at the Oxford canopy workshop,
2. To determine the resources needed and to forge the international partnerships in research, education, training and conservation who wish to have a stake in the program
3. To combine these groups into an alliance of organisations who support and expect to benefit from a proposal, which seeks funding at a level necessary for the task on a global scale, for submission to major national and international donors to implement the program.

This initiative will be formally launched at the 3rd International Canopy Conference in Cairns, Australia in June 2002. Since November an international Steering Committee and Science Advisory Committee has been set up plus a network of in-country representatives. Research has been carried out into the scientific projects currently in progress around the world related to the issues above. Representatives of these groups have been contacted and all have expressed enthusiasm at the prospect of collaborating in a global program of research provided funding is available and a mechanism for such collaboration exists. Institutions and projects currently contacted have been divided the into three potential networks:

1. Canopy Biodiversity and Ecosystem Function Network
2. Canopy Climate Change Network
3. Canopy Conservation, Policy and Education Network

It is clear that those in the Climate change network are already quite well organised internationally often using standard protocols, shared data bases and an extensive network of towers to obtain measurements of gas fluxes in the canopy. These include such organisations as Fluxnet, and the Large Scale Biosphere-Atmosphere Experiment (LBA). Globally, funding for these programs is already at the \$100 - \$150 million level. (P. Jarvis, pers. comm.)

Those projects concerned with biodiversity and ecosystem studies are growing rapidly but are less well organised internationally as a network with few common protocols or shared databases. These include ten canopy access jib cranes now situated in both temperate and tropical forests plus numerous towers, walkways, and other individual canopy access systems such as the Canopy Operation Permanent Access System (COPAS) under development and Operation Canopée.

Extensive forest related education and conservation organisations are in existence but few specifically focussed on forest canopies or the science being conducted within them. The flow of information at the policy level from canopy science has yet to be investigated but may benefit from better international co-ordination and it is the intention of GCP to enable this information to be easily accessed by scientists, the public, educators and decision makers and to support governments in their efforts to implement the Conventions on Biodiversity and on Climate Change.

One question now being tackled by the GCP is how to link these three areas together into one program and what benefits would arise to each group from such a collaboration. We welcome input from interested collaborators on this question and also welcome contacts from researchers or institutions interested in linking existing projects or contributing new ones for potential funding within the framework of the proposed GCP. A 3 year grant from NSF in 2000 will enable ICAN to design the 'Big Canopy Database' which will provide a principal repository of shared information for the proposed GCP.

There never has been a better time to scale up and co-ordinate forest canopy research activities into a much better organised and integrated research effort across the world to address the greatest scientific and conservation challenges facing humans over the next fifty years – namely the loss of genetic diversity and the impact of climate change.

References

Mitchell, A. (2001). "Canopy Science – time to shape up 'in' *Tropical Rainforest Canopies: Ecology and Management. Proceedings of the 3rd International Conference at Oxford*." Edited by E. Linsenmair., A. Davis., M. Speight., B. Fiala. Kluwer Academic Publishers, Dortrecht. (In Press).

Nadkarni, N., Mitchell, A. and Rentmeester, S. (2000). *Forest Canopy Planning Workshop: Final Report*. Evergreen State College, Olympia Washington, USA. Unpublished Report.

Acknowledgements

The Global Canopy Program is supported by the Rufford Foundation, the Maurice Laing Foundation and Earthwatch Institute. Contacts and support from The International Canopy Network (ICAN) has also been invaluable in starting the program.

Illustrations

Table 1.

Funding comparisons for major physical science projects under consideration in 1998 within the European Science Foundation's Large Facilities Program (Mitchell, 2001)

European Spallation Source (Project investigating the nature of neutrinos)	ECU 950 million
X-Ray Vision Project (A bio-molecular structure synchrotron)	ECU 150 million
100 Telsa High magnetic field magnet	ECU 50 million
ESF Tropical Canopy Research (Total budget estimate 1994-1998/9)	ECU 327,240

11
GENETIC SPECIALTIES OF CONIFEROUS TREE GEOGRAPHICAL POPULATIONS ON THE NORTH-WEST OF RUSSIA

Marina Nikolaeva, Natalia Pelevina
Institutsky Pr., 21, Saint-Petersburg
Forestry Research
Institute

Keywords: geographic crops, genotype, growth, preservation, origin of seeds, inheritance, seed breed

Background

The study of variability, proceed from the formula: genotype = phenotype + environment, has purpose to reveal the distribution of intraspecific diversity in populations, that is the study of geographical variation of species (and kind) in connection with environment (Pravdin, 1973). One of the main methods for this study is creation of net of the geographical crops. Proceed from the All-Union program of 1972 year on the north-west of the country geographical crops of Coniferous tree are planted in 4 regions: Leningrad, Vologda, Pskov, Iaroslavl. In the most complete way specific diversity is presented in cultivations of Leningrad region: pine, spruce, and introductional breed – larch and cedar pine.

Study System

In the capacity of the united document for Russia was accepted the method (1972). Now these young stands are from 17 to 25 years. The number of acounted trees is not less than 150 per variant. At the different age stages preservation and conditions of plantations, mean growth parameters – diameter and height were determined. Mean height was determined by height graphs. More detailed research works were conducted in the spruce crops on recognition of forms – properties in the frame of population.

Results and discussions

Different reaction of aboriginal provenances – pine and spruce, to the change of climatic conditions is observed. North forms of Scotch pine, including its subspecies *P. lapponica*, genetically are more stable against mushroom disease shutte, which has took place at the earliest stages of plants development. And when crops are 22 years old climatypes with, provenance from coniferous forest zone (59° – 63° North) had 50-66% preservation, to 8% from steppe zone; connection of preservation with latitude remain invariable considerable, r =0,67. During the period of observation in geographical cultivation of spruce is retraced lowering of stability to new growing conditions of north breeds, r = -0,50, and east , r = -0,27. Climatypes of Picea abies and P. fennica with properties P. abies are marked good preservation, 58-80% , (54,4° –61,7° North; 25,6° –37,0° East). Till 5-10 years the growth of crops to greater degree was defined by technological factor and soil conditions, than by genetic and physiology-ecological peculiarities of seed breed. The age of 9-10-years is a period of the beginning of closing the crowns in rows, when competitive relations among trees arise, it is characterized by diminution of increase in high on 5-10% (Kairjukshtis, 1976). The share of genotypical influence on speed of growth is reducing, rang status of coniferous climatypes, become smooth. At the following closing of crowns mutual oppression weaken and the current increase rise again. The more to the north and east the point of pine seeds storage is, the worse growth is to the end of the first age class, as in height (r = -0,41; r = -0,31), so in diameter (r =-0,55;r = -0,44). The best variants are – from zone of deciduous forests; the more heigh are (middle H = 10,0 m) – Pskov, Mogilev, Moscow. Among climatypes from zone of coniferous forests local – Laningrad sharply differs at speed of growth. In the majority of breeds of *Picea abies* is observed tendency of rise in rang (Pskov is the leader, middle H=8,2 m). Climatypes of *P.sibirica* and *P.fennica* (Murmansk, Archangelsk, Perm, Sverdlovsk, Tatar, Kirov region and central part of Karelia), continue falling behind in growth.

Among a lot of other species spruce differs by exceptional polymorphism (Pravdin, 1975). One of the properties of genotype features is belonging of the individual to early or late blossoming out form. The difference of periods of the beginning of vegetation between extreme forms is 10-12 days. Invariable early beginning of kidney swelling of spruce provenances from north and east regions of Russia is steady. Murmansk climatype is presented exclusively by early blossoming out form; Komi, Sverdlovsk, are more close to it. To late blossoming out form is refered *P. abies* from Zakarpatie, and also spruce of Kaluga, Vitebsk and Novgorod provenances. Phenoform is typical for spruce of local population. On the north-west Russia populations of *Picea abies* are marked by a high point of blossoming of 2000 year. The further to the north and east the place of cones collection from the place of seeds test is, the worse was point of fruitage (table). Great variability in form and size of cones and external adge of seeded scales is exposed: the lengs of cones with rhombic form and with sharp scales (Zakarpatie, Leningrad, Novgorod, Baltic, Kalinin, Moscow) reaches 130 mm; the length of cones with round scales is not exeed 88 mm. By the colour of carpellate strobiles on objects is marked predominance of individual with red cones and transitional forms . Spruce with green cones are met in Karelia, Komi, Kostroma, Zakarpatie climatypes. The percentage of seeds output from cones, the hardnes of seeds – quantitative properties, also indicate to inheritable features of population. The mass of seeds may increase or decrease because of size of the seed. Hardness is a supplementary reliable description of quality of seeds.

Larch crops grows on the sites with a soils, but overmoisthered. nevertheless, mortolity is still growing up to 95% only in the climatypes of south-east origin (Irkutsk – *Larix sibirica* and Chabarovsk – *L.dahurica*), which are more far from north-west region. At 12 years age they have the most slow growth. As at the earlest stages of development, as nowadays L.Sukaczowii from Ivanovo region (1 range, middle H =9,4 m) and Sverdlovsk region has the successeful growth and vitality (50-70%). Last inventory of geographical crops of Siberian stone (*Pinus sibirica*) has indiccated high resistance (62-75%) to new soil-climatic conditions. Only the most far to north-east Jakutsk origin has vitality at 40% and slow growth. The best growth was indicated for cultivation with origin of seeds from Tomsk and Irkutsk regions.

Preliminary Findings

So, on the territory of north-west of Russia populations of *P. abies* and spruce from introgressive hybridization zone with *P. abies* properties, have more high genetically stipulated predisposition to rapid growth and successful natural regeneration, in comparison with *P. Sibirica* and its hybrid forms. Seeds of European origin (*Larix Sukaczowii*) give more sustainable stands in the Leningrad region. Unique experiment for new series of geographical populations of Siberian stone pine in the Leningrad forest-seeds subregion was established in the conditions when requirement of this breed to aeration of soil was not taken into account. Therefore correction of growth with factors of cedar pine geographical provenance is not great. By productivity of geographical population and their stability to the change of habitat one can judge about that inherited information, which is gave in them by maternal stand or by an individual, and also about the accordance of growing conditions in native land to new soil-climatic conditions in region where tests; and besides share of genotypical influence is increased with age.

References

Kairjukshtis L.A., Juodvalkis A.U. 1976. The origin of changing of relationships character between individuals in the frame of breed // Silviculture and forestry. – M. N° 11. – p.16-24.

Pravdin L.F., Abaturova G.A., Morozov G.P., Shershurkova O.P. 1973. The importance of tree breeding genetic for biogeocenotic investigations // The results of research works in forestry and forest biogeocenology. Abstracts of seminar. M.. Vol. 3, p. 54-56.

Pravdin L.F. *Picea abies (L.) Karsten and Picea obovata Ledebour* in the USSR. 1975. Science. 176 p.

Program and method “The study of available and creation of new geographical crops”. 1972. Pushkino

Table

Yielding ability and seeds quality of spruce geographical populations (Leningrad region)

Provenance of seeds	Geographical coordinates		Point of yielding ability (Kraft scale)	Middle crops length, mm	Output of seeds from cones,%	Mass of 1000 seeds, gr.	Hardness gm/m^3
	North	West					
Picea abies							
Leningrad	59,5	30,9	5,0	93,2	7,80	7,39	0,943
Estonia	58,4	25,6	5,0	83,1	4,52	7,13	0,903
Novgorod	57,4	31,2	5,0	106,8	5,82	7,14	0,917
Pskov	56,4	30,5	5,0	78,6	6,11	7,70	0,930
Latvia	56,2	26,5	5,0	98,2	4,73	7,40	0,953
Kalinin	56,2	32,8	5,0	94,8	5,03	6,70	0,900
Lithuania	55,3	22,3	5,0	92,3	2,84	5,78	0,898
Vitebsk	55,1	29,5	5,0	89,7	6,15	5,95	0,886
Zakarpatie	48,1	24,0	5,0	96,5	6,30	9,38	0,938
Picea fennica with properties P. Abies							
Karelia	61,7	36,7	5,0	82,1	6,05	6,65	0,922
Moscow	56,3	38,2	4,7	92,4	4,97	5,85	0,889
Kostroma	58,4	42,3	3,5	75,2	7,62	4,55	0,934
Picea fennica with properties P. Sibirica							
Udmurt	56,8	53,1	3,0	64,6	2,51	4,20	0,801
Tatar	56,0	50,5	2,8	59,0	2,21	3,82	0,790
Archangels	64,2	41,6	1,0	66,3	4,46	4,41	0,807
Picea sibirica							
Murmansk	67,8	33,0	1,0	73,1	1,07	4,54	0,836
Perm	60,2	57,1	1,5	68,1	1,64	6,36	0,856
Sverdlovsk	58,1	65,3	0,9	73,0	2,10	5,51	0,844

12
AUDITING BIODIVERSITY AT THE LANDSCAPE SCALE – A CASE STUDY FROM QUEENSLAND, AUSTRALIA

Paul Sattler[1] Andrea Leverington [2] Sally Egan[2], Chris Mitchell [2] and Julia Playford [2*]

1) Australia biodiversity assessment, National Land and Water Resources Audit, 68 Sanctuary Drive, Mt Cotton, Qld. 4165
2) Research Coordination Unit, Queensland Parks and Wildlife Service PO Box 155 Brisbane Albert Street, Qld. 4002

Keywords: biodiversity assessment, landscape conservation, threatening processes, conservation management

Extended Abstract

Australia has been divided into 85 bioregions within which a total of 350 subregions have been identified. These subregions represent relatively homogenous geomorphic units and often reflect historical and current land use patterns and associated threatening processes. Synopsis reports are being produced for each of these subregions to record the condition and trend of a number of biodiversity elements at a landscape, ecosystem and species scale. This is an ambitious project which will provide useful information for regional conservation planning.

At the subregional landscape scale, known special values in terms of rarity, endemism, refugia and areas of high diversity (ecosystem and species richness) are being recorded. Owing to the significant role of wetlands and riparian zones for the maintenance of biodiversity, the condition, trend and key threatening processes are being particularly assessed for wetlands and for riparian zones.

At the ecosystem level the first attempt is being made to comprehensively identify threatened regional ecosystems across Australia and to relate this information to threatening processes at a subregional scale. At the species level the trend in status and condition of listed threatened species is being assessed. Much of this information is being collated by drawing upon the depth of information residing with regional ecologists and resource rangers across Australia.

Four broad taxonomic groups are being assessed viz. birds, mammals, eucalypts and acacias. Part of this study will consider the sub fossil record of regional mammal extinctions since European settlement. The studies will then consider trends in species distribution in conjunction with landscape modification as well as identifying centres of endemism and species richness. The condition, trend and threatening processes of each species will also be assessed.

Management Options

The second part of this Audit Project is to assess management options for conservation. Conservation actions under the National Strategy for the Conservation of Australia's Biodiversity can be grouped under three principal measures viz.

- reserve consolidation
- off-park conservation for species and ecosystem recovery
- integrated national resource management and threat abatement.

Accordingly, a comprehensive gap analysis is being undertaken of the National Reserve System including both the formal IUCN Reserves 1-4 and the informal IUCN 5 & 6 Reserves and covenants. This analysis is being undertaken in relation to the three CAR criteria: Comprehensiveness, Adequacy and Representativeness. Comprehensiveness will assess the total percentage of all ecosystems sampled in reserves at a bioregional scale whereas representativeness will assess the proportion of ecosystems sampled across their subregional occurrence. Bioregions and subregions will then be prioritized in terms of these CAR criteria together with an identification of ecosystem priorities for reserve consolidation. The standard of reserve management is also being ranked in each bioregion across Australia.

Priority threatened species or species groups are to be identified for recovery planning together an identification of the principal recovery actions required. Recovery actions and locations for identified threatened ecosystems are also being considered.

Biodiversity Strategy Case Studies

Detailed biodiversity strategy case studies are being developed. These case studies will assess the condition of biodiversity at a finer scale and the management options required to address biodiversity decline. This will involve consideration of the management options and resource implications to implement conservation measures over the short and medium terms.

It is proposed that these case studies provide indicative examples of the resource commitment required for biodiversity conservation across similar subregions throughout Australia.

In summary the proposed outputs of this project will include:

(i) Assessment of regional conservation priorities on a subregional and bioregional basis.
(ii) Broad assessment of landscape/ecosystem/species priorities for conservation.
(iii) Identification of the range of conservation measures required to conserve biodiversity in each subregion/bioregion in terms of reserve consolidation, off-park conservation and integrated NRM strategies.
(iv) Completion of 14 indicative biodiversity strategy case studies to identify the range of actions required and the associated resource implications to conserve biodiversity across a range of environments.
(v) Extrapolation of case studies across similar subregions to identify broad management and resource implications.
(vi) Development of a distributed database in each jurisdiction on biodiversity and management needs at the regional scale.

13 CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT IN FINLAND

Jouni Suoheimo*, Jaana Kaipainen, Heli Mikkela & Elina Nikkola
Ministry of Agriculture and Forestry
PO Box 30, FIN-00023 Government, Finland
E-mail: jouni.suoheimo@mmm.fi

Keywords: criteria, indicators, sustainable forest management, biodiversity

Introduction

Finland is located in Northern Europe between the 60th and 70th parallels of latitude, and a quarter of the Finnish territory lies north of the Arctic Circle. The total surface area of Finland is 337,000 km^2, and the land area is 305,000 km^2. 68 per cent of the total area is covered by forest, and the share of agricultural land is 8 per cent. Owing to the climatic conditions there is a lot of peatland in Finland, accounting for about 11 per cent of the total surface area. Finland lies in the boreal coniferous forest zone, whose four sub-zones, hemiboreal as well as southern, central and northern boreal forest zones, are determined mainly on the basis of the temperature sum and vegetation. There are altogether 24 tree species native to Finland, and the number of coniferous species is only four: Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*) and juniper (*Juniperus communis*) as well as yew (*Taxus baccata*), which occurs naturally on the Åland islands. Economically the most important tree species are Scots pine (45 per cent of the volume of the growing stock, Norway spruce (37 per cent) as well as downy and silver birch (*Betula pubescens and Betula pendula*, altogether 15 per cent). The share of the other species is only 3 per cent. Certain deciduous species, such as aspen (*Populus tremula*) and goat willow (*Salix caprea*), are highly significant as they maintain a large number of species of living organisms.

In the Second Ministerial Conference on the Protection of Forests in Helsinki in 1993, the European countries and European Union made a commitment to promote the implementation of the principles of sustainable forest management established at the UN Conference on Environment and Development held in Rio in 1992, both nationally and internationally. The criteria for sustainable forest management and the quantitative and descriptive indicators for this were drawn up in the monitoring of the Helsinki Resolution, the so-called Helsinki process.

These criteria and indicators for sustainable forest management and the related principles on the level of praxis were approved at the Third Ministerial Conference in Lisbon in 1998. The signatory countries undertook to continue the application, revision and development of the criteria and indicators.

In Finland national criteria and indicators have been applied since 1994, and the first comprehensive report on the state of sustainable forest management in Finland was completed in 1997. At this first stage of the application the pan-European criteria and indicators were adjusted to the Finnish conditions. In particular, the criteria were modified and complemented by including indicators for the biological diversity of forest ecosystems and socio-economic sustainability.

Selection of criteria and indicators - the first round

The first criteria and indicators for sustainable forest management in Finland were established in 1995. The list of criteria covered all aspects of sustainable forest management: forest resources and their contribution to carbon cycles, vitality and health of forest ecosystems, wood products and other forest products, biological diversity and conservation of forest ecosystems, significance of forests in the protection of soil and waters, as well as the social, economic and cultural significance of forests. A number of qualitative and descriptive indicators was selected to show the realisation of measures relating to each of the criteria.

The criteria and indicators were tested in the research project concerning the implementation of the development strategy for sustainable development in forest management, the so-called Pirkanmaa project (Pirkanmaa is a region in Western Finland). The objective of the project was to establish the principles for a regional forest strategy and to design indicators and control methods for assessing the sustainability of forest management at the regional level. The project continued until the end of 1996. It became evident that the number of indicators chosen (160) should be reduced and they should be more concrete and easier to monitor in order to facilitate their application in practice. The measurability of the indicators and compilation of data could also be made more efficient through appropriate classification of the indicators.

Development of the criteria and indicators

Owing to the changes in the operating environment of forestry, in 1998 it was noted that further development of the criteria and indicators was necessary, and a work group with broad representation from the various interest groups involved in the forest sector (ministries, forest research institutes, universities, industry and nature conservation organisations) was appointed for this purpose. The task of the work group was to check all the national indicators for sustainable forest management, taking into account the national and international development and the most recent information. Another objective was to apply the criteria and indicators in the monitoring of Finland's National Forest Programme 2010 (published in 1999) and regional forest programmes. Further, the Finnish know-how and initiative in the international arena in the development of indicators and monitoring of sustainable forest management was to be maintained and reinforced.

The criteria and indicators were designed in the spirit of open cooperation and thus this work led to a national consensus on the content of sustainable forest management and factors through which the realisation of sustainability can be measured and followed in practice. The revised list of indicators is based on research data, but it also includes a number of indicators for social values relating to forests and their management.

Organising the compilation of data through criteria and indicators

The main objective has been to develop appropriate indicators for measuring the realisation of sustainability in forest management and changes in forest ecosystems. A number of distinct indicators have been combined into larger wholes, and certain indicators for compiling basic data have been left out.

No objective or recommended levels for practising sustainable forest management have been set in connection with the indicators, but such levels are defined e.g. in the implementation of the Finnish forest and environmental legislation, Finland's National Forest Programme, regional forest programmes, environmental programmes and the national action programme concerning biological diversity in Finland. The indicators show the realised development, but they do not necessarily describe the phenomenon as a whole or the causes for the development or changes. Indicators can be used to monitor and guide the implementation of the forest policy at all levels. The forest, environmental and biodiversity programmes are implementation programmes, and the realisation of the objectives set in these is now measured by commonly accepted indicators.

One of the most challenging tasks relating to the indicators is the development of the compilation of data into a clear, continuous and efficient instrument, both nationally and regionally. The most important sources of data on the national level are the National Forest Inventory, forest statistics, statistics on the national economy, as well as statistics and databases on forest conservation and environmental issues in forest management. The Forest Research Institute, Forestry Development Centre Tapio, Finnish Environment Institute and the Regional Forestry and Environment Centres are responsible for compiling data on sustainable forest management.

Indicators for biological diversity

Indicators relating to the protection and management of biological diversity are divided into three hierarchical levels. *Regional diversity* covers the abundance and diversity of forest types, communities of organisms and ecosystems, i.e. their number and structural variety. *Inter-species diversity* refers to the abundance and diversity of species inhabiting the forests, i.e. variation in the number of species, their relative abundance and functional significance. *Intra-species diversity* is the genetic diversity within each species, i.e. the genetic variation of the species. In Finland the following indicators for the maintenance and protection of biodiversity are used:

Indicator 1: Instruments to regulate the maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems (the descriptive indicator contains data on the following instruments relating to forest management: international agreements and action programmes, Finnish legislation, conservation programmes and areas and their representativity, economic instruments for protecting forests, monitoring and maintenance of sites of biological diversity in forests, producing information).

Indicator 2: Endangered and vulnerable species (estimated number of endangered species according to habitats based on survey)

Indicator 3: Protected forests and forests with harvesting restrictions (development in the total area of protected forests, ha)

Indicator 4: Valuable forest habitats and their protection (area of valuable habitats according to the National Forest Inventory in the territories of different Forestry Centres,%)

Indicator 5: Tree species composition (dominance of different tree species in the total forest area,%)

Indicator 6: Pure and mixed forest stands (whether the forest composed of one dominant species or a mixture of several species, share of each forest type of the total forest area,%)

Indicator 7: Decayed and wildlife trees in commercial forests and conservation areas (m^3/ha)

Indicator 8: Gene reserve forests (number and area (ha) of these)

Sources

Ministry of Agriculture and Forestry (1997). Criteria and Indicators for Sustainable Forest Management in Finland.

Ministry of Agriculture and Forestry (1999). Finland's National Forest Programme 2010. Publications of the Ministry of Agriculture and Forestry 2/1999.

Ministry of Agriculture and Forestry (2000). State of Forestry in Finland 2000. Criteria and Indicators for Sustainable Forest Management in Finland. Publications of the Ministry of Agriculture and Forestry 5/2000. Helsinki.

14
BIOLOGICAL DIVERSITY OF FOREST ECOSYSTEMS IN THE REPUBLIC OF MOLDOVA

Alexandru Teleuta*, Gheorghe Postolache
Botanical Institute of the Academy of Sciences.
18 Padurilor Str., Chisinau, MD – 2002,
Republic of Moldova.
E-mail : bsapm@dnt.md
Tel./ fax 24.20.22

Keywords: forest, ecosystem, communities, species, flora, fauna.

The Republic of Moldova is situated in the South-East of Europe (the surface - 33800 sq. km.; the population – 4,293 mln. inhabitants). The territory of Moldova is situated at the crossing point of three biogeographical zones: Central-European, Mediterranean and Eurasian. The total forest area is 325,4 thousand ha (cover 9,6% of Moldova) and comprises about 800 forest grounds.

Quercus robur and *Cerasus avium* are significant species of northern zones forests of the country. *Forests with Fagus sylvatica, Quercus petraea and Quercus robur, Carpinus betulus, Tilia tomentosa, Fraxinus excelsior* and others are specific to the central zone. The forests with *Quercus pubescens* are spread in the southern part of the Republic of Moldova.

The forest vegetation consists of 130 communities that belong to the following formations: *Querceta roboris, Querceta petraeae, Fageta sylvaticae, Carpineta betuli, Querceta pubescentis, Populeta albae* and *Saliceta albae* .

Moldova's forest flora includes 859 species and is characterized by a high weight of species introduced from other floristic regions, thus occupying 34,1 % of the total afforested surface. This fact shows the low vital potential of the forest ecosystem.

Fauna covers 172 terrestrial vertebrate species (68% of the total number) and about 9 thousand insect species, most of which are on the decline.

The phenomenon of forest degradation is also confirmed by the considerable number of vulnerable and endangered plant species (55 species).

The forest protected area covers 60,7 thousand ha (18,8% of the total forest area). Unfortunately, the regime of natural protected areas is only partially observed within scientific reserves, where the forest cover is 16,4 thousand ha (5% of the total area covered by forests). The analysis of representation of the main forest communities in scientific reserves indicates that *Quercus petraea* and *Quercus robur* groves are not efficiently protected, constituting less than 10% of the total area of these communities.

In order to increase the capacity of ecological protection, including efficient conservation, of forest biodiversity, it is required to:

- improve the legal background, institutional framework and management of forest resources;
- ensure the functional connection between fragmented forest compartments;
- extend the area of afforested lands up to 15% of the national territory;
- facilitate the natural regeneration of the forest stands having a balanced diversity, structure and functions;
- conserve rare and endangered taxa and communities;
- monitor the forest biodiversity components etc.

The National Strategy and Action Plan for Biodiversity Conservation in the Republic of Moldova stipulate the priority activities for the protection of forest ecosystems and valuable species and communities, restoration of ecological corridors, sustainable use of forest resources, staff training and public awareness.

Fig. 1. Geographical position of the Republic of Moldova

Fig. 2. Forest vegetation of the Republic of Moldova

Nr	Species name	Area, Thousands ha
1	Robinia pseudacacia	93.1
2	Quercus robur	78.2
3	Quercus petraea	56.5
4	Fraxinus excelsior	16.6
5	Quercus rubra	9.4
6	Carpinus betulus	9.4
7	Quercus pubescens	4.8
8	Ulmus laevis	3.1
9	Acer pseudoplatanus	2.9
10	Tilia cordata	2.9
11	Salix sp.	1.9

Table 1. Distribution of main species in the forest fund

Nr.	Communities	Area Thousands ha	%
1	Cvercinae, inclusively	140.6	43.2
	I. Quercus robur	78.2	24.1
	II. Quercus petraea	56.5	17.3
	III. Quercus pubescens	4.8	1.8
2	Acacia grove	124.0	38.1
3	Beech tree grove	16.6	5.1
4	Hordeam grove	9.4	2.9
5	Resinous	7.2	2.2
6	Poplar grove	5.7	1.8

Table 2. Significant forest communities

References

Gheideman Tatiana. (1986). *Opredeliteli visih rastenii Moldavskoi SSR.* Stiinta, Chisinau.

Postolache Gheorghe. (1995). *Vegetatia Republicii Moldova.* Stiinta, Chisinau.

Teleuta Alexandru and others. (2000). *First National Report on Biological Diversity of the Republic of Moldova*. Stiinta, Chisinau.

Teleuta Alexandru and others. (2001). *Biological Diversity Conservation National Strategy and Action Plan*. Stiinta, Chisinau.

15
CHEMOTYPICAL VARIABILITY OF PINE STANDS IN THE NORTH-WEST OF RUSSIA

S.Ye. Maslakov, A.V. Zhigunov
St.Petersburg Forestry Research Institute,
Russian Federation, 194021,
St. Petersburg, Institutsky pr. 21,
E-mail:spb330@spb.sitek.net

Keywords: Pinus sylvestris, terpenic compounds, flavonoids, chemotypical variability

Introduction

The intraspecific systematic of Scotch pine (*Pinus sylvestris*) and population genetics closely connected to it are undoubtedly of vital importance due to the practical significance of this species. As is well known, Scotch pine does not have any clear genetic markers that allow identifying individual populations and other intraspecific structures. Morphological indicators are difficult to use for identification, as there is no set of features that would be easy to identify, besides, they vary greatly depending on forest site conditions. To establish natural differentiation of this species, the authors studied variability of chemical characteristics, such as the content of mono-, sesqui-, diterpenic compounds and flavonoids extracted from pine needles.

The subject and methods of the investigation

The subject of the investigation was the content of extracts from Scotch pine needles. The samples of needles were selected from more than 500 model trees in different forest conditions at stationary sites and the net of forest monitoring in the North-West of Russia. The gas-liquid chromatography - mass spectrometry method was used to study the content of the extracts.

The results and discussion

More than 90 compounds that contain over 50–75 mg/kg, including monoterpenic hydrocarbons and oxygen-bearing monoterpenic compounds – 26; sesquiterpenic hydrocarbons and oxygen-bearing sesquiterpenic compounds – 31; diterpenic hydrocarbons and oxygen-bearing diterpenic compounds - 7; flavonoids – 11, were extracted from Scotch pine needles. The study showed that there were both qualitative and quantitative differences in terpenic compounds and flavonoids caused, first of all, by genetic factors and stress metabolism. Statistic methods were used to determine the influence of ecological conditions on the composition and content of essential oils in Scotch pine needles. As a result, four genetic lines of Scotch pine were selected, differing in heterogeneity of biosynthesis by Δ^3- carene, diterpene hydrocarbons and flavonoids. In accordance with the content of extracts five main chemotypes of Scotch pine were determined for the North-West of Russia (Table 1.).

Diterpenic hydrocarbons and oxygen-bearing diterpenic compounds content proved to be the most variable in the compounds extracted from needles. It allowed selecting two main phylogenetic lines of pine: the first one (chemotypes I and II) – with practically no diterpenic hydrocarbons in pine needles, the second - (chemotypes III and IV) – on the contrary, with a high content of diterpenic hydrocarbons and oxygen-bearing diterpenoids in pine needles. Each of these two main phylogenetic lines is divided into other two: the one containing Δ^3- carene (II and IV) and the other (I and II) that does not contain it. Chemotype V differs from the previous ones in a high content of flavonoid compounds in pine needles and their different quality.

The main ecological and physiological functions of terpenic compounds that make up the major part of essential oils in pine needles are antimicrobial, fungicidal, insecticidal, and the regulation of intracellular processes. The differences in the content and composition of monoterpenic compounds and flavonoids in needles suggest different resistance of chemotypes to diseases and pests, while the differences in the content of diterpenoids - some other mechanisms of intracellular processes, including chlorophyll synthesis.

The investigations showed that the stands can consist of trees either of the same or a few different chemotypes. The comparison of trees of different chemotypes by the content of chlorophyll in needles and morphological parameters of needles (the weight of 100 dry needles and their average length) shows their significant statistical differences (Table 2.). The needles were selected at 134 points of continuous control of the Leningrad Oblast (Region) forest monitoring net.

The average content of chlorophyll in the needles of the chemotypes that contain Δ^3- carene (II and IV) was 1.4 times less than does not containing Δ^3- carene (I and III). Also essential is the difference between chemotypes in morphological parameters of needles.

The comparison of stands with domination of this or that chemotype also demonstrates significant statistical difference between the values of a number of parameters (Table 3.). Thus, the stands with the chemotype I surpass the others in average girth increment, stem and crown diameters. There are also differences in other indicators, among them damage of stands, but the level of their statistical significance is less than 95%.

In the conditions of the Leningrad Oblast on the forest trials where the anthropogenic load is low, stands, as a rule, consist of trees of different chemotypes with the prevalence of one of them. The availability of some phylogenetic lines of the species in Scotch pine stands seems to provide resistance of the stand to abiotic and biotic damaging factors. Stands consisting of trees of only one chemotype are not found frequently. The distribution of trees by chemotypes is as follows: I – 16, II – 18, III – 33, IV – 28, V – 5%.

In the zones of high recreation and man-caused loads bioproduction indices of Scotch pine stands are not simply lower but their chemotypical structure underwent changes. The stands mainly consist of chemotypes III and IV. Trees of the most productive chemotypes I and II are found extremely seldom as recreation load and air pollution are high (ambient air standard limit is exceeded 5 and even more times). The distribution of trees by their chemotypes is as follows: I – 2, II – 1, III – 49, IV – 43, V – 4%.

Table 1.

The content (mg/kg and%) and standard deviation from the average of the main classes of compounds, α-pinene and Δ³-carene extracted from pine needles for different chemotypes of Scotch pine

Compounds	Chemotype				
	I	II	III	IV	V
Monoterpenes and their oxygen-bearing derivatives	4510±1910 31,8±13,6	5500±3210 35,2±8,8	3860±2270 27,4±8,4	4860±3060 34,4±10,5	5090±3050 34,2±10,5
Sesquiterpenes and their oxygen-bearing derivatives	9000±6050 51,2±16,2	8460±5190 52,7±9,2	5670±4480 36,2±12,1	5980±4610 35,6±13,5	4160±2810 28,9±15,3
Diterpenes and their oxygen-bearing derivatives	270±240 2,1±2,0	210±200 1,3±1,1	3780±2110 27,7±11,0	3120±2230 22,6±11,6	1450±1140 10,6±7,5
Flavonoids	2330±1310 14,9±6,8	1710±1210 10,7±4,5	1280±940 8,7±4,5	1060±730 7,4±4,3	3690±1380 26,2±7,0
α-pinene	3100±1150 20,8±9,3	2410±1790 15,0±6,8	2500±1650 17,3±6,4	2110±1070 14,0±5,8	3210±2650 19,7±10,0
Δ^3- carene	следы	1640±1220 9,9±5,2	следы	1470±970 11,0±6,0	480±840 4,6±6,8

Note. Numerator – total content, denominator - percentage.

Table 2.

The comparison of Scotch pine chemotypes by the average content of chlorophyll in needles, average weight and length of 100 dry needles

Chemotype	N*	Optical density of solutions, λ = 665 nm	Weight of 100 dry needles, gr	Average length of 100 needles, cm
I	21	0,29	**1,45**	**4,38**
II	45	**0,31****	**1,26**	4,02
III	25	**0,22**	**1,21**	4,19
IV	38	**0,21**	**1,07**	**3,81**
V	5	0,22	**1,97**	**4,80**

* the number of stands with the domination of the given chemotype.
** the chemotypes that have statistically significant difference (p>95%) in the parameter are given in bold type.

Table 3.

The comparison of stands with different chemotypes of Scotch pine by the average girth increment, average crown diameter, average forest site capacity and average estimated productivity

Chemotype	N	Average girth increment. mm/year	Average crown diameter, m	Average forest site capacity	Average estimated productivity, %
I	21	**1,14**	**4,4**	2,77	66
II	45	**0,87**	**3,8**	3,01	63
III	25	**0,85**	3,9	2,53	69
IV	38	**0,86**	**3,4**	3,40	63
V	5	**0,79**	3,5	3,00	49

* 100% of the estimated productivity corresponds to forest site capacity Class 1

16
MYCOPHAGOUS BEETLE DIVERSITY IN PERIURBAN ENVIRONMENTS

Charlotte L. Hardy*, Richard A. B. Leschen & Pierre Paquin
School of Biological Sciences, Auckland University, Private Bag 92019, Auckland, New Zealand; Landcare Research, Private Bag 92170, Mt. Albert Road, Auckland, New Zealand; Université du Québec à Montréal Département des sciences biologiques C.P. 8888, Succursale "Centre-Ville" Montréal, Québec H3C 3P8, Canada

Keywords: Forest remnants; mycophagous beetles; periurban forest biodiversity

Purpose of Study

Mycophagous beetles play an important role in ecosystem function within forest remnants. However little data exist comparing fungus beetle habitats in urban, periurban and rural environments in New Zealand. This study determined whether species diversity and composition of fungus-feeding beetles varied among forest and pasture habitats and differing forest patch sizes. The model groups Leiodidae (saprophagous and mycophagous) and Scaphidiinae Staphylinidae (mycophagous) were studied.

Methodology

Twelve sites in a periurban environment were chosen, including nine forest and three pasture sites within the Rodney district in northern New Zealand. Eight Pitfall traps were set along a single transect (started fifty metres from the edge of the fragment to reduce edge effects) at nine metre intervals. Traps were serviced fortnightly for six months and then monthly for the following seven months.

Results

Fifteen species were identified, comprising a total of 989 individuals. Six species were found in pasture and fourteen in forests, with one (introduced) species unique to pasture. No patch size effect was discerned for mycophagous beetles, contrasting with more ambulatory Carabidae species studied concurrently. A clear correlation in diversity among forest and pasture sites was detected. Decreasing species diversity of fungus beetles in pasture is probably due to a lack of fungal hosts and suitable microclimate conditions, but indicates native species migration between habitats. The generalist species *Brachynopus latus* for example is wingless and requires resupinate polypore fungal hosts that grow on wood. This species was found in all habitats and could be invading pasture or travelling between suitable vegetation patches. Comparing other habitat studies and beetle diversity shows changes in the ratio of native to exotic species in pasture sites in different environments. We predict increasing exotic species diversity in pastures if all families of mycophagous beetles are sampled.

17
THE STABILITY OF THE FORESTS OF NORTH-WEST REGION OF RUSSIA UNDER CONDITIONS OF GLOBAL CLIMATE WARMING

Chabounine D.A., Pelevina N.N., Nikolaeva M.A.
Saint-Petersburg Forestry Research Institute, Saint-Petersburg
E-mail: spb330@spb.sitek.net

Keywords: climate warming, population biodiversity, forest stability

There is a question: Which consequences can entail of a global climate warming in the forestry of north-west region of Russia?

It is doubtless, that the local populations of trees have adapted during evolutionary development under rather stable climatic conditions and now its correspond to local grow conditions in greatest degree. At slow enough change of climatic conditions there will be evolutionary changes in a population of wood plants, therefore the population will again correspond to new environmental conditions. If there is no time for evolutionary processes, in this case the local population will be replaced with other population, which is more adapted to new conditions. Thus the changes should occur not only at a population level, but also at a species level. The motley picture will be observed. One species will be oppressed, the development of the others will be stimulated.

The technogenous increase of temperature occurs so quickly, that, the last scenario is more possible. It is clear, that the climate warming will not have an negative effect on plants growth but rather positive. As the increase of temperature occurs on a background of increase of CO^2 concentration. However, there are in a nature “an extremely interested persons” which intense observe the correspondence of any population to their occupied place. These “persons” are diseases and pests populations. They sensitively will react by their number to slightest changes in balance of a tree and environment. Thus, at fast global climate warming it can be expected, that the first consequences will be increase of number and scale of outbreaks of insects and diseases.

If to consider a modern condition of forests, it is quite probable, that the distribution in 80 years, so-called, “new damages of forests” and mass decline of forests in 90 years XX century (for example, the prompt ruin of pine forests in the south of the Pskovskaja region in Russia surveyed by us in 1998-99 years (Semakova T.A., Chabounine D.A., Maslakov E.L., 2000), and also sharp increase of coniferous forests decline in Byelorussia (Fedorov N.I. *et al.*, 1997), Poland (Sierota Z., 1998), Hungary (Koltay A., 1998), connected with root rot and insects) are the consequences of a climate warming. If the assumption about stimulation of pest and disease activity by a climate warming is correct, the forestry enters into a condition of instability.

To study the geographical variability of hereditary properties of forest species, to increase efficiency and stability of forests, to improve the seed district division the large-scale program is carried out in Russia with uniform technique (Study, 1972). A lot of forest plantations were established for test the seeds of main forest species from various geographical areas. In north-west of Russia the spruce geographical cultures are established in Leningradskaja (27,6 ha), Vologodskaja (20,8 ha), Yaroslavskaja (1,2 ha) regions; a pine geographical cultures in Vologodskaja (23,3 ra), Leningradskaja (29,0 ha), Pskovskaja (33,0 ha), Yaroslavskaja (1,5 ha) regions.

We investigated the geographical cultures in Leningradskaja region. The study of an opportunity of pine and spruce seeds moving from other geographical areas for use in the Leningradskaja region has shown, that usually the best growth have the climatic types from warmer areas. Thus, frequently southern climatic types surpass local populations both in growth in height and in diameter. As it seems, it can also testify to reaction of coniferous trees to climate warming. As on the data of inspections 15 and 20 years ago which have been carried out in the same objects (geographical cultures) the so obvious superiority of southern climatic types were not marked. The similar results are received by the researchers in geographical cultures of a pine in the Pskovskaja region.

There is no problem of shortage of the local origin seeds in the Leningradskaja region. Therefore our recommendations are that the movement of seeds from southern areas can be carried out in extreme cases. However, considering a problem from the global climate warming point of view, the question raise: may be we hold in hands a key to the decision (though in any degree) of the problem of forest stability at future global climate changes by increase of forest biodiversity?

Certainly, it would be extremely careless to carry out the large-scale movement of seeds from southern areas. However, we believe, that it will be very useful to expand the works on study of geographical cultures, to attract the greater attention to forests monitoring, to study the connection of number of outbreaks of insects and diseases with climate warming, to study opportunities of complication of population structure of new forests raising their biodiversity by introduction in local populations more southern climatic types for improvement forest stability in north-west region of Russia.

References

Fedorov N.I., Rihter I.E., Raptunovich E.C., Sarnatskii V.V. (1997) Features of management conducting a facilities(economy) in spruce woods in connection with mass trees decline // a Forest science on a boundary XXI of century: The proceedings of forest institute of National Science Academy of Bjelorussia, vol. 46 – Gomel, 1997 – P. 205-208 (in russ.)

Koltay A. (1998) Health condition of Hungarian pine forests // Methodology of Forest Insect and Disease Survey in Central Europe, Proceedings from the IUFRO WP 7.03.10 Workshop, Ustron–Jaszowiec (Poland), April 21–24, 1998 – C. 133–137

Semakova T.A., Chabounine D.A., Maslakov E.L. (2000) The lost of pin stand stability in the Northwest of Russia // Forest and Society: the role of research: XXII IUFRO world congress, 7–12 August 2000, Kuala Lumpur Malaysia / Edited by Baskaran Krishnapillay et al., vol. III poster abstracts – Kuala Lumpur, 2000 – P. 394–395

Sierota Z. (1998) Fungal diseases in last years in Poland // Methodology of Forest Insect and Disease Survey in Central Europe, Proceedings from the IUFRO WP 7.03.10 Workshop, Ustron–Jaszowiec (Poland), April 21–24, 1998 – C. 153–155

Study available and creation of new geographical cultures (Program and technique of works). Is authorized by the decision of Problem council on forest genetics, selection and seeds at April 5 1972. - Pushkino, 1972 –52p. (in russ.)

18
DIVERSITY OF VEGETATION COVER IN NORWAY SPRUCE FOREST PLANTATIONS AND DYNAMICS AT FIRST STAGES OF SUCCESSION — A CASE OF STUDY FROM NORTH-WEST RUSSIA

Anton V. Dorochine
Laboratory of Reforestation,
St. Petersburg Forestry Research Institute,
Saint-Petersburg, Institutskiy prospect 21,
194021 St. Petersburg, Russia
E-mail: spb330@spb.sitek.net

Keywords: Picea abies, forest plantations, stages of vegetation cover development.

Introduction

The biodiversity change as a result of clear fellings of boreal spruce forests is one of the most urgent problems at the dynamics estimation of forest ecosystems (Hannerz and Hanell, 1996). Structural and species diversity after fellings can raise as a result of the open space areas increase or reduction of crown density (Lee, 1993), while the number and biomass of the majority of forest herbs and mosses are reduced (Nikvist, 1997; Olsson and Staat, 1995). It is considered that biodiversity is better provided in the natural forests with local tree species but it is not the same for forest plantations. Nevertheless, they play positive role for the environment as a buffer zone protecting weak areas. The requirements for preservation of the biodiversity in forestry activity first of all consist of creation of the conditions for various ecosystems development. Plantations are capable to play rather positive role in biodiversity preservation and in its enrichment with new species, but however it can not be the evidence of stand stability increase and forest ecosystem in a whole. In this respect very much depends on the chosen technology of forest growth including maintenance, scales and degree of influence on biogeocenoses.

Methods

The researches have carried out on 86 sites of Norway spruce forest plantations (*Picea abies (L.) Karst*) in Leningrad region. The plantations were planted with the various purposes: for timber growing and for recreation and ecological aims. All plantations were planted on clear cuttings with age less than 4-5 of drained spruce stands. The ages of plantations were 1-70. The plantations were established using various soil cultivation techniques: plough soil cultivation (5 different plough types were used, 3 of which built in our institute), discrete soil cultivation (3 different mechanism types, built in our institute) and without cultivation (served as a control). On each site the vegetation cover were described on sample plots with size of 400 sq.m. Accuracy of measurement consist that the sites were selected very carefully for two attributes: to habitat type (binomial drifts D2 and starved loam GM2), (Chertov, 1981) and forest initial type (*Piceetum myrtillosum and Piceetum oxalidosum*). The total area of the investigated plantations were 154 ha.

Results and discussion

The research has shown that with artificial reforestation the period of forest environment restoration is reduced. The stages of forest phytocenoses development were marked depending on features of the formation of composition and structure of vegetation cover.

I-A stage of development (during 1-7 years) — initial. It is accompanied with sodding of sites, mass growth of heliophilous meadow, edge-meadow, edge-ruderal and forest-meadow species. At cuttings swamping the bog-forest species are spread. In the plantations many adventive species occur which are not typical for the initial forest types. The grass cover doesn’t have definite structure characteristic for climax or long developing forest communities without fundamental ecotope breach. Plantations of the age of 7 are taken to the forest covered lands in connection with crown covering.

I-B stage of development (during 8-20 years) — a stage of covered stand formation. Fast-growing forest vegetation suppresses the development of fast-grow light-requiring plants (*Calamagrostis sp., Poa sp., Agrostis sp., Chamaenerion angustifolium, Juncus sp*., etc.). Frequently these plants don't disappear at all, but only strongly reduce parameters of productiviy. But elements of vegetation eliminated in the result of forestry implementations complex(clear felling, soil cultivation and land treatment) start to restore: forest mesophile herbs and mosses characteristic for initial forest types. The species-companions of a spruce expand with its edificating influence. At this age the highest biodiversity is provided because of distinctions in ecological regimes of ecotope.

II stage of development (during 21-40 years) — restoring. It is characterized by restoration of a great many typically forest species lost after cutting and further degradation of cereals and others light-requiring species.

III stage of development (41 year and more) — a stage of vertical and horizontal phytocenoses structure formation.

Lessons learned

Relict radical coniferous forests of Russia is the unique standard of nature, the reservation of a biodiversity of virgin forests kept from times of ice age. As a result of active cutting down the radical forests can absolutely disappear. The clear fellings and reforestation transform the forest ecosystems, reduce their stability and unique biodiversity. For preservation of virgin forests, it is offered: 1) to remain as large areas of such forests as possible as the global ecological reservation; 2) to produce timber at special plantations as raw material. It will allow to proceed to a new level of silverculture development from collecting of wood to its production. Cultivation of soil changes the direction of succession and strongly slow down the restoration of initial vegetation: digressionaly-replaced phytocenoses are formed. Phytocenoses of plantations with age of 41-70 have features of initial and virgin forests, however the initial forest type is not restored. For diversity increase and sustainability of a stand it is recommended to leave wide spaces between rows which serve as buffer zones.

References

Chertov, O.G. 1981. Ecology of forest lands: soil ecological investigation of forest sites. Nauka, Leningrad, Russia, 192 p. (in Russian).

Hannerz M. & Hanell B. 1996. Changes in the vascular plant vegetation after different cutting regims on a productive peatland site in Central Sweden // Vegetation succession after clearcutting and shelterwood cutting. Report no.84.- Swedish University of Agricultural Sciences, Uppsala, Sweden, 28p.

Lee Steve A. 1993. Examines the relationship between biodiversity and tree plantations. Study no.6. Biodiversity. Shell/WWF Tree plantation review. Manchester, England.

Nikvist N. 1997. Changes in species accurance and phytomass after clearfelling, prescribed burning and slash removal in two Swedish spruce forests. Swedia Forestalia Suecica, no.201. Swedish University of Agricultural Sciences, Uppsala, Sweden.

Olsson B. & Staaf H. 1995. Influence of harvesting intensity of logging residues on vegetation in coniferous forests. Report no.80. Swedish University of Agricultural Sciences, Uppsala, Sweden, p. 26-49.

19
FOREST ECOSYSTEMS OF CANADA: A COMPONENT OF THE CANADIAN NATIONAL VEGETATION CLASSIFICATION

Natural Resources Canada
Canadian Forest Service
Great Lakes Forestry Centre, 1219 Queen Street East,
P. O. Box 490 Sault Ste-Marie,
Ontario P6A 5M7 Canada

Keywords: ecosystem classification, forest communities, woodland habitat

Forest Ecosystems of Canada Project

Forest Ecosystems of Canada, a project led by Natural Resources Canada – Canadian Forest Service in conjunction with numerous federal, provincial, territorial, and non-governmental agencies, seeks to develop a standardized taxonomic classification of Canadian forest and woodland ecosystems at the level of the vegetation community. The resulting classification, called the *Canadian Forest Ecosystem Classification (C-FEC)*, can be thought of as an "encyclopedia" or "dictionary" of Canadian forest communities, containing standardized definitions and descriptions using common nomenclature and terminology. This classification will identify known forest and woodland habitats in Canada, describing them with reference to their constituent species and environmental contexts, and provide an ecological language and database to guide information exchange and conservation planning at both the community and species levels.

Conservation of specific ecosystems can be considered as a coarse filter approach to protecting the constituent species and genetic diversity within those ecosystems. Conservation of forest ecosystems requires that a mosaic pattern of different forest ecosystems (a diversity of patches) be maintained across the landscape with each patch respecting forest structure (the vertical layering of trees, shrubs and other plants) and function (the major dynamic life-supporting processes).

The first step towards conservation of forest ecosystems is characterization of the major forest types within the forested land base. A nationally standardized classification system and accompanying nomenclature for community-scale ecosystems is a critical tool for biodiversity conservation at the ecosystem, species and genetic levels, essential for habitat recognition and implementation of protected areas strategies.

There is currently no national classification standard in Canada for identifying, naming, or describing forest ecosystems at the level of the vegetation community. Existing provincial/territorial forest ecosystem classifications (FEC's) were developed independently, so there is a lack of correspondence between them and the level of overlap between provincial/territorial FEC's is unknown. Consequently, Canada has no mechanism for establishing a national inventory of forest communities, for tracking and reporting on their conservation and health status, or for analyses of the distribution of critical species habitat.

Canadian National Vegetation Classification Project

The *Canadian National Vegetation Classification (C-NVC)* project is being initiated under the leadership of the Canadian branch of The Association for Biodiversity Information (ABI-Canada), in collaboration with numerous governmental and non-governmental partners. It is the Canadian component of the *International Classification of Ecological Communities (ICEC)*, a hierarchical, taxonomic, vegetation classification that combines information about vegetation structure, species composition, and habitat characteristics to classify vegetation communities into *associations* and their first order aggregates, *alliances*. The ICEC, developed by ABI-International together with associated natural heritage programs and conservation data centres (CDC's), is an international ecosystem classification standard that is being concurrently implemented in the United States, Canada, Mexico, and several other Caribbean and Latin American countries.

Development of the Canadian Forest Ecosystem Classification

The *Canadian Forest Ecosystem Classification* will employ definitions and conventions that are consistent with those of the *International Classification of Ecological Communities*. Based on this compatibility, C-FEC community types will be synonymous with C-NVC forest and woodland associations and alliances, effectively constituting the forest and woodland component of the C-NVC. The ICEC system has been endorsed by the United States federal government as a national standard for vegetation classification, the US National Vegetation Classification (US-NVC). The C-FEC types will be able to be compared to existing US forest and woodland associations / alliances that either approach or extend across the international border.

At present, existing provincial / territorial forest ecosystem classifications (FEC's) identify and describe over 4000 forest and woodland community types across Canada, but because provincial/territorial FEC standards are only consistent within their jurisdictional boundaries, it is not possible to directly compare FEC community types across provincial/territorial borders. A *Canadian Forest Ecosystem Classification* will be constructed by correlating these systems into a common system, using ICEC standards. Inter-jurisdictional correlations and review of the resultant C-FEC types will be achieved using provincial/territorial FEC data and professional ecological expertise. ICEC data, together with ecological expertise from ABI-Canada & US and regional CDC's, will be applied to the international correlation of resultant C-FEC types with US forest and woodland associations/alliances. Thus, C-FEC types will relate to existing provincial / territorial FEC units, as well as to known US-NVC associations and alliances. Data-based linkages to spatial (mapped) reporting structures such as the National Forest Inventory (NFI) or satellite-derived landcover schemes will provide the ability to attribute additional, ground-level ecological information to remotely derived map polygons and legend classes.

The *Canadian Forest Ecosystem Classification* will include: 1) a list of nationally standardized, community-level forest ecosystems that are defined and described in terms of vegetation characteristics in relation to climate, site, and process factors and will be equivalent to associations of the US- and Canadian National Vegetation Classifications (both components of the ICEC); 2) a classification database containing summaries of ecological attributes for the C-FEC units, as well as for their first-order aggregates (alliances), including information on community species characteristics, habitat and biogeographic attributes, and ecological process (e.g., successional) relationships; 3) linkages with nationally and regionally mapped ecological entities, such as the National Forest Inventory, the National Ecological Framework, and other reporting, conservation, and forest management planning structures.

Partners

This project will be realized as a result of collaboration between the following organizations:

Alberta Community Development; Alberta Environment; Association for Biodiversity - Canada (soon to be renamed NatureServe - Canada); Association for Biodiversity - US (soon to be renamed NatureServe); Atlantic Canada Conservation Data Centre; British Columbia Ministry of Forests; Department of Indian Affairs and Northern Development -Yukon; Manitoba Conservation; Ministère des ressources naturelles du Québec; Natural Resources Canada-Canadian Forest Service; New Brunswick Department of Natural Resources and Energy; Newfoundland and Labrador Department of Forest Resources and Agri-foods; Nova Scotia Department of Environment and Labour; Nova Scotia Department of Natural Resources; Ontario Ministry of Natural Resources; Parks Canada; Prince Edward Island Department of Agriculture and Forestry; Saskatchewan Environment and Resource Management; Yukon Renewable Resources.

Conservation and Sustainable Use (sustainable forest management)

20
SUGGESTED ACTIONS FOR AN IMPROVED MANAGEMENT OF FOREST BIODIVERSITY IN GABON

Célestine Mengue Medou
Université du Québec à Montréal[3]

Keywords : assessment; fauna; flora; biodiversity loss; corrective measures

Context

Located in Central Africa, Gabon owns a dense rain-forest (21 million hectares) hosting one of the largest African biodiversity with 8000 plant, 150 mammalian and 600 bird species. In 1960 the area granted to forest harvesting was less than 3 million hectares. As of 2000, that area has increased to 11 million hectares (WRI, 2000), representing about 60% of the national territory. The increased rate of forest and mining permits delivery is not without consequences on forest biological diversity as the current rate of harvesting mainly for timber is unsustainable (Glastar, 1999).

Method

The direct factors (forest harvesting, mining, poaching, road construction) and indirect factors (socio-economic crisis, poverty, institutional deficiencies) that lead to the loss of Gabon's forest biological diversity were studied/identified. On their basis, short-, mid- and long-term measures are proposed which could stop the present trend of biodiversity loss and allow for the restoration of the forest cover up to a level that could at the same time meet human needs as well as economic and environmental requirements of the goods and services of forest biodiversity.

Results

In Gabon, forestry is the main cause of biodiversity loss, followed by mining. Forestry is carried out without following the established country's norms. It affects, in particular, protected areas because of a lack of control mechanisms and conflicts between mining and forestry policies/legislation.

The impacts of logging on animals can be illustrated by the decline in the density of chimpanzee (up to 30%) in the Lopé reservation. In the so-called Bee Forest, road constructions have affected 70% of the primates and drastically decreased their number. As for the impact on the flora, damages are mainly seen at the ground and canopy levels. Some studies of the impact of forestry show that deforestation in Gabon has caused a loss of 20 to 50 percent of forest cover. The ecology of more than 70% of animal species living on seeds produced by trees shows that these species, such as the multipurpose Baillonella sp., *Irvingia gabonensis*, and *Tieghemella* sp., suffer from the reduction in tree population density caused by forest fragmentation. Regeneration of these species is low in areas where animals responsible for seed dispersal have become rare.

The reduction in faunal population is caused by a range of interlinked pressures, including essentially socio-economic crises (e.g. increasing unemployment) and behavioral factors (food habits) as well as emerging diseases (Ebola virus). Bush meat consumption is the main source of animal proteins to complement food obtained through agriculture. In fact, annual consumption of bush meat amounts to 17,500 tons representing 95% of animal proteins in the diet of the Gabonese population (Pfeffer, 1996). Poaching is reaching alarming levels. A recent study by WWF in the Minkébé forest in the northern part of the country shows that some hunters are killing between 8 to 12 animals per week, whether the species is protected or not.

[3] This study was carried out as part of an internship at the Secretariat of the Convention on Biological Diversity

Actions needed

Proposals for action concern not only the State of Gabon, the main manager of the forest domain but also the economic operators who exploit resources. Short-term measures address mainly the strengthening of the institutional framework; the protection of ecosystems, and vulnerable and endangered species; restoration of degraded areas; and measures for monitoring protected areas. As for long-term measures, emphasis should be put on a better knowledge of forest dynamics, valuation of traditional knowledge and betterment of the life conditions of local communities through institutional reforms.

Specific measures should include:

(a) Status of forest biodiversity: assess biodiversity with a view to identifying measures for its preservation, and set aside series of small parcels of land in forestry concessions as protected areas;

(b) Social context: assess the impact of the working population in forests. This study should lead to the establishment of a dialogue mechanism bridging enterprises, employees and local populations;

(c) Operation damages: evaluate logging and transportation techniques/methods and institute training in reduced impact logging;

(d) Cynegetic interventions: forest operators should be able to propose, based on inventory, measures aiming to limit impact of activities on animal populations in order to be able to develop appropriate plans/programmes for fauna management;

(e) Protected species: update the Red List of threatened or endangered species and ecosystems;

(f) Protected areas: increase the surface of protected areas up to 4 million hectares, as planned in legal texts already in force, and reinforce their protection;

(g) Forest management: development and implementation of management plans in forest concessions;

(h) International conventions: development of consolidated strategies and action plans for the implementation of international convention signed and ratified by Gabon, in particular CITES and the Convention on Biological Diversity.

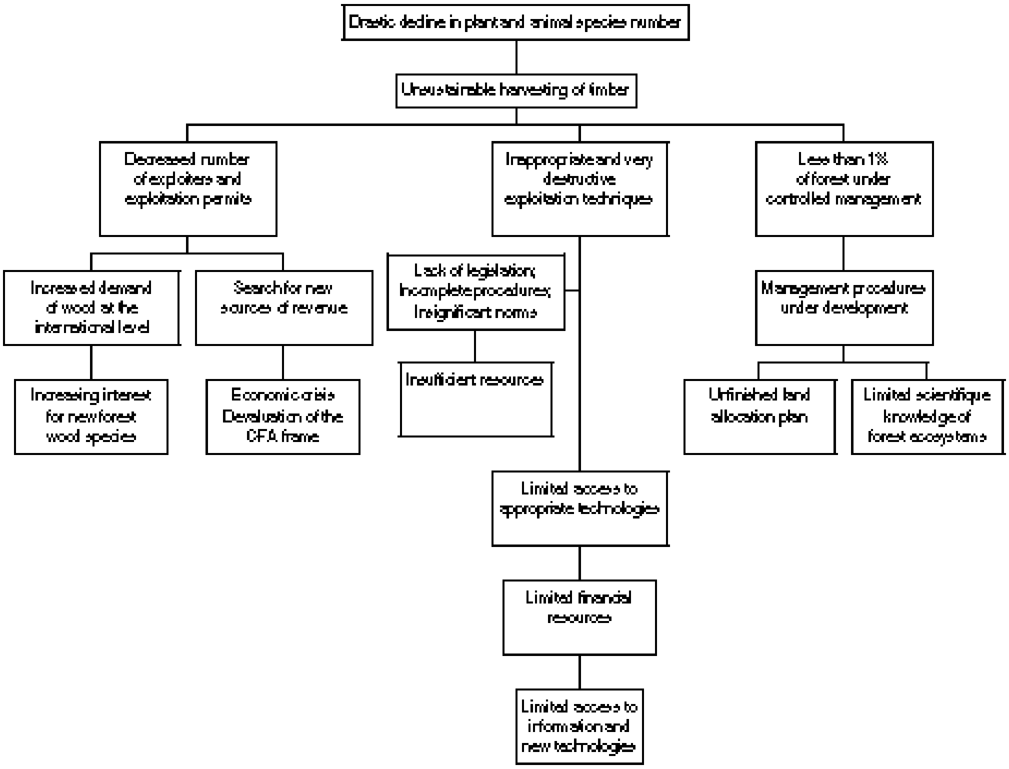
References

WRI, 2000. Un premier regard sur l’exploitation forestière au Gabon, Washington, DC. 50p.

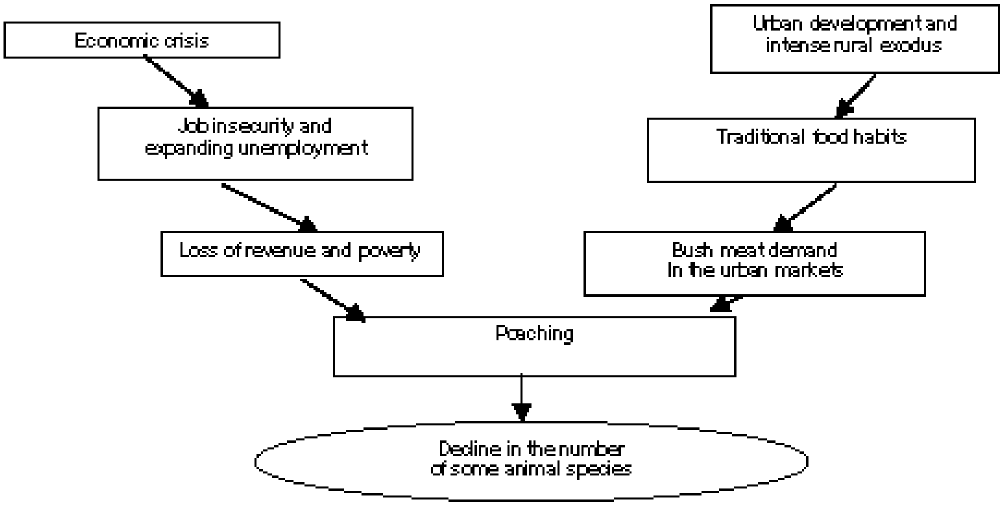
Glastar, R. 1999. Cut and Run: Illegal loggings and timber trade in the tropics. CIRAD. Ottawa, Canada. 112p.

Pfeffer, P. 1996. Importance économique et conservation de la grande faune africaine. Le courier de la nature, 158: 12-13.

Causal chain for Forest Biodiversity loss and ecosystem degradation



Pressure on wildlife



21
TOWARDS AN ECOSYSTEM APPROACH IN DESIGNING LARGE-SCALE INDUSTRIAL PLANTATION LANDSCAPES: CORRIDORS FOR A WIN-WIN SOLUTION

John Grynderup Poulsen
Center for International Forestry Research
P.O. Box 6596 JKPWB
Jakarta 10065
Indonesia
E-mail: J.Poulsen@cgiar.org

Keywords: ecosystem approach, industrial plantations, landscape-level design, natural forest corridors, set-asides, connectivity, local communities, biodiversity conservation, profitability of plantations, company-community conflicts, mitigation of negative social and ecological impacts

Introduction

Tropical plantations are rapidly expanding as a source of industrial wood and fuel. Plantations, as currently managed (structurally simple forests; mono-culture) may directly contribute to fragmentary processes on a landscape level, by reducing the inter-connectivity of natural/native vegetation patches. Corridors are extensively used in ecological restoration initiatives to alleviate the detrimental effects of fragmentation by restoring landscape inter-connectivity and returning a level of integrity and resilience. Given current rates of environmental transformation and increasing dependency on plantation forestry within the humid tropical zone, further scientific inquiry into the potential environmental, ecological, and human benefits provided by corridors is crucial.

In a plantation context, corridors have mostly been considered by plantation owners as merely constraints to maximizing short-term earnings. In this study, I explore whether and how corridors (and other patches set aside from production) may be used to balance the goals of sustainable production of plantations with maintenance of biodiversity. Potential short-term economic incentives and benefits include: minimizing plantation damage caused by wind throw, fire, and insect pest attack (by functioning as windbreaks, firebreaks, providing habitat for biological control organisms, and as barriers to invasives, respectively), protecting and maintaining water quality and supply to both the plantation stands and the people living there, providing resources such as beneficial plants, and other NTFPs - for people living within and around the plantation landscape.

Methodological Approach

The specific study was conducted in central Sumatra, Indonesia, in an area developed for large-scale industrial plantations. The research design was strategic in nature, therefore – in principle - making the research results generally applicable. The plantation landscape managed by the company (i.e., the concession) consisted of several non-contiguous ‘sectors’, the area of which ranged from 10,000 ha to 60,000 ha. Each sector is somewhat independently managed, with overall control from the company headquarters.

Each sector was stratified based on landscape patterns and vegetation type, followed by a random selection of 50 100ha sampling plots within each stratum (thereby maximizing the sampled range of those variables). Plots had identical shape (squared), size, and have random orientation and direction. A statistical power analysis was performed after pilot surveys, to ensure that an adequate number of plots were monitored. Comparative analyses focused on two key “landscape” variables: the proportion of total land set aside from production (ranging from 0% to 40% of the concession), and, the landscape level configuration of land set aside from plantations. These key independent variables were nested with respect to elevation/slope, general landscape pattern (other than the above), distance from national park boundary, and plantation productivity.

Within each plot, one corridor was randomly selected. Each corridor was characterized with respect to management and design (condition, width, degree of connectedness to other green belts, distance to conservation areas, vertical structure, tree species composition, herbal/shrub composition). Biological surveys were conducted within the 100 ha plots.

Profitability of the entire concession was also assessed based on stand and sector level data.

Results

Profitability of plantations

The profitability of the plantation concession increased as an increasing proportion of the concession was set aside and retained as natural forest corridors, until a threshold of 25-30%, above which the profitability rapidly declined.

Both pest incidence and the area damaged by wind, within plantation stands declined with increasing proportion of the concession set aside as natural forest corridors. Other factors, including fires and invasives, were of negligible economic impact upon the profitability of the plantation concession.

Interests of local communities

The density of the ten most important tree species currently used by local communities for non-timber purposes, increased linearly with increasing proportion of the concession in natural forest corridors.

Conservation of biodiversity

Density of primates, and number of primate species, both increased, initially linearly, and then asymptotically approached the maximum of the region as a whole, with increasing proportion of the concession set aside and retained as natural forest corridors. At 25-30% of the concession in natural forest corridors, 85-90% of the primate species and density thereof had been retained. Connectivity of corridors to other corridors and to larger areas of natural forest was critical: corridors not connected to other larger patches of natural forest, hosted no primates.

Discussion

Appropriate design and management of natural forest corridors and remnant patches can be used to mitigate or reduce the negative impacts of large-scale industrial plantations on native biodiversity and towards maintenance of environmental and social functions of the original natural forest landscape.

The ecological and environmental services have substantial impacts on the profitability of the plantations.

Recommendations and Lessons Learned

First, plantation landscapes should be designed so that on the one hand, the landscapes are penetrable and permeable for those biodiversity components which are of conservation concern in the area under consideration, and on the other hand, impenetrable and impermeable for pests, weeds, and invasives. Second, from a human/social standpoint, priority must be to design plantation and manage landscapes in a way that minimizes the adverse impacts on the local people and communities living in and around these areas. This includes the importance of natural forests for the livelihoods of local people, both in terms of the resources that they can obtain from those areas, and from the environmental services, e.g., maintenance of good water quality.

Likewise, the economic costs (both directly and indirectly) to the plantation companies from conflicts with local communities are substantial, and as the dependency on plantations for food and fiber increases globally, these conflicts and the economic implications thereof, are likely to increase. Further, disincentives and/or constraints to better design and management of corridors in the long-term can be very important. For example, in the specific case presented here, leases on natural (selectively, logged-over) areas classified for plantation development, are approximately 20 years, too short a period for the companies to fully commit to long-term planning, and current lease-holders have therefore no guarantee that their lease can be extended beyond the current lease period. This uncertainty is a further impetus for maximizing short-term incomes at the expense of long-term sustainable management.

22
INFLUENCE OF CHEMICAL TREE INJECTION ON POPULATIONS OF BARK BEETLES IN YOUNG SPRUCE AND PINE STANDS

Rostislav Vlasov* and Igor Shutov

Forestry Research Institute, 21 Institutsky pr.,
194021 St. Petersburg, Russia
E-mail: spb330@spb.sitek.net

Keywords: Scolytidae, spruce, pine, injection, glyphosate

Introduction

Restoration of primary (original) forest vegetation types having unique biodiversity is a very important task. This work, as a rule, is impossible to fulfil without removal a part of invasive secondary plants. Elimination of undesired vegetation is feasible through the use of effective modern chemicals (Egorov 1989, Martynov et al. 1998). Such a measure is suitable only if it does not cause different negative consequences, including outbreaks of biological organisms able to destroy existing phytocoenoses. In our case, thinning experiments were conducted to study influence of arboricide injection into stems of coniferous trees on bark beetles' (Coleoptera: Scolytidae) attack behaviour. In such cases, the danger of bark beetle outbreak can arise in an area having large numbers of arboricide-treated trees dying. In addition, bark beetles can move to surrounding stands. We should know if there is a danger to the remaining healthy trees in the stand. Also, the questions of forest protection should be discussed in the case of bark beetles' successful development in treated trees and subsequent colonisation of healthy trees.

Methods

The study was conducted in Siversky Experimental Forest, about 70 km south of St. Petersburg, Russia. Several 20- to 39-year-old Norway spruce, *Picea abies* (L.) Karst., and Scotch pine, *Pinus sylvestris* L., plantations growing on good sites were chosen for the study. The reason for selection was because these stands needing precommercial thinning appear to be most susceptible to bark beetle attacks due to tree size. The total area was 1 ha for spruce and 1 ha for pine experimental plots. Diameter at breast height (DBH) ranged 3-12 cm for spruce and 4-14 cm for pine. The arboricide Roundup® (active ingredient glyphosate) was injected into the stems of pine and spruce trees on the experimental plots. Felling, mechanical girdling (by removal of a complete bark belt from the tree), and plots without any treatment served as controls. A total of 1100 spruce and 300 pine trees were subjected to different treatments. Pheromones were not used to attract bark beetles into the plots. In all experimental stands and plots with chemical treatment, 1 to 3 spaced frills (notches) were made per experimental tree to be treated, depending on the tree diameter, with a hand hatchet at approximately 1 m above the ground. The arboricide was applied at the rate of 1 ml per frill with a plastic squeeze bottle. Strength of the arboricide, the number of frills per a tree, and the rate of arboricide application followed recommendations by Egorov (personal communication). Treatments were carried out in mid- to late August 1997, 1999, and 2000.

The experimental plots were examined and sampled for bark beetle activity next year after treatment. In each plot, 5 sample trees (attacked by bark beetles) were taken randomly in late August. Three 25-cm-long sample bolts for spruce bark beetles (50-cm-long for pine bark beetles) were taken from the infested part of each sample tree. First, exit holes of bark beetles were counted in each sample bolt. Then bark was removed from each sample bolt to count egg galleries, nuptial chambers and young beetles. The length of all egg galleries in each sample bolt was measured and beetles found were identified. Population characteristics of bark beetles such as attack density (that is the number of bark beetle families per 1 dm^2 of bark surface), the number of parent (males plus females) and young beetles (including exit holes) per 1 dm^2 were determined as described in Mozolevskaya *et al.* (1984). Statistical methods were used to analyse results obtained.

Results

Spruce stands

All the injected spruce trees in experimental plots with Roundup injection were dying by late May next year after injection and nearly all of them attracted bark beetles. Only trees of the smallest size (DBH ≤ 4 cm) were not attacked or had rare attacks because of their very thin bark and faster drying. The following bark beetle species were found in the injected trees: *Pityogenes chalcographus* (L.), *Polygraphus poligraphus* (L.), *Ips typographus* (L.), *Ips amitinus* (Eichh.), *Crypturgus cinereus* (Herbst), *Pityophthorus micrographus* (L.), *Trypodendron lineatum* (Oliv.). *Pityogenes chalcographus* dominated in experimental plots. Bark beetles avoided attacking the tree stems adjacent to the points of arboricide application but colonised other parts of the tree stems successfully. Our preliminary conclusion is that the arboricide affected bark beetle attack behaviour but did not prevent the killed trees from being attacked. Time of tree death influenced bark beetle species composition and relative abundance. In addition, the weather, the presence of bark beetles and weakened trees in surrounding stands, and concentration of treated trees seemed to influence bark beetle attack behaviour. Predaceous insects and parasitoids did not appear to play important roles in regulating the number of bark beetles the year after injection. A danger of the serious pest *Ips typographus* (L.) attacking the larger diameter injected trees is thought to be low. In summary, bark beetles found favourable conditions for development on injected spruce trees and constructed egg galleries of normal length. Untreated healthy trees on the experimental plots remained free of attack the year after late summer injection.

In experimental plots with mechanical girdling, the treated spruce trees were dying more slowly. Nevertheless, they were also attacked by bark beetles, mainly by *Pityogenes chalcographus*. In addition, *Polygraphus poligraphus* and *Pityophthorus micrographus* were also present. We did not detect bark beetle attack on the remaining healthy spruce trees in the plots with mechanized thinning. Light natural mortality occurred among trees (DBH<6 cm) in the plots without treatment. The dead trees were lightly attacked mostly by species preferring dead material.

Pine stands

All the injected pine trees in experimental plots with Roundup injection were dying by late May next year after injection, and trees with DBH > 8 cm were readily attacked by *Tomicus piniperda* (L.), *Tomicus minor* (Hart.), *Pityogenes chalcographus, Ips duplicatus* (Sahl.), *Crypturgus cinereus* and *Trypodendron lineatum*. Pine trees with DBH < 8 cm were attacked mainly by *Hylurgops palliatus* (Gyll.), *Trypodendron lineatum*. Only sporadic attacks by *Tomicus piniperda* were seen here in the lower part of the tree stems. *Tomicus piniperda* avoided attacking the sides of tree stems adjoining the frills.

Trees in experimental plots with mechanical girdling were dying much more slowly, and only a few of them had sporadic bark beetle attacks (for example, *Tomicus piniperda*). These trees had green crown and phloem next year after treatment at the time of inspection in late May. These trees were partly attacked two years after treatment by *Tomicus piniperda, Tomicus minor,* Pityogenes chalcographus, Trypodendron lineatum. Most trees felled in experimental plots with felling were removed. Several of the felled trees that remained in experimental plot were not preferred by bark beetles and were only lightly attacked. Bark beetle gallery distribution was irregular on these trees. No bark beetle attacks were found on the remaining neighbouring healthy trees and in plots without any treatment.

References

Egorov, A.B. (1989). Method of arboricide injection into stems of trees abroad. *Forestry abroad: Express information.* Issue 11. VNIITslesresurs Goskomlesa USSR, Moscow. p. 2-22. (In Russian).

Martynov, A.N., Krasnovidov, A.N., and Fomin, A.V. (1998). *Roundup usage in a forest*. SPbNIILKh, St. Petersburg. (In Russian with English summary).

Mozolevskaya, E.G., Kataev, ?.A., and Sokolova, E.S. (1984). *Methods of forest stem pest and disease foci survey*. Lesnaya promyshlennost, Moscow. (In Russian).

23
THE ROLE OF FIRE IN THE MEDITERRANEAN FORESTS: PAST, PRESENT AND FUTURE PERSPECTIVES

Margarita Arianoutsou
Department of Ecology and Systematics,
Faculty of Biology, School of Sciences,
University of Athens, 15784 Greece
E-mail: marianou@biol.uoa.gr

Keywords: Mediterranean pines, landscape changes, fire, biodiversity

Introduction

Fire is a major ecological factor in many biomes of the world (Rundel, 1981). In the Mediterranean ecosystems fire has acted as an integral part of their evolutionary history, by having shaped their adaptive traits (Naveh, 1975). Fire has probably played an important role in the selection of many extant Mediterranean plants: the protective bark of the widespread cork oak (*Quercus suber* L.) and its remarkable capacity to resprout after fire from aerial buds is difficult to be explained without the evolutionary intervention of fire. The specific regeneration behaviour of plants is closely related to their physiological traits and is strongly influenced by fire regime (fire season, intensity, interval), (Arianoutsou, 1998). More specifically, plants of these ecological systems can regenerate through resprouting from intact buds situated at the base of the root crown or from other root rhizomes, or from underground organs such as the lignotubers or the bulbs. Other plants can preserve their reproductive units either in hard cones (e.g. Pines) remaining on the plant, forming thus a canopy seed bank, or by forming hard-coated persistent soil seed banks (e.g. Cistaceae, Leguminosae). Both seed banks are not destroyed by fire and they become available after its passage.

Post-fire succession in the Mediterranean plant communities is an autosuccession that leads to the recovery of the pre-fire vegetation. This means that all species, which occurred in the site before fire, are present immediately after it, even in different numbers and relative cover. In this autosuccession, herbaceous plants are abundant in the early post-fire communities and within the herbaceous taxa, legumes are the dominant functional group. Pre-fire community structure is rapidly re-established. Woody plants dominate in the late post-fire communities, both in species numbers and in phytomass.

Fire frequency is an important parameter of fire regime. Very frequent fires may diminish plants that have either short life cycles, such as the rockroses or other long living plants, which require an adequate period before they can regenerate. Pines belong to the last category, as they require at least 6-8 years to produce cones and these cones require some period before they become mature. Although our knowledge on the factors that control species richness in post-fire Mediterranean environments is poor, available evidence indicated that species richness is more sensitive to fire severity and fire frequency than plant cover. The ‘natural’ window time between two consecutive fires is between 50 -60 years for the Mediterranean Basin.

Man and the Mediterranean Landscapes

Man early settled the Mediterranean Basin. Consequently, Mediterranean landscapes have long ago experienced the human impact. Indigenous agriculture and animal husbandry have been practiced here for more than 10000 years, in combination with deforestation practices and fire management. Plant community structure and diversity patterns have therefore being evolved under the influence of this interaction. These patterns were kept in a dynamic equilibrium at least until the Second World War. Since 1950 major changes have occurred to the economies, the livelihood and hence the landscapes of the Mediterranean countries (Arianoutsou, 2001).

Pinus halepensis forests of Greece: a study case

Pinus halepensis Mill. and Pinus brutia Ten. are two major forest species widely distributed around the Mediterranean, from sea level to relatively high altitudes and they alone account for about 25% of the forested area of the Mediterranean Basin. They are both highly flammable seeding species, growing on virtually all kind of substrates, landforms and topography. Pinus halepensis (Aleppo pine) and *Pinus brutia* (East Mediterranean pine) forests cover approximately 40% of the coniferous forests and approximately 9% of the total forested area in Greece. They develop at areas of low altitude at relatively dry Mediterranean conditions. Mediterranean forests of Greece host almost 10% of the plants, which are endemic in the fire-prone environments of the country.

Almost 1/5 of the fire events which occurred in Greece during the last 30 years have burst over Aleppo pine forests consuming ~ 400000 ha of them. *Pinus halepensis* ecosystems are resilient to fire provided that fire interval follows the 'norm'. This time window must not in any case be less than a minimum time required by Aleppo pine to accomplish its biological cycle, that is to establish new seedlings and reach reproductive maturity. This period is not less than ~25 years.

Traditional use of Aleppo pine forests was primarily related to resin collection and secondarily to wood collection and grazing. During the last 30 years Aleppo pine forests attract other human activities, e.g. recreation and housing constructions. This shift is clearly reflected to the number of fire events starting at the wildland - urban interface.

Pinus halepensis natural forests of Mountain Penteli in Attica is a typical example of such landscape changes and fire interactions, having experienced very frequent deliberate fires at quite short time intervals. Plant community structure and diversity are greatly affected. The short fire interval has stronger impact on the occurrence of the woody plant species than on the herbaceous. Pinus seedlings are no longer appearing and ruderal taxa become dominant. Therophytes become more abundant both in species richness and in cover. The relative representation of key-functional groups changes significantly. Evidence that at least 3 plant endemic taxa *Campanula drabifolia, Erysimum graecum*, both biennial hemicryptophytes and *Onobrychis ebenoides*, a perennial pubescent chamaephyte protected by the Presidential decree 67/1981, did not manage to survive.

Conclusions

There has been an increasing interest in many terrestrial biomes on issues relating biological diversity and ecosystem function. Mediterranean ecosystems of the World have been proposed as critical in this scientific effort in the sense that they provide important models for searching new paradigms relating biodiversity with ecosystem stability and resilience. Given the fact that these ecosystems are under the threat of severe and progressing landscape changes, the need of full understanding the processes underlying these links is essential and becomes crucial under the foreseen climate change scenario.

References

Arianoutsou, M. (1998). Aspects of Demography in post-fire Mediterranean plant communities of Greece. In: *Landscape degradation in Mediterranean-Type Ecosystems*, edited by P.W. Rundel, G. Montenegro & F. Jaksic. Ecological Studies 136. Springer-Verlag, Berlin/ Heidelberg. pp. 273-295.

Arianoutsou, M. (2001). Landscape changes in Mediterranean ecosystems of Greece: implications for fire and biodiversity issues: Journal of Mediterranean Ecology, in press.

24
AUSTRALIA'S APPROACH TO SUSTAINABLE FOREST MANAGEMENT PRACTICE

Stuart M. Davey*[1], James R.L. Hoare[1], Karl E. Rumba[1], Michael W. Ryan[2], Michael Stephens[2]
[1]Bureau of Rural Sciences, P.O Box E11 Kingston ACT 2604 [2]Department of Agriculture, Fisheries and Forestry Australia GPO Box 858 Canberra ACT 2601
E-mail: Stuart.Davey@brs.gov.au

Keywords: sustainable mangement, reserve criteria, modelling technology, forestry standard

Australia is considered as one of the worlds 17 'megadiverse' countries with a high level of endemism that makes it significant on the world stage. Forest ecosystems found in Australia are unique and are hence considered a world asset in terms of biodiversity. This is recognised by the Commonwealth of Australia and a range of activities have been put in place to help meet its obligations under the Convention on Biological Diversity with respect to forests. The National Forest Policy Statement, comprehensive, adequate and representative forest reserve system criteria, Regional Forest Agreements, forest modelling technology, Montreal Process-based regional criteria and indicators and the Australian Forestry Standard are recognised as key elements in the forestry sector for promoting the conservation of biological diversity and adopting ecological sustainable forest management practice. In the 2001 *Review of the National Strategy for the Conservation of Australia's Biological Diversity* the objective of achieving conservation of biological diversity through the adoption of ecologically sustainable forest management practices was considered to be achieved.

The National Forest Policy Statement (1992)[4] sets out the principles, vision and goals for achieving ecologically sustainable development and use of Australia's forests. It seeks to achieve a balanced return to the community from all forest uses within a regionally based planning framework that integrates environmental, commercial, social and heritage objectives so that, as far as possible, provision is made for all forest values. The Statement is a whole of government approach to forest issues. Its goals, objectives and initiatives form the foundations of ecologically sustainable forest management practice across Australia. Commitments made through policies outlined within the Statement provide the Australian commitment to help meet the country's obligations under the Convention.

A comprehensive, adequate and representative reserve system is a key element in the Australian approach to ecologically sustainable forest management practice. Australia has developed and agreed a set of criteria, standards and principles that underpin such a reserve system. The reserve system protects a range of biodiversity conservation values as well as old-growth forests and wilderness areas. Importantly, the reserve system had to achieve conservation goals using formal, informal and off-reserve management strategies aimed at ecologically sustainable and complementary management of forests on public and private lands. The criteria for establishing the reserve system is world's best practice with the goal of reserving 15% or more of each forest type determined to have occurred before 1750[5]. This exceeds the criteria used by IUCN.

Regional Forest Agreements within Australia are the basis and foundation for the States of Australia to implement the policy commitments of the National Forest Policy Statement and hence meet the UNCED Conventions and non-legally binding instruments. These twenty-year Agreements are regional strategic forest plans, which integrate the conservation and sustainable use of forest biological diversity as envisaged under Article 6b of the Convention. Agreements cover much of the commercial forests of Australia and are based on conservation management and sustainable use principles taking on board community and forest industries needs, issues and values.

[4] NFPS (1992) National Forest Policy Statement: A new focus for Australia's forests, 2nd edition. Commonwealth of Australia, Australian Government Publishing Service, Canberra.
[5] The 1750-baseline was used in recognition of the changes in the forest estate following European settlement in Australia in 1788. The IUCN adoption of the 1750-baseline relates to the forest estate as it existed prior to the Industrial Revolution.

Australia has developed or adapted several forest planning tools useful in landuse planning and sustainable use of resources. These tools were used extensively to facilitate the development of options for sustainable forest management. They included tools for, (a) designing efficient reserve systems and, (b) understanding consequential effects on the sustainable use and supply of wood. Examples include, Whatif?/LUPIS, a land-use allocation model; SPECTRUM, a forest planning model for determining sustainable yield and use; C-Plan, a conservation reserve selection method that allocates areas of conservation priority to the reserve system. Whatif?/LUPIS enabled management intentions to be spatially presented and balanced through specification of goals and guidelines. SPECTRUM provided the capacity to model silvicultural regimes and prescriptions and their consequential temporal effects on a range of values. These tools provided perspectives on how to model practices and regimes across the forest landscape. The knowledge gained through the use of these tools contributed to the development of the Regional Forest Agreements and understanding of the sustainability of practices and management regimes. C-Plan was used in the development of the Comprehensive, Adequate and Representative reserve system for all four Regional Forest Agreement regions in New South Wales.

ECOPLAN, which was developed to help undertake assessments associated with regional forest agreements, is a suite of concepts, methods and software useful in biodiversity assessments and ecological planning. Capabilities of ECOPLAN include:

- fauna and flora assessment tools useful in setting conservation targets based on population viability analysis principles and management requirements for conservation;
- data auditing facilities to assist in identifying data errors, data gaps, areas for priority surveys and efficacy/efficiency of surveys;
- spatial modelling facilities for individual species based on statistical relationships between species and the presence of biological entities and environmental data;
- reserve design tools based on optimising conservation goals while reducing socio-economic impacts.

An important element of Australia's commitment to the maintenance of biodiversity values is the work on implementation of both national and sub-national (regional) indicators for sustainable forest management, drawing on the Montreal Process Working Group. Australia has endorsed the Montreal Process framework of seven criteria and 67 indicators for monitoring and reporting on forest values at a national level as well as providing a basis for the development of regional indicators. A coordinated approach to monitoring trends in the sustainability of forest management practice, forest environment conditions and values and socio-economic values is in place and being achieved through reporting on sub-national criteria and indicators. The State of the Forests Report that is produced every five years is a public and international reporting mechanism that helps to support Australia's achievements of sustainable management practice, together with the development of sustainability indicators as part of the monitoring cycle for Regional Forest Agreements.

The Australian Forestry Standard, which is currently under development, once finalised will be a nationally endorsed standard that draws on the international frameworks of Montreal Process Criteria and Indicators, the requirements of like initiatives such as the pan-European Forest Certification scheme, and the International Organisation for Standardisation (ISO) 14001 environmental management system series. The Standard distils community values and the science of forest management to develop biological, environmental, social, indigenous and economic forest management performance criteria and requirements to ensure forests are well managed and ecologically sustainable forest management practice is promoted. The Standard will reflect broad stakeholder support. While the Standard is voluntary it will assist in certification of Australian forest products. Through its use the Standard will promote sustainable practices in forests managed for wood production regardless of ownership, forest type or whether it is natural forest or plantation.

Australia is well placed to continue to achieve the conservation of biological diversity through the application and continual improvement of ecologically sustainable management practice. The elements described above are recognised by the Commonwealth of Australia as fundamental to meet its obligations with respect to forests as envisaged by the Convention on Biological Diversity.

25
GAME BROWSING AND TREE SPECIES DIVERSITY – A LONGTERM EXPERIMENTAL APPROACH

Hermann Ellenberg* , Thomas Buhmann, Olaf Kuehnast,*****
*Institute for World Forestry, Federal Research Centre for Forestry and Forest Products, Hamburg, Germany;
**MSc – thesis, Faculty of Biology, University of Hamburg, Germany; ***Lauenburger Str.76,
Geesthacht, Germany.
E-mail: ellenberg@holz.uni-hamburg.de

Keywords: browsing; Roe deer, hunting; forests, Northern Germany; experiment.

Question

Does intensified hunting pressure have consequences for browsing intensity by deer? Are there today – after experimentally raised hunting intensity – more individuals of young trees, and less browsed, in comparison to earlier times ?

Approach

In spring 1998, an investigation of browsing pressure was conducted in twelve forest fragments in Northern Germany (Kreis Herzogtum Lauenburg, east of Hamburg). Field methods were identical to the 1990-investigation.: the foresters in charge had to mark areas on a map being actually relevant for – mainly natural – forest regeneration. Inside these patches of many hectares, each, long and narrow plots (2 x 20 m) were established following a chance approach. Here every young tree was registered in five height classes, up to a height of 320 cm. Species, height class, and browsing intensity were noted for more than 20 000 young trees, in 1990 as well as in 1998. During these eight years, hunting pressure on Roe deer (Capreolus capreolus), the most distributed and numerous deer species in Germany, has been intensified. In several of the investigated forests the hunting bag was more than doubled (Fig. 1).

Results

As in earlier years, there still exist more than 20 tree species in the lowest height class (up till 20 cm). Many thousand young tree individuals exist per hectare (ha). Only a few of them “make it through”: in the no longer browsed height class (160 – 320 cm) only 3 to 6 species with a few hundred individuals remain, most of them with significant old browsing scars. This in principle appears to be normal, as there exist many causes for failure to grow in young tree individuals. Nevertheless, the percentage of „successful“ young trees (more than 160 cm height; 100% = density in young trees in the “below 20 cm” class) duplicates from 1990 to 1998 (1,7% to 3.6%). – In 1990, of the “appreciated” or palatable (browsing) tree species, there existed only a few individuals of sycamore (*Acer pseudoplatanus*) and ash (*Fraxinus excelsior*) in heights above 160 cm. In 1998, there were also *Carpinus betulus, Sorbus aucuparia, Crataegus spec., Quercus robur, and Populus tremula* present in this height, and in the next lower height class plenty of individuals of these species existed. This means, there was a double number of tree species “out of browsing” (above 160 cm) in comparison to 1990.

Apparently the higher hunting pressure contributes significantly to this success, as may be seen by the negative correlation of hunting intensity and browsing pressures in the example of 20 to 40 cm sycamore (Fig. 1): But browsing pressure in this “convenient” height (for browsing Roe deer) still remains high, even at elevated hunting bags (Roe deer shot per 100 ha of forest per year). – As in former years, browsing pressure also in 1998 culminates in the “especially convenient” height of 40 to 80 cm, but overall browsing pressure (all species combined) significantly diminished from 1990 to 1998. This provides a chance “now” for many more young trees to grow higher (faster) as compared to the time of lower hunting pressure. Relatively speaking, there existed 1.12, 1.48, and 2.38 times more trees in the height classes above 40 cm, respectively, in 1998 as compared tp 1990.

Conclusion

Intensified hunting pressure on Roe deer obviously approves growth in young trees. The less numerous among the browsing-exposed ("appreciated"/palatable) tree species get chances to overcome browsing pressure during times of higher hunting pressure, only. The number of successful tree species raises significantly with growing hunting bags.

Whether browsing is considered "tolerable" or "desatrous" depends from forest management goals. As forest management in Germany decided for the future to rely more on natural regeneration an promote a higher mix of different tree species than had been done in the past, forest "became defined" more exposed to deer browsing than before – even without any change in deer population densities or in browsing situation – as European beech (Fagus silvatica) or spruce (Picea abies), the main tree species for traditional (less close to nature) forestry in Germany are less intensively browsed – as a rule – in comparison to many other tree species.

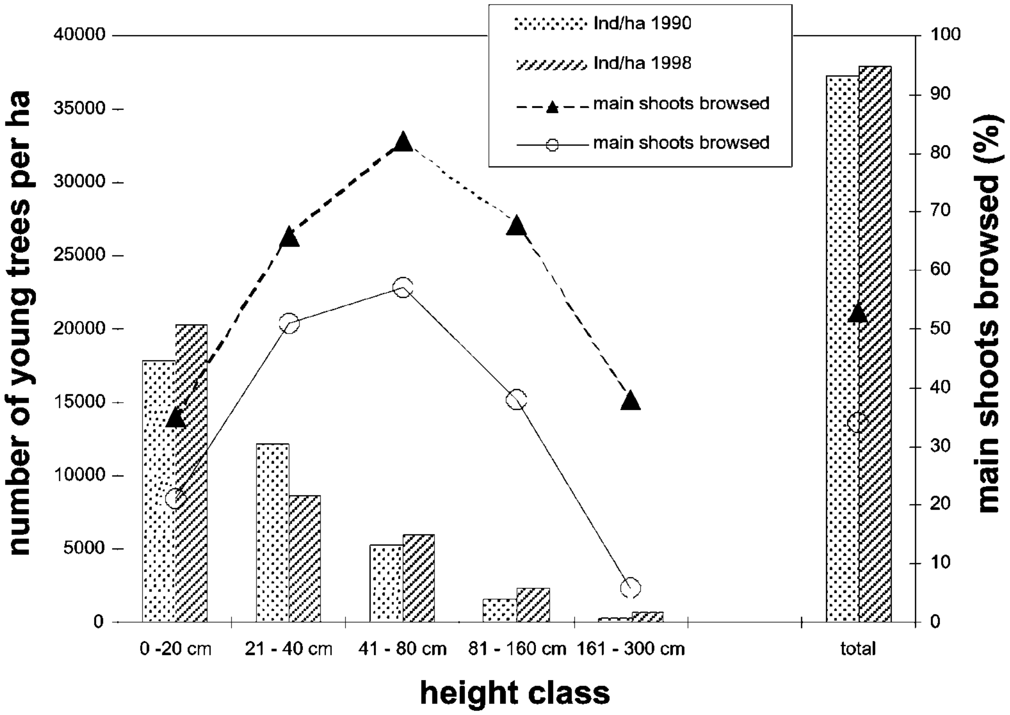
Legends to Figures

Figure 1: Browsing intensity diminishes with growing hunting bag. – Browsing intensity is measured as the percentage of main shoots browsed during the last winter and before (field work mainly during April). Hunting bag is the number of Roe deer shot per 100 ha of forest per year. The example is for Sycamore (*Acer pseudoplatanus*) of the height calss 20 to 40 cm, a highly palatable tree species for browsing deer and a rather comfortable height for browsing. The lines in the graph are for different patches of forest, more than 100 ha, each. They start with 1990 in the upper left and end with 1998 in the lower right. Browsing pressure on this palatable species went down considerably with raising hunting bags, but still remains high with about 50% - 20 to 30% could be considered tolerable.

Figure 2: Number of young tree indiviuals and browsing intensity per height class, all tree species and forest patches combined, for 1990 (left column/triangles) and for 1998 (right column/circles). – With growing height, the number of tree individuals goes down, as a large number of them have to die, not only due to browsing. Browsing pressure (% of browsed main shoots during the last winter and before) is highest at a convenient height for the deer (40 to 80 cm) in 1990 as well as 1998, but it is much less intense at the later date due to an elevated hunting pressure (see Fig. 1). That's why in the height classes above 40 cm the young tree individuals (ind/ha) in 1998 outnumber those in 1990: relatively more of them manage to get larger in 1998 due to a lower browsing intensity. (see text).

Figure 1:

Figure 2



26
SUSTAINABLE FOREST MANAGEMENT IN GERMANY: THE ECOSYSTEM APPROACH RECONSIDERED

Michael Scherer-Lorenzen*, Andreas Häusler & Gernot Bäurle
Institute for Biodiversity – Network (ibn)
Dr.-Johann-Maier-Straße 4, 93049 Regensburg, Germany
E-mail: InstBN@t-online.de

Keywords: Sustainable Use, Forestry, Ecosystem Approach

Introduction

In recent years, it has been increasingly recognized that biological diversity can be successfully conserved only if it is understood in the context of ecosystems, and if the multitude of its interactions with humans living in and subsisting on ecosystems is taken into account. Therefore, within the framework of the Convention on Biological Diversity (CBD), the “ecosystem approach” was developed as a basis for the implementation of the convention.

This presentation is based on a case study (Häusler & Scherer-Lorenzen, 2001) that analyses the current state of forest use in Germany with regard to its compatibility with the ecosystem approach.

Forests in Germany

An extensive system of legal provisions pertaining to the forest sector exists in Germany, according to which all forest owners are under the obligation of “sustainable, proper management”. Besides the economic utility of the forest, “the continuous capacity of the natural resources” and other functions of the forests (conservational and recreational functions) need to be taken into account as well. Based on the concept of “multifunctional forest use”, several management systems were developed in Germany. All types of management ensure the quantitative sustainability (i.e. harvest smaller than regrowth), but differ in their fulfilment of ecological and social criteria of sustainability. In the future, these criteria should be taken more into account through the introduction of certification measures or through the initiation of Forest Programmes on a national and federal state level.

Reconsidering the 12 Principles of the Ecosystem Approach

Regarding the 12 Principles of the ecosystem approach, the case study presents the following findings:

> The societal choice regarding the objectives of ecosystem management as postulated in Principle 1 is mainly affected by the existing ownership structure. In privately owned forests rights and interests of other sectors of society are usually considered only within the limits of respective legal provisions, whereas in state-owned forests they are generally dealt with more appropriately. Nevertheless, there are often rivalling interests, which frequently result in conflicts. The involvement of the various stakeholders in management decision within the scope of the National Forest Programme, and of certification activities, may be a feasible method to help solve such conflicts.
>
> In accordance with Principle 2 regarding the decentralization of management, local forest authorities are in charge of all management activities in relation to the forest ecosystem. Although local management is limited in its authority when it comes to decisions concerning national or international obligations, local stakeholders can contribute their specific knowledge. That is why in individual cases or areas, centralized and decentralized approaches should ideally coexist or be interlinked.

Ecosystems are connected with each other. Thus management activities in any ecosystem inevitably effect other ecosystems, which according to Principle 3 should be considered by ecosystem managers. In order to be able to assess those effects, a sound knowledge of the functional interactions between individual ecosystems is required. Even though such interactions are comparatively well known for Central European forests, there is a need for further research. With the mapping of forest biotopes, a first step has been taken in the direction of avoiding negative effects on special biotopes within forest stands.

The vast majority of German forests are fully managed forests, which have been understood in a purely economic context. In line with Principle 4, forestry development programmes with an unfavourable impact on forest biodiversity have been revised and complemented with new criteria for ecological management. While there are promising efforts for the reduction of market distortions and the creation of positive incentives, there is still room for improvement as regards the internalisation of costs and benefits in the given ecosystem.

Apart from ecosystem goods, forests also provide a number of ecosystem services. Therefore, conservation of structures and functions should be a priority target of the ecosystem approach according to Principle 5. While in the past there has been a focus on the commercial function of forests, the protective, recreational and nature conservation functions now gain in significance. In contrast to the concept of multifunctional forest use, management practice still gives priority to ecosystem goods compared to ecosystem services.

The requirement of Principle 6 that ecosystems must be managed within the limits of their functioning is consistent with the requirement for management within the limits of sustainability. This means that an assessment depends on a tangible and measurable definition of sustainability. In the sense of quantitative sustainability this principle has already been implemented in Germany.

The natural life cycle in the forest ecosystem may easily cover several centuries. Thus, in line with Principle 7 time intervals of several generations represent the appropriate temporal scale for forest management to be sustainable. In various developmental stages of the forest, however, forest owners are unable to earn a profit. Consequently, certain phases are being deliberately shortened (regeneration phase) or even eliminated (old-growth phase) as a result of management activities but also because of legal obligations that support rapid reforestation. Respective laws should be amended.

Due to the ownership structure, forest management in Germany is practised on areas of extremely inhomogeneous size (ranging from a few acres to several thousand hectares). For the purpose of forest management, the forests are furthermore divided into various planning and operational units. Therefore, the implementation of appropriate spatial scales of management as postulated in Principle 7 will be a rather slow and lengthy process. On the model of a natural Central European forest, which can be described as a “mosaic” of various stages of succession, the area size chosen for interventions of forest management should primarily be aligned with the dimensions of this natural mosaic.

In view of the long temporal scales of ecosystem processes in forests, appropriate management must inevitably be set for the long term (as highlighted in Principle 8). This Principle is a logical consequence of Principle 7, and it seems therefore appropriate to treat those two principles as one.

In line with Principle 9 silviculture recognizes that management is dependent on natural site conditions, on disturbances due to natural events, and on resulting changes in the ecosystem. In addition, man-made phenomena will have to be increasingly considered in the future, although they are largely beyond management on a local level (e.g. climate change, atmospheric pollution), and must therefore continue to be discussed and dealt with on a higher level of both society and politics in order to arrive at strategies for their solution. Nevertheless, forestry will have to deal intensively with the issue of how to improve capacity for response and adaptation to changing ecological conditions.

The concept of multifunctional forest use allots equal importance to use and protection (thus following Principle 10 to seek the appropriate balance and integration of these objectives). However, this model of equivalence can hardly become operational in practice since as yet 90% of the proceeds from our commercial forests are obtained from timber sales. Thus, forest owners make little if any investments in the conservational functions and nature conservation in the forest. Concepts to launch a system of remuneration of ecological services, in particular in privately owned forests, should therefore be developed without delay. In addition, the implementation of zoning concepts must be followed up, comprising areas with different intensity levels of utilization.

Forest management in Germany is based on a long tradition of experience, traditional knowledge, and research, and is therefore compatible with Principle 11. Although there has always been some sort of feedback from research to practice, it is mainly the communicative aspect of the know-how transfer that needs to be improved in Germany. In the field of forest research more effort should be made to develop and promote intersectoral and multidisciplinary projects.

The involvement of all relevant sectors of society and scientific disciplines (Principle 12) has been, fairly successfully in this domain, predominantly on a regional, national, or even international level; whereas the involvement on a local level must be rated as rather poor due to the prevailing ownership structure. Since the involvement of the various relevant sectors of society is usually dependent on the consideration of knowledge and information, Principles 11 and 12 should also be treated as one.

Conclusions and Outlook

While, by and large, the principles of the ecosystem approach of the CBD are being taken into consideration in German forest management, there is certainly a need for further development in some fields.

In the assessment of forest use in Germany on the basis of the ecosystem approach, we encounter the basic problem that the wording of the principles and guidelines allows a host of different interpretations. The ecosystem approach in its current form may serve as a superordinate concept for further ecological optimisation of sustainable forest management in Germany. However, the results of the case study suggest that its wording is not tangible enough for the promotion or assessment of specific activities to integrate biological diversity considerations into forestry. Therefore, we recommend that the ecosystem approach be understood as a basic guideline for the integrated management of ecosystems rather than a *modus operandi*. While it is certainly possible to successfully employ the approach for introducing the concerns of the CBD into relevant policies, it may not be adequate as guidance for tangible projects due to its level of abstraction. Therefore, concrete guidelines, including, as appropriate, possible restrictions that are directed at specific ecosystems and forms of use need to be elaborated and implemented.

The strong points of the ecosystem approach might be seen primarily in the promotion of communication and discussion between the various stakeholders and actors. This approach may therefore, similar to the international approach for a National Forest Programme, serve to win the support of as many stakeholders as possible for the implementation of a broad range of sustainability objectives.

This study was supported by the German Federal Agency for Nature Conservation (BfN) with funds of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

References

Häusler, A., and Scherer-Lorenzen, M. (2001). Sustainable Forest Management in Germany: The Ecosystem Approach of the Biodiversity Convention Reconsidered. BfN-Skripten, Bonn.

27
MODEL FORESTS: DEVELOPING TOOLS TO ADDRESS BIODIVERSITY ISSUES

Canada's Model Forest Program
Natural Resources Canada, Canadian Forest Service
580 Booth Street, Ottawa, ON (Canada) K1A 0E4
E-mail: modelforest@nrcan.gc.ca
www.modelforest.net

Keywords: model forest, biodiversity, sustainable forest management, Canada, guidelines

Canada's Model Forest Program

The government of Canada, through Natural Resources Canada – Canadian Forest Service, launched Canada's Model Forest Program in 1992 to address the challenge of balancing the extensive range of demands we place on our forests today with the needs of tomorrow's generations. A network of model forests representative of Canada's diverse forest ecosystems was established to bring together, through partnership, individuals and organizations striving to make the goal of sustainable forest management (SFM) a reality. Each model forest in the Canadian Model Forest Network provides a forum where partners can gain an understanding of other stakeholders' views, share knowledge, and combine expertise and resources to develop innovative techniques, tools and approaches to SFM. Model forests act as giant, hands-on laboratories in which leading-edge techniques are researched, developed, and applied. The network also transfers the knowledge and techniques it develops so the benefits derived from its work can be shared with others.

MODEL FORESTS DEVELOP TOOLS FOR SUSTAINABLE FOREST MANAGEMENT

By exploring a wide range of technologies from remote sensing to state-of-the-art computer modelling, model forest partners are developing and demonstrating effective solutions to resource management issues. Canada's model forests have developed tools that have been adopted by forest managers, researchers and others, at home and abroad. Designed to meet the needs of diverse groups of partners, these tools tend to be more widely applied and readily accepted than those developed by only one organization. Tools developed by model forests include soil disturbance guidelines, a manual for inventorying woodlots, guides to developing indicators of SFM, alternative harvesting practices, and protocols for assessing water quality.

BIODIVERSITY RELATED TOOLS DEVELOPED BY MODEL FORESTS

The conservation of biodiversity is an important component of sustainable forest management. It has been highlighted as one of the primary criteria at both the international level through the Montréal Process Criteria and Indicators and at the national level in the Canadian Council of Forest Ministers' (CCFM) criteria and indicators framework. Many of the tools developed by model forests have focussed on biodiversity. Some of these include: GIS systems designed to assess biodiversity implications of forest management practices, guidelines to protect native biodiversity, and matrices linking wildlife and habitat in a fragmented landscape.

Biodiversity Assessment Project (Western Newfoundland Model Forest)

This Western Newfoundland Model Forest (WNMF) project will led to the development of a suite of tools to assess biodiversity implications of forest management practices. These strategic planning tools, developed in an ARC/INFO environment, describe the effects of different forest management strategies on landscape patterns and ecosystem diversity (coarse-filter) and will describe wildlife supplies (fine-filter) in the long run. Interpretation of outputs focus on ecosystem diversity and landscape patterns. Trends will be identified from outputs to develop guidelines in terms of rotation period, zonation, siliviculture intensity, patch shape and size distribution, and spatial layout of harvesting patterns on the landscape.

Forest Management Guidelines to Protect Native Biodiversity (Fundy Model Forest)

These guidelines were developed by the Greater Fundy Ecosystem Research Group, a Fundy Model Forest (FMF) partner, after considerable on-site research and a review of similar efforts. The guidelines are based on a belief that forest harvesting and biodiversity conservation can co-exist in the same landscape. At the landscape level, the guidelines consider elements such as patch size, connectivity, stand age and protected areas. Site-level considerations include snag and cavity tree retention, coarse woody debris and special status tree species. The guidelines include best management practices, nine overarching principles of biodiversity conservation, and tips for applying the suggestions to private woodlots. Many aspects of these guidelines have been incorporated into the management plans of the FMF landowners. J.D. Irving, Limited, for example, is working to replicate natural disturbance patterns as recommended in the guidelines.

Biodiversity Decision-making Tool (Bas-Saint-Laurent Model Forest)

Two types of learning algorithms, artificial neural networks and bin smoothers, were used to develop models for predicting bird assemblages, species richness and avian density in forests, based on two sets of geographic and forest variables. Such predictions constitute indicators of avian biodiversity, itself an indicator of overall biodiversity, which is essential information in assessing the condition of commercial forests. The models perform a range of predictions, from simple presence or absence of species to accurate forecasts of species densities. They use variables obtained not only from forest inventories but from the basic classification of satellite images. By drawing on these data and appropriate expertise, it should be possible to create a model that can predict the avian components of the various forest habitats of the Bas-Saint-Laurent Model Forest and characterize the avian biodiversity of its forest habitats.

Eastern Ontario Matrices Linking Wildlife to Habitat: A Biodiversity Management Tool (Eastern Ontario Model Forest)

Based on a study developed by the USDA Forest Service for New England forests, the Wildlife Habitat Matrices project identified links between particular wildlife species and their associated habitats within eastern Ontario. A field test of more than 100 forest habitat features was used to link habitat requirements of over 300 mammals, birds, reptiles and amphibians in eastern Ontario. The resulting computer model permits assessment of specific management practices / habitat manipulations on particular wildlife species. The matrices identify concerns of special species / species at risk as well as issues of human disturbance and habitat fragmentation for specific species. They also serve as a database assisting in the identification of potential species present in any given habitat within eastern Ontario.

WWW.MODELFOREST.NET

The four highlighted projects are only a small sample of the projects undertaken by the Canadian Model Forest Network. More examples and further information on Canada's Model Forest Program can be found atwww.modelforest.net

References

Bouvier, J. and L. Howes. 1997. Eastern Ontario Matrices Linking Wildlife to Habitat: A Biodiversity Management Tool. (Report can be requested at modelforest@eomf.on.ca)

Woodley, S. and G. Forbes (eds.). January 1997. Forest Management Guidelines to Protect Native Biodiversity in the Fundy Model Forest. (Bilingual) PDF download available at:
http://www.unb.ca/forestry/centers/cwru/opening.htm

28
SUSTAINABLE FOREST MANAGEMENT AUGMENTS DIVERSITY OF VASCULAR PLANTS IN GERMAN FORESTS

G.von Oheimb*, H. Ellenberg, J. Heuveldop***, W.U. Kriebitzsch****
*Institute for Ecology and Environmental Chemistry, University of Lueneburg, Germany;
** Institute for World Forestry, Federal Research Centre for Forestry and Forest Products, Hamburg, Germany;
*** Chair for World Forestry, University of Hamburg, Germany. –
E-mail: ellenberg@holz.uni-hamburg.de

Keywords: species diversity, vascular plants, forest management intensity, sustainable forest management Germany

Introduction

There exists a need in politics, administration, and in practice of forest management for knowledge and decision support information on conservation and sustainable use of biological diversity in German forests. Therefore the present study investigated the following hypotheses:

1) As a consequence of forest management, there exists a higher number of vascular plant species per unit area in the herb layer of managed forests in relation to ecologically comparable non managed forests.
2) With growing management intensity, species composition in vascular plants shifts towards higher fractions of indicator species for disturbance.

Methods

Vegetation analysis was conducted in 1997 and 1998 in broadleaved lowland forests of Northern Germany on rich soils (county of Herzogtum Lauenburg, east of Hamburg: “SH”) as well as on moderately rich soils (beech, *Fagus silvatica*, forests of the Mueritz National Park “MV”). Virgin forests do not exist in Germany. So, non-managed (at least for 30 years, up to more than 150 years) forests were contrasted against managed forests of different management intensity. The latter was measured among others as cubic metres of timber taken per hectare and per year. Soil quality and water supply as well as tree species composition and stand age were as comparable as possible. Contrary to no longer managed forests, thinning and final timber harvest were conducted in managed forests.

Results

In almost every comparison, higher mean species numbers per unit area were found in managed forests as opposed to no longer managed forests (Fig. 1 and 2).
In every investigated forest stand, managed or not, the widespread and frequent indicator species for the forest types of *Querco-Fagetea* and *Fagetalia* (“typical” forest species in a narrow sense)existed in similar densities. On the other hand, a significantly higher distribution and density was observed in managed forests for nitrophytes and for indicator species for light (open canopy) and for soil compaction (Tab. 1 and 2). The steadyness values of these latter species grows further with raising intensity of forest management (Tab. 1, Fig. 1).

Conclusions

Higher numbers of vascular plant species per unit area are possible in managed forests due to a better light climate in the herb layer as a consequence of forest operations for timber harvest that open up the canopy. Additionally, heterogeneous soil conditions (bare, accumulated, compacted, etc.) are caused by timber moving operations and a higher forest road density, both leading to better conditions for establishment and growth of vascular plants at least temporarily.

Most of the species found are well distributed "typical" forest species. Their occurrence appears not to be threatened in the investigated managed forests. Many of those species with better distribution and density in managed forests as opposed to non-managed forests – may be considered disturbance indicators in forests. In more intensely managed forests a ruderalisation of the herb layer vegetation may take place.

Literature

Oheimb, G. von, Ellenberg, H., Heuveldop, J., Kriebitzsch, W.U., 1999: Einfluss der Nutzung unterschiedlicher Waldökosysteme auf die Artenvielfalt und –zusammensetzung der Gefaesspflanzen in der Baum-, Strauch- und Krautschicht unter besonderer Berücksichtigung von Aspekten des Naturschutzes und des Verbissdruckes durch Wild. (*Influence of management of different forest ecosystems on species diversity and –composition of vascular plants in the tree- shrub– and herb layers – with special consideration of aspects of nature conservation and browsing by game*). In: Wichtige Einflussfaktoren auf die Biodiversitaet in Waeldern. Scholz, F.; Degen, B (editors). Hamburg: Max Wiedebusch Kommiss.-Verl.,1999, Mitt.Bundesforschungsanst. Forst-Holzwirtschaft, Nr. 195, p. 279 – 450.

Tab. 1: Steadiness of selected common vascular plant species in non-managed (NW) broad leaved forests and in comparable managed forests (WW) in the investigation area "SH" (n = 43 stands). Comparison between NW and WW by Fisher's Exact Test: *p<0,05; **p<0,01; ***p<0,001. – „Typical" forest species are underlined. WW1 = less intensively managed (mean yearly timber harvest between 0,8 and 7,5 cubic metres per hectare). WW2 = more intensively managed (3,5 – 17,6). – "Anm." = remarks: N = nitrogen indicator plant; V = indicator for soil compaction; L = indicator for light/opened canopy.

	NW	WW 1	WW 2	Anm.
Acer pseudoplatanus	28	43***	39**	N
Deschampsia cespitosa	25	34	36*	V
Galium aparine	15	21	35***	N
Melica uniflora	14	34***	40***	
Urtica dioica	14	22	37***	N
Carex remota	10	21*	38***	V
Geranium robertianum	6	10	19**	N
Rubus idaeus	3	25***	33***	L
Stachys sylvatica	2	24***	24***	N
Rubus fruticosus agg.	0	22***	24***	L
Stellaria nemorum	0	18***	24***	N
Juncus effusus	0	10**	16***	V

Tab. 2: Steadiness of selected common vascular plant species in non-managed beech forests (*Fagus sylvatica*) in the investigation area "MV" (n = 75 stands). For further comments see Tab.1.

	NW	WW	Anm.
Moehringia trinervia	40	57**	N
Quercus petraea	33	48*	
Carex pilulifera	28	42*	
Calamagrostis epigejos	23	59***	L
Oxalis acetosella	22	40**	
Agrostis capillaris	17	40***	L
Urtica dioica	15	42***	N
Sorbus aucuparia	15	27*	
Luzula pilosa	14	26*	
Dryopteris carthusiana	12	32***	
Deschampsia cespitosa	10	22*	V
Rubus idaeus	7	23**	L

Fig. 1 and 2: Species-area-relationships for vascular plants in the herb layer in different ecologically comparable beech-dominated forests in Northern Germany. Fig. 1: situation on richs soils, region "SH". Fig.2: situation on modrately rich soils, almost pure beech, region "MV".- The compared forests differ in management intensity as measured by the mean (17 years) amount of timber harvested per hectare and per year (figures give cubic metres of timber).

Figure 1:

Rich soils, mainly mixed beech forests, management intensity quite different (0 to 17.6 m³ timber harvested/HA/year).

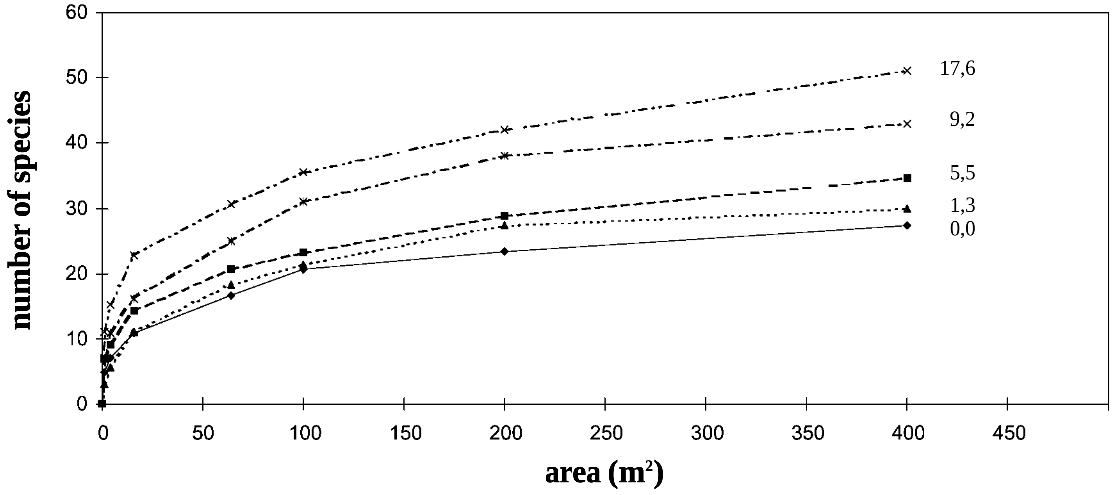
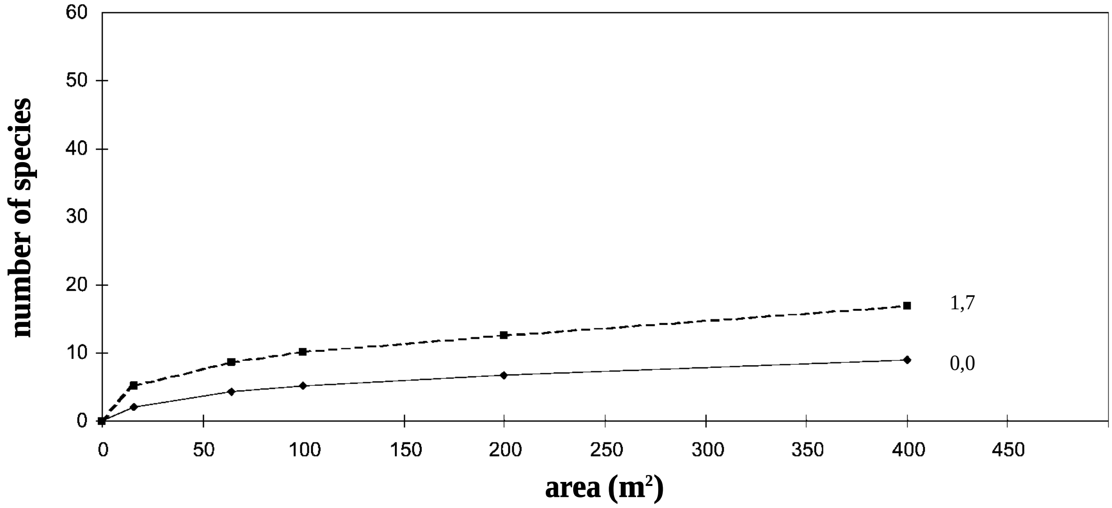


Figure 2:

Moderately rich soils, almost poor beech forests, management intensity very low (0 to 1.7 m³ timber harvested/HA/year) to zero.



29
INTEGRATED FOREST RESOURCES MANAGEMENT AND UTILISATION BY RURAL COMMUNITIES IN MALAWI

Samuel Kainja*
Forestry Department, Box 30048, Lilongwe 3, Malawi
E-mail : skainja@malawi.net,
Tel : (265) 771 000, Fax : (265) 772 656

Keywords : participation, sustainable, incentive, deforestation, degradation.

From time immemorial, Government of Malawi was the main producer of forest goods and services through Forestry Department. It became clear early 1990's that Government was not able to produce sufficient forest goods and services single-handed. With the revision of Forestry Policy in 1996, emphasis has now been on creating conducive environment for the active participation of all stakeholders, including rural communities, in forest resources management.

In Malawi, local communities are the major beneficially of forest goods and services. Forests goods and services are exploited often in unsustainable way for consumption and for sale. The majority of rural communities are poor and poverty contributes to environmental degradation through unsustainable woodfuel and charcoal production for sale and domestic consumption. Malawi is one of the Highly Indebted Poor Countries (HIPC) . The key problem in dealing with this major stakeholder is how to provide tangible incentives in order to promote active and sustained participation in forest management and at the same time enable them meet their needs. This calls for urgent community empowerment to manage and utilise forest resources in a sustainable way.

One of the successful initiatives aimed at promoting community participation in forest management started in 1996 in Mwanza District (Mkamanga, 2001). A total of five villages are involved in Sustainable Management of Indigenous Forest Project. This Project was developed as a joint exercise involving Forestry Department, as a Government institution, the Germany Government as a donor and Wildlife Society of Malawi, a Non-Governmental Organisation, as the implementing agency. With the support of Wildlife Society of Malawi, rural communities have established local institutions that are responsible for planning and implementing development activities that revolve around forest resources management. Rural communities are involved in commercial activities such as bee keeping, guinea fowl raring, tree planting and production of fruit juice from indigenous fruits of *Adansonia digitata and Tamarindus indica.* The Project has diverted the communities from sorely depending on roadside sale of charcoal and firewood, which was resulting in deforestation and degradation of the forest.

Financial gain from commercial activities has become a sustainable incentive for community participation in sustainable conservation of forests. Every month some of the financial gains are used for community development work while some cash is shared among the participants of the Project. As a result, of tree planting and forest management, the forests are now recovering from degradation and deforestation.

Reference

Mkamanga, G and Chimutu, P. (2001) Sustainable management of indigenous forests : Mwanza East community based natural resources management: Project Evaluation mission; Final evaluation report.

30
MANAGEMENT OF BIOLOGICAL DIVERSITY AT TSAMBA FOREST RESERVE

J.S. Kamwendo, A.C. Chikuni*
NHBG, P.O. Box 528, Zomba, Malawi
Central Africa

Keywords: Management; sustainable use; Biodiversity; Tsamba; Malawi.

Abstract

Forests are habitats for a wide range of plant and animal species. They are sources of wild food (e.g. fruits, vegetables, tuber, honey, fodder, insects and meat), medicine, fuelwood, building and construction materials, timber, arts and crafts materials and charcoal.

This biodiversity is however under threat due to agricultural expansion, followed by food and fuelwood demands. In addition, forest encroachment for settlement and poaching also pose great threat on the biological diversity. It is on this basis that a project entitled Management of biodiversity in Protected Areas of Malawi funded by GTZ was established. The project is executed in three pilot study areas, namely Tsamba, Ntchisi and Mughese forest reserves. This paper focuses mainly on Tsamba forest reserve because it is where more data has been collected. The objectives of this project are to document all the biodiversity found in these three forest reserves and to address massive loss of useful biodiversity through collaborative management. To fulfill these objectives, local communities around the study area "Tsamba forest reserve" were interviewed using questionnaire, Participatory Rural Appraisal (PRA), transect walks in the forest and construction of quadrats. These methods were used to collect information on composition of the biodiversity in the study area, useful biological diversity and their abundance.

Preliminary results of Tsamba forest reserve show that a total of 388 tree, shrub and herbaceous species from 165 and 56 families have been recorded. 10 grass species have also been recorded. A total number of 32 birds from 13 genera, 21 animal, and 83 insect species have been recorded. Out of the 83 insects recorded, only 17 are edible. Tables 1 and 2 show plant and animal species, which are mostly preferred by the local communities around the forest reserve for food, fuel, construction material, timber and making charcoal.

Introduction

Malawi's forests occupy 3.6 million hectares of land and 97% of forest cover are indigenous forest, mostly Miombo woodland (DREA, 1994). Of the total forest cover, Mwanza district contributes approximately 231,025 hectares (Anon, 1993a). There are two gazetted forest reserves in Mwanza, Tsamba and Thambani. Tsamba is 3,237 hectares whilst Thambani is 10,670 hectares. This indicates that over 217,118 of Mwanza forest cover is under customary land tenure (Sitaubi, et al, 1995).

Mwanza district is in the Southern region of Malawi and has a population of 138,015.The population density of the district is 116 people per square kilometre (Malawi Government, 1998). The people practice subsistence agriculture. They cultivate maize and potatoes for food, tangerines and cotton for sale. Like most Malawians, the people of Mwanza live below the poverty line and as such rely on forestry resources for a living. It is thus not surprising that rural communities around this forest reserve unsustainably collect fruits (e.g. *Parinaria curatelifolia*, *Uapaca kirkiana, Annona senegalensis*, *Flacourtia indica*, *Ximenia caffra*), vegetables, mushrooms and other non-forest products (e.g. edible insects, birds, rodents and bush meat) to supplement their diet. The forests are also a source of firewood and charcoal. Mwanza district is considered the main charcoal producer in the Southern Region of Malawi.

Tsamba forest reserve was selected for this research because of its richness in biological diversity and very little information available about its biodiversity and it is utilised.

Preliminary results have shown that 13 plant species are preferred for charcoal production, 8 species are used as source of fruits, 13 mushroom species are collected for food and sale, 5 plant species are source of vegetables, 19 animal and 17 insect species are used to supplement protein. See the tables below:

Table 1:

A List of Plant Species Used in Charcoal Production

MOST PREFERRED SPECIES	
Sclerocarya bimea	*Acacia regrescens*
Diptorrhynchus condylocarppon	*Loncocarpus capassa*
Brachystegia boehmii	*Pterocarpus angolensis*
Julbernardia globiflora	*Pterocarpus rotundifolia*
Combretum imberbe	*Periscorpusis angolensis*
Combretum molle	*Terminaria serricea*
Diospyros kirkii	

Table 2:

List of Animal and Insect Species Preferred by Local People at Tsamba Forest Reserve

ANIMAL SPECIES	INSECT SPECIES
ANIMALS	
Geochelone pardalis	*Acraea baxteri*
Lexodonta Africana	*Epizygaena procrioides*
Tatera	*Isolabis meredithi*
Civet cats	*Dromica laterodeclivis*
Squirrels	*Neochila kigonserana*
Acomys	*Prosopocoilus natalensis*
Bush pigs	*Aphodius auriculatus*
Monkeys	*Didymus sansibaricus*
Hares	*Ropaloteres nysa*
	Trox pusillus
BIRDS	*Copris sp*
Turter chalcospilos	*Cylindera marshallisculpta*
Columbia guinea	*Macrotermes sp*
Tripias namaguus	*Gryllotalpa gryllotalpa*
Nectarinia vilolacea	*Mimnermus sp*
Tchagra australis	*Carebara vidua*
Streptopelia capicola	*Brachytrypes membraneus*

CONCLUSION:

The initial study, which has been undertaken, has shown that Miombo woodlands of Tsamba forest reserve are greatly threatened due to charcoal production. In addition, non-forest products such as wild animals and insects, which are edible are unsustainably collected and most of them are now non-existent. Based on this information, that is why this project was established to document the biodiversity of Tsamba and to address loss of biological diversity in the study area.

References

Anon (1993), Forest Resources, Mapping and Bioman Assessment for Malawi, Satellitbild, Kirona, Sweden and Department of Forestry, Lilongwe, Malawi.

Malawi Government (1994), Deapartment of Research and Environmental Affairs. National Environmental Action Plan, Volume 1, Malawi .

Sitaubi, L., Steward, M. and Coote. H. (1995). The Role of Miombo Research Woodland in Malawi, National Development, Climate Change and Research.

31
SUSTAINABLE USE CONSERVATION BENEFITS WILDLIFE, HABITATS, AND PEOPLE

Stuart A. Marks
Department of Wildlife Conservation
Safari Club International Foundation
441 E. Carlisle Drive
Herndon, VA 20170 USA

Keywords: sustainable use, wildlife conservation, solutions through partnerships, equity

Hunters as Active Agents in Sustainable Use Conservation

The use of wildlife, which has occurred since the beginning of humankind, can provide strong incentives for conservation around the world. The Convention on Biological Diversity links wildlife conservation with sustainable use and the equitable sharing of benefits from such uses. Sport hunting is widely recognized by scientists, professional conservationists, and rural communities as an important form of sustainable use. Sport hunting provides a major source of funding for wildlife and habitat conservation including forest lands, stimulates local economies in remote rural locations in the United States and around the world, and provides incentives for conservation for many species. In the United States, hunters contribute their time, effort, and money (more than $440 million annually through taxes and license fees) directly to wildlife.

Hunting and the Recovery of Species

In the United States, sport hunting has been a major factor in the recovery of many species- including white-tailed deer, elk, and wild turkey. In addition, many other species- such as bald eagles, beaver, and bluebirds- have benefited from the conservation programs supported and developed by sportsmen. In southern Africa, some species of wildlife (white rhino, elephants, red hartebeest) have recovered in numbers and are now are part of conservation programs funded by hunters. Other species (black rhino, cheetah, some elephant populations) may be featured in projects supported by hunters, but not taken by them.

Hunting and the Distribution of its Benefits

Sport hunters contribute some US$68 million dollars to the economy of Namibia (Ashley & Barnes 1996), $130 million to Tanzania (Leader-Williams 1996), and $139 million in Zimbabwe (Muir et al 1996). Although the capacity for sport hunters and tourists to generate national and commercial benefits is well-known. A high national value is not alone sufficient to ensure that wildlife and habitats will be conserved for they are often balanced in favor of the people who live outside wildlife areas and often outside bio-diverse countries.

Throughout sub-Saharan Africa, the incidence of poverty and unemployment is high with sources of income and subsistence limited. Often people living in wildlife areas are economically marginalized with insecure livelihoods. Here even if wildlife has intrinsic or existence values, these values alone may not be sufficient incentives for rural people to conserve it and the habitat. The absence of direct incentives may mean that rural people are unable to afford conservation; destroying wildlife may make more economic sense than conserving it.

Most recent wildlife initiatives in southern Africa have been nominally community-based . Programs such as CAMPFIRE in Zimbabwe and ADMADE in Zambia have attempted to overcome past inequities in wildlife benefit distribution. These programs mainly rely on indirect methods of distributing wildlife benefits to landowners, either as individuals or corporate groups, in cash or infrastructural developments (clinics, schools, wells, etc.) or in combination with other community incentives such as permitting limited wildlife use or employing local people as wildlife workers or protectors. While these development benefits may improve community welfare and lead to short term improvements, they neglect the local forces motivating wildlife and habitat loss. Three important factors are the nature of livelihood systems in wildlife areas and the form in which wildlife benefits are received, the costs that wildlife incurs on local livelihoods, and the broader policy factors which influence local land use and economic activities (Emerton 2000).

Safari Club International Foundation and its Contributions to Change

Safari Club International Foundation (SCIF) is dedicated specifically to conservation, education, and humanitarian services. SCIF operates a cutting-edge wildlife conservation program that will spend over US$400,000 in 2001 in project around the globe. These projects are intended to work on major issues in conservation, to gather information on wildlife conservation, and to demonstrate how sustainable use, including sport hunting, benefits wildlife conservation. These projects range from quality deer management in the state of Michigan to local villager involvement and knowledge in monitoring wildlife and in setting sustainable hunting quotas in rural Zimbabwe. A few examples of project are:

Capacity-building among rural villagers in wildlife management (CAMPFIRE in Zimbabwe):

Problem addressed through partnering with governments, NGO's, CAMPFIRE Association, and District Councils to provide training and manuals for assessing wildlife numbers and establishing offtake quotas.

Community-Based Wildlife Management Assessments:

Poaching, competition with livestock, and farming are reducing wildlife and its habitat; coercive conservation efforts are failing in most places; while governments are demanding increased community involvement and benefits. Problem approached through the case studies and best practices, monitoring and supporting new initiatives in Pakistan, South Africa, Zambia, and Botswana, and through the development of new models of sustainable use in appropriate areas.

Argali and Urial Populations in Central Asia

Widespread but thinly distributed species beset by poaching and livestock competition; also political pressure to eliminate sustainable use options. SCIF provided support costs for workshop and surveys to develop new management plans reflecting of these conditions.

References

Ashley,C. and Barnes,J. (1996). Wildlife Use for Economic Gain: the Potential for Wildlife to Contribute to Development in Namibia, Research Discussion Paper No. 12, Directorate of Environmental Affairs, Windhoek

Emerton, L. (2000). Community Conservation Research in Africa: Principles and Comparative Practice, Paper no 9. Institute for Development Policy and Management, Manchester, UK.

Leader-Williams, N. (1996). Wildlife Utilization in Tanzania. Paper presented at workshop on Costs and Benefits of Wildlife in Africa, Lewa Downs

Marks, S. (1999). Contextual Factors Influencing a Rural Community and the Development of a Wildlife Management Regime in Zambia (1987-1997), Journal of Environmental Policy & Planning 1:235-246.

Muir, K., Bojo, J. and Cunliffe, R. (1996). Economic Policy, Wildlife and Land Use in Zimbabwe, in The Economics of Wildlife: Case Studies from Ghana, Kenya, Namibia, and Zimbabwe, edited by J. Bojo, World Bank, Washington, D.C.

32 LANDSCAPE-ECOLOGICAL APPROACH TO CONSERVATION OF BIODIVERSITY IN THE KARELIAN ISTMUS

Valeri Sergienko
Forestry Research Institute, 21 Institutsky pr., 194021 St. Petersburg, Russia,
E-mail: spb330@spb.sitek.net

Keywords: Landscape-ecological planning, ecology, nature protection, rare plants

The problems of nature protection and use of natural resources under landscape-ecological planning of forestry in the Karelian Isthmus in the Leningrad region are considered. A tendency to go to landscape principles of forest management is taken into account. Complex of aims, connected with "ecologization" of forestry, includes theoretical elaboration of criteria and indicators of conservation, management and sustainable development of the regional forests with taking into account rational distribution of specially protected natural areas (SPNA) and working out effective measures on conservation of biodiversity ecosystem landscapes (plants, animal and microbiota)

Conservation of biodiversity, providing ecological safety and stability of the region are important conditions under landscape-ecological planning and forming the net of SPNA. The system of SPNA must be projected with taking into account all various types of protection-needing landscapes and natural complexes. This system must be a net of interdependent natural objects connected with each other by ecological corridors in the form of protective belts along rivers and lakes or as forests of the Ist group where forest exploitation is strictly limited. River net, watersheds in the form of bog systems and forest-protection zones are also such corridors.

The distribution of SPNA in the isthmus is irregular. Most of them are situated in the southern half. Few protected areas were established in districts that have boundaries with Finland, in the north, and in Priladozhsky district of the isthmus. On the whole, the area of SPNA in the isthmus occupies only 2.7% of the region area. The area of SPNA is 108000 ha, including forest protective plots, protection zones of reserves and water-protection territories. Forest protective plots include environment-protection categories of forests where harvest cutting is prohibited, border belts with full or partial prohibition of cutting, the water expanses of the Gulf of Finland, protection belts along roads, and others.

Realization of Russian-Finnish project on developing the stable tourism in the Karelian Isthmus will allow sanctuary Lindulovskaya Grove that was listed among the objects of the world heritage by UNESCO and other SPNA to become one of the objects of natural international tourism. European Union finances this direction within the TACIS project. Realization of the project will allow to decide a number of recreational questions in the Karelian Isthmus.

In the Karelian Isthmus the system of SPNA, in international meaning, is not developed enough. There are not any reserve and national natural park by classification of The World Conservation Union (IUCN) here. The status of protected objects here is lower than in IUCN system. However, there are a number of unique territories that should be given higher protection status (Sergienko 2000). Organizing SPNA of higher status is possible in the future.

At the present time, Nature Conservation Complex Scheme of Leningrad Region (KSOP) is being elaborated till 2005, including the Karelian Isthmus. Of 56 existing and 57 projected and proposed SPNA in the region, 19 SPNA exist, 9 SPNA are being projected and 6 proposed for including in the system of SPNA in the isthmus (Red Data Book, 1999). Among SPNA existing in the Karelian Isthmus there are 10 regional sanctuaries, 8 natural monuments and 1 dendrological park. Protection regime here prohibits or limits forest cuttings, melioration works and changing hydrological regime, building works, hunting as well as other forms of human activities damaging natural complexes.

The system of SPNA is based on including the set of landscapes, unique ecosystems and natural objects with rare and endangered plant and animal species, as full as possible. The aims of conservation of ecosystems and biota are: 1. Conservation of key (environmental) plots with stop-over sites, and White Sea-Baltic migration ways of birds; 2. Maintenance of reproduction of marketable animals and fishes; 3. Forming zones of regimented recreation in areas of traditional visit of people; 4. Conservation of environment around cultural-and-historical objects and plots of river banks, as well as seaside and islands of the Gulf of Finland and Lake Ladozhskoye where biological productivity is high; 5. Protection of plots with rare and protected animal and plant species concentration.

Under quite difficult anthropogenic conditions in the Karelian Isthmus, a problem arises of establishing the optimal number of SPNA of small area (sanctuaries, natural monuments and mini-reserves on the basis of existing protected areas or other interesting objects). Pressure of economic activities on natural ecosystems of the Karelian Isthmus and its considerable dispersal on the territory does not allow to establish here large reserves (Sergienko, 1999).

About 1100 wild vascular plant species of 115 families in total have been registered in the isthmus (Illustrated key, 2000, Red Data Book, 2000). The flora was formed during the degradation of the last (Valdai) glacier in the post-glacial period. The flora has a distinctly migratory character and include a number of very rare and protection needing species. Zone taiga plant species are predominant. Some of species are relict.

Analyses of floras of SPNA and publications concerning protected areas showed out that 112 rare and protected vascular plant species (of 204 vascular plant species needing protection in Leningrad region) have been revealed in the Karelian Isthmus (Red Data Book, 1993, 2000, Kotiranta *et al.* 1998). Red-listed plant species of the Karelian Isthmus are distributed as follows: extinct (or probably extinct) (5 species), endangered (11 species), vulnerable (38 species), rare (58 species).

Among the rare and protected species of the isthmus of flora there are plants with a wide habitat range: forests, meadows, bogs, rocky outcrops, pebbles, seaside, typical and intrazonal plant communities. Many of the rare species in the region needing protection are located outside, or on border of, their own natural.

Finding rare and protected plant in SPNA is the basis for monitoring and protecting rare, relict and endangered species in the region. At the same time, the aim to conservation rare plant communities of natural ecosystems unique by their importance and ecologically susceptible must be reached. Protection of such objects is necessary for conservation of historically formed biodiversity and for the balance of coenofund in nature.

Effective functioning of SPNA on the region, and managing them, depends on their importance for conservation of the most susceptible ecosystems against the anthropogenic influence. Integrating the net of SPNA of Russia in general European system of protected areas is need. It is actual for the considered region, which borders on the Baltic countries and Finland.

References

Illustrated key to plant of the Karelian Isthmus. 2000. SPb. 478 p. (In Russian).

Kotiranta, H., Uotila, P., Peltonen, S.L. 1998. Red Data Book of East Fennoscandia. Helsinki. 351 p.

Red Data Book of the Baltic Region. 1993. Upsala, Riga. 95 p.

Red Data Book of Nature of the Leningrad Region. Protected Areas. 1999. SPb. 1. 352 p.

Red Data Book of Nature of the Leningrad Region. Plants and Fungi. 2000. SPb. 2. 384 p.

Sergienko, V.G. 1999. Problems of ecosystems protection in the Baltic Region. In: The Book of Abstracts. Biological basis of the study, management and protection of flora, fauna and the soil cover in Eastern Fennoscandia. Petrozavodsk. p. 45-46. (In Russian).

Sergienko, V.G. 2000. Formation of system of specially protected natural areas under landscape-ecological planning for Karelian Isthmus. In: Proceedings Saint-Petersburg Forestry Research Institute. 1 (2). SPb. p. 120-131. (In Russian).

33
FAO AND THE BUSHMEAT CRISIS

ElHadji Sène and Douglas Williamson
Forestry Department, FAO, Rome
E-mail:douglas.williamson@fao.org

Keywords: Bushmeat, FAO, agriculture

Introduction

The formation of groups like the Ape Alliance and the Bushmeat Crisis Task Force, the establishment of a CITES Working Group on bushmeat as a trade and wildlife management issue, the predictions of primate extinctions and regular media reports of the devastation of forest wildlife, create an aura of crisis about the wild meat issue. The purpose of this paper is to consider what the implications of this situation are for FAO and to explore appropriate responses to it.

Wild meat is directly relevant to FAO's mandate in at least two contexts. The first is the context of food security, the second is the context of forest conservation, broadly defined to include sustainable forest management.

Wild meat and food security

There is copious evidence that wild meat is an important component of the dietary intake of many people [e.g. Barnett 1997, Bennett & Robinson 2000, Caspary 1999a and 1999b, Caspary et al. 2001, Hofmann et al. 1999, Ntiamoa-Baidu 1997, Ojasti 1996]. In some countries wild meat is the basis of a substantial business. In Côte d'Ivoire, for instance, it was estimated that in 1996 around 120,000 tonnes of wild meat was harvested by over a million hunters [Caspary 1999b]. This was more than twice the yearly production of meat from domestic livestock, and its market value of around US$ 150 million represented 1.4% of the gross national product. But even though the cash value of wild meat can be substantial, this does not necessarily capture the full value of the contribution that wild meat makes to the well-being of poor rural people [Barnett, 1997].

In the sense of being a dietary component, wild meat is directly related to food security, but the relationship is not a simple one. The importance of the contribution that wild meat makes to food security is greatest where it is the only or the main source of animal protein and is difficult to replace. Importance to food security declines when wild meat is simply one of a number of interchangeable choices that are readily available to the consumer.

Wild meat also contributes indirectly to the food security of those who derive some or all of their income from the harvesting, distribution, sale and/or marketing of wild meat. The magnitude of its contribution to the food security of such people depends on what proportion of their income it provides and how readily it is replaceable as a source of income.

Another way in which wild meat [in the form of animal parts] can contribute indirectly to food security, is through its role in the practice of traditional medicine, which provides livelihoods for many people.

Since wild meat manifestly contributes to food security and is derived from wild animals, which are a component of biodiversity, this is one way in which there is an unequivocal link between biodiversity and food security. There are other linkages between biodiversity and food security, but they are not relevant to this paper.

Because wild meat manifestly contributes both directly and indirectly to the food security of many people, a decline in the availability of wild meat to the people who depend on it will have a negative effect on food security. This must be a cause of concern for FAO.

Wild meat and forest conservation

In FAO's constitution agriculture is broadly defined to include fisheries and forestry, which means that forest conservation and sustainable forest management fall squarely within its mandate. Sustainable use of biodiversity is seen as an important tool for facilitating conservation by reconciling it with the needs and expectations of rural people. This reconciliation is achieved only if the use of biodiversity is indeed sustainable. The many indications that the harvesting of wild meat is often unsustainable thus have negative implications for the successful reconciliation of conservation with the needs of rural people.

Unsustainable use of wild meat also has negative long term implications for the maintenance of forest biodiversity. The radical depletion of forest animal species, known as "the empty forest syndrome", is increasingly prevalent, afflicting even protected areas like the Korup National Park in Cameroon [Terborgh 1999]. Since forest animals play important roles in ecological processes such as herbivory, predation, pollination and seed dispersal and germination, the loss of forest animal species will eventually be followed by the loss of the plant species that depend on them in one way or the other.

This is a further cause for concern.

What FAO is doing about the Bushmeat Crisis?

FAO's current and planned activities in response to the Bushmeat Crisis involve working with partners to address the issue at all levels from policy, legal and institutional considerations to working directly on the ground through projects. Recent and ongoing activities include:

- holding an FAO/IUCN/TRAFFIC workhop on bushmeat in Cameroon during October 2001;
- developing a checklist of crucial policy, legal and institutional considerations which must be addressed to facilitate improved sustainability of the use of forest wildlife;
- holding of national workshops to develop national action plans addressing the bushmeat issue;
- developing a substantial project to address the bushmeat issue on the ground and strengthen the World Heritage Programme in the Congo Basin in partnership with UNESCO, the United Nations Foundation and a number of key international conservation NGOs.

It is expected that FAO involvement in the bushmeat issue will grow in the coming years.

References

Barnett R ed. [1997] FOOD FOR THOUGHT: The utilization of wild meat in Eastern and Southern Africa. Nairobi: Traffic East/Southern Africa.

Bennett E L & J G Robinson [2000] *Hunting of Wildlife in Tropical Forests*. World Bank. Biodiversity Series – IMPACT STUDIES, Paper No. 76

Caspary H-U [1999a] *When the monkey 'goes butcher': hunting, trading and consumption of bushmeat in the Tai National Park, Southwest Cote d'Ivoire.* In: Seminar Proceedings '*NTFP Research in the Tropenbos Programme: Results and Perspectives*', M A F Ros-Tonen ed., pp 123-130. Wageningen, Netherlands : The Troppenbos Foundation.

Caspary H-U [1999b] Utilisation de la faune sauvage en Cote d'Ivoire et Afrique de l'Ouest – potentiels et contraintes pour la cooperation au developpement. Eschborn: GTZ.

Caspary H-U, Koné I, Prout C and M de Pauw [2001] La chasse et las filière viande de brousse dans l'espace Tai, Cote d'Ivoire. Tropenbos-Cote d'Ivoire Série 2. Abidjan: Tropenbos-Cote d'Ivoire.

Freese C H [1998] Wild Species as Commodities: Managing Markets and Ecosystems for Sustainability. Washington DC; Covelo, California: Island Press.

Heymans J C [1996] L'élevage de l'aulacode **[***Thryonomys swinderianus***]**. Cahier Conservation No 31. Rome: FAO.

Hofmann T, Ellenberg H and H H Roth [1999] Bushmeat: A natural resource of the moist forest regions of West Africa – With particular consideration of two duiker species in Cote d'Ivoire and Ghana. Eschborn: GTZ.

Ntiamoa-Baidu Y [1997] *Wildlife and food security in Africa*. Conservation Guide No. 33. Rome: FAO.

Ojasti J [1996] *Wildlife utilization in Latin America* – Current situation and prospects for sustainable management. Conservation Guide No. 25. Rome: FAO.

Smythe N y O Brown de Guanti [1995] *La domesticación y cría de la Paca* **[***Agouti Paca***]**. Guía de Conservación No. 26. Rome: FAO.

34 FORESTRY IN THE BRAZILIAN AMAZON: AN ADDED PRESSURE ON FOREST BIOLOGICAL DIVERSITY[6]

Boris Romaguer
Institut des sciences de l'environnement
Université du Québec à Montréal
C.P. 8 888 Montréal
Québec H3C 3P8 Canada
E-mail : Boris.Romaguer@biodiv.org

Keywords: Sustainable forest management, sustainable yield management, plantations, tropical ecosystems, barriers, opportunities.

Introduction

The Brazilian Amazon, an administrative area of 5 million km^2 henceforth referred to as Amazonia, is renowned worldwide for its exceptionally rich biodiversity and for being one of the world's largest remaining area of pristine tropical forests. It is also well known for its alarming rate of deforestation. Indeed, the average annual deforestation rate in Amazonia during 1978-1988 was 20 000 km^2. Although this rate declined at the beginning of the 1990's, it has since increased again and the latest figures indicate 19 836 km^2 were cleared from 1999 to 2000. Assuming that the loss of forest biodiversity is grossly related to forest cover loss and that several biodiversity hotspots are located among the cleared areas, it is safe to suggest that Brazil is rapidly losing many of its forest species.

Historically, governmental incentives to populate the area and to convert it to agricultural lands were the major forces behind this deforestation. However in recent years, the tax incentives and subsidies that prompted this deforestation have been reduced. Besides the pressure of agriculture, at present, mining, industrial activities and especially logging for timber are becoming increasingly significant in the deterioration of forests in Amazonia. Although all these human activities exert a significant pressure on Amazonia's biodiversity, this paper focuses exclusively on forestry.

Some factors responsible for the emergence of forestry in Amazonia include the increasing commercial value of tropical trees, and their increasing demand in southern Brazil and in industrialized countries (mainly Japan, Europe and the United States). Other factors include the gradual depletion of forests in Southeast Asia and southern Brazil as well as the fiscal incentives in the lumber sector provided by the Brazilian government.

Particularities of forestry in Amazonia

Since Amazonia is essentially composed of tropical forests, which are inherently complex systems, carrying out sustainable forestry in such ecosystems can be considerably more challenging than in temperate and boreal forests. Challenges include: large number of tree species, many of which being non-commercial; rapid and luxuriant growth of vines and creepers in the open spaces created by felling; fragility of the soils and its vulnerability when fully exposed; difficulties of access and difficulties with natural regeneration. Consequently, the cost for sustainably managing tropical forests is higher than in temperate and boreal forests, which makes it particularly difficult when the countries possessing tropical forests tend to have fewer financial resources.

[6] This study was carried out while the author was an intern at the Secretariat of the Convention on Biological Diversity.

Forestry trends in Amazonia

The forestry trends emerging in Amazonia are unsustainable selective logging, plantations and to a very limited extent, sustainable yield management and sustainable forest management.

Selective logging, where the most valuable species are extracted, has become the most common form of forestry in the region. This unsustainable harvesting does not take any precautions to regenerate the tree species that were extracted. According to a study carried out in 1999, more than 10 000 km^2 of forests in Amazonia were stripped of their most valuable trees. Selective logging started in the inundated areas (*várzea*) and has since the 1970's expanded to the non-inundated areas (*terra firme*). However, research suggests that selective forestry should be maintained in the várzea as much as possible because they have fewer tree species; are densely stocked with timber; grow more rapidly and the damage to the canopy and ground during logging is less severe than in *terra firme*.

Forest plantations are often hailed as the solution to the silvicultural problems associated with the tropical forests. Indeed, they are more productive and are capable of greater final wood volume per unit area, reducing the area of human disturbance. However, plantations in Amazonia tend to be established on natural forests instead of on already degraded land, which reduces the local biodiversity. Furthermore, since plantations tend to be composed of monocultures, they are vulnerable to environmental disturbances such as soil fertility, climate, disease and pests, the latter two being particularly prevalent in the tropics,. All the attempts of establishing large-scale plantations in Amazonia have failed. Examples include the rubber plantation of Fordlandia that was abandoned after a fungal outbreak and the Jari plantation of non-native softwood species which gave yields much lower than expected. More recently, 50 000 km^2 of natural forests are being replaced by plantations in order to provide charcoal in the Projeto Grande Carajás and this project is likely to be doomed by natural disasters.

Sustainable yield management focuses on providing sustainable amounts of timber. This type of forestry was not initially successful in Amazonia because the Brazilian government chose to promote forest plantations and agriculture by various incentive measures. Several large-scale sustainable yield management projects in Amazonia have failed, namely the pilot project initiated by FAO and the Brazilian government of the Tapajós National Forest.

Sustainable forest management strives to preserve not only timber resources but also biodiversity and other natural systems such as aquatic systems and climate. In effect, this management, also known as "reduced-impact logging" is a refinement of sustainable yield management based more on a holistic ecosystemic multi-resource, and multi-service approach. Examples that come closest to such management are the extraction techniques employed by Precious Wood in Itacoatiara near Manuas and the Rosa Group in Paragominas which is now applying for certification by the Forest Stewardship Council.

Barriers and opportunities in establishing sustainable forestry in Amazonia

Amazonia will have to surmount various barriers in order to establish sustainable forestry. The most notable examples of environmental barriers are difficulties in monitoring and assessing logging activities; wastes in logging operations and in sawmills as well as mercury contaminations caused by soil erosion after cuts. Sociological barriers include corruption, population growth and an outdated agrarian system. Economic barriers include uncontrollable timber prices, inappropriate stumpage fees, and the undervaluation of rainforest goods and services. The political barriers include an absence of a central land register as well as underfunded and overburdened governmental institutions, resulting in their inability to enforce regulations.

There are also opportunities for sustainable forestry in Amazonia. Environmental opportunities include adoption of standards such as certification, technological transfer for better monitoring and harvesting equipment, promotion of non-timber forest products and agroforestry. Sociological opportunities include educating the forest workers and managers of the importance of work safety and sustainable forestry practices. Interesting economic opportunities considered were eco-tourism and the debt-for-nature swap where industrialized nations agree to reduce the debt of a rainforest country if the latter agrees to use an equal amount of local currency to fund environmental programmes. An important political opportunity identified was increasing international cooperation between non-government organisation, bilateral and multilateral donor agencies in the forestry sector. Other political opportunities include: placing mahogany in appendix II of the Convention on International Trade of Endangered Species so as to force forestry operations that harvest protected species to close down; eliminating subsidies to unsustainable development project such as the Projeto Grande Carajás or further transamazonian highways; and reinforcing the protection of indigenous lands.

Conclusion

Forestry in Amazonia has great potential and to exclude it from the sustainable development of this basin would be unwise. Indeed, forestry will continue to be a major driving force in the region's development. The question is not whether forestry can be stopped but rather how it can proceed in a more sustainable manner.

For the sake of protecting biodiversity, sustainable forest management appears to be the most appropriate kind of forestry. However, given the socio-economic situation of the region, its predominance in the near future is uncertain and it is likely that uncontrolled selective logging will continue to be the main type of forestry.

The barriers and opportunities examined reveal that the overwhelming forces in determining the path of forestry sustainability are political in nature. Indeed, although the scientific knowledge pertaining to tropical forest management is incomplete (e.g. forest growth dynamics, precise location and area of the different forestry practices), what is most urgently needed at the moment is the political commitment to stop the biodiversity crisis of Amazonia.

Sources of information

Barros, A. C. and Uhl, C. 1995. Logging along the Amazon river and estuary: Patterns, problems and potential. *Forest Ecology and Management* 77 p. 87-105.

Fearnside, P. M. 1995. *Sustainable Development in Amazonia*. In: Kosinski, L. A. (ed.) Beyond ECO-92: *Global Change, the Discourse, the Progression, the Awareness*. p. 207-224. International Social Science Council (ISSC), United Nations Educational and Scientific Organization (UNESCO), and Editora Universitária Candido Mendes (EDUCAM), Rio de Janeiro.

Glastra, R. (ed.) 1999. *Cut and Run: Illegal Logging and Timber Trade in the Tropics*. International Development Research Center, Ottawa.

Hanan, S. A. and Batalha, B. H. L. 1995. *Amazônia: Contradições no Paraíso Ecológico*. Cultura Editores Associados Ltda, São Paulo.

Lele, U., V. Viana, A. Verisimo, S. Vosti, K. Perkins, and S. A. Husain. 2000. *Brazil. Forests in the Balance: Challenges of Conservation with Development. Evaluation Country Case Study Series*. World Bank Operations Evaluation Department, Washington, D. C.

Nepstad, D. C., A. Verissimo, A. Alencar, C. Nobre, E. Lima, P. Lefebvre, P. Schlesinger, C. Potter, P. Moutinho, E. Mendoza, M. Cochrane, and V. Brooks, 1999. Large-scale Impoverishment of Amazonian Forests by Logging and Fire. *Nature* 398 (6727) p. 505-508.

Parayil, G. and Tong, F. 1998. Pasture-led to logging-led deforestation in the Brazilian Amazon: The dynamics of socio-environmental change. *Global Environmental Change* 8(1) p. 63-79.

Uhl, C., P. Barreto, A. Verrissimo, E. Vidal, P. Amaral, A. C. Barros, C. Souza, J. Johns, and J Gerwing,. 1997. Natural resource management in the Brazilian Amazon, an integrated research approach. *Bioscience* 47(3) p.160-168.

Institutional and socio-economic aspects

35
INCENTIVES AND MOTIVATIONS FOR SUSTAINABLE FOREST MANAGEMENT

Diwakar Sinha
Assistant Conservator of Forests, Uttar Pradesh
Indranagar Forest Colony, Indranagar, Dehradun-248006 (UP), India
Tel: +91-135-764229 Fax: +91-135-620334,
Email: (1) eyesint@nde.vsnl.net.in & diwakar42@hotmail.com
Website: http://education.vsnl.com/eyes_international/index.html

Keywords: Incentives; Motivations; Sustainable Forest Management; Watershed Management; attitudinal change

Till the late seventies the forests in India were mainly considered as productive ones. They were looked upon as a source for supply of fuel, fodder and building timber together with minor forest produces such as bamboo, grasses, fibers, honey and the like. It was in late seventies that people started investigating the invisible role of the forests in maintaining the ecological balance. With this, the environmental group gaining more momentum than the productive group, the ideas regarding the forest management were given a different thought. It was the then, the concept for sustainable management of forests crept in and words like optimum utilization, sustainability, socio-economic development, community participation, incentives and motivations became popular.

A review of the forestry sector reveals that though there were some self-motivated groups that looked after their forests well, but it was confined only to few pocket of the country. To broaden the development base of forestry sector, the National Forest Policy 1988 was formulated. This introduced the concept of participatory forest management on usufruct sharing basis. The new approach included active participation of the village communities, especially women, weaker sections and voluntary agencies in strengthening the hands of the forest department for sustainable forest management and regeneration activities.

Pursuant to the policy, the Government of India issued a notification in June 1990 requesting the State Governments to involve local communities in the management of forests. It was envisaged that the communities, in lieu of their participation in protection and development of forest areas, would be entitled to sharing of usufructs in a manner specified by the concerned State Forest Departments. This led to the development of Joint Forest Management (JFM) Programme. So far 22 States Governments have issued resolutions in this regard. Nearly 36,130 Forest Protection Committees are managing a total of about 10.25 million ha. of forests. Together with this, National Watershed Development Projects for Rainfed Areas (NWDPRA) was launched in 1990-91, which covered 25 States and 2 Union territories. The objective of the project was restoration of ecological balance in rainfed areas and sustainable biomass production. Under this World Bank assisted Watershed Development Projects, Agricultural Development Projects, Danida Aided Projects, Swiss Development Corporation assisted Projects and European Commission assisted Doon Valley Project are noteworthy.

In most of these projects, incentives and motivation have been provided to the villagers to bring about attitudinal changes, by satisfying the basic needs, so that they may work collectively for the welfare of forests and environment.

The present paper discusses and highlights various issues relating incentives and motivation for sustainable management of forests in the villages taken up by the Doon Valley Integrated Watershed Management Project which was launched in the year 1993 and covers an area of about 2508 sq.km covering nearly 303 villages of Garhwal and Kumaon Regions. It is a joint venture of Government of Uttar Pradesh and European Commission with focus on agriculture and social forestry related sectors. The major objectives of the project are (1) Arrest and as far as possible, reverse the on going degradation of the Doon Valley Eco-system (2) Improve the living conditions of the rural people (3) Ensure positive involvement of rural people in managing this environment.

36
ASSESSING THE TOTAL ECONOMIC VALUE OF FOREST RESOURCES IN TUNISIA

Hamed Daly-Hassen* and Ameur Ben Mansoura
Institut National de Recherches en Génie Rural, Eaux et Forêts (INRGREF),
B.P. 10, Ariana – 2080, Tunisia. Tel. 216.1.230.039, Fax. 216.1.717.951.
E-mail : Dalyhassen.hamed@iresa.agrinet.tn

Keywords: Economic value, Forest resources, user benefits, Tunisia.

Introduction

The economic value of forest resources is traditionally appreciated by that of timber production and its contribution to the gross domestic product, or by the extent of satisfaction of timber demand. In Tunisia, the production of wood remains timid despite the country's substantial efforts in costly forest plantations since access to independence, in 1956. Wood imports are rising and they accounted in 1998 for 86% of the country's total timber demand. Besides wood, Tunisian forests offer other important economic benefits to local users and services towards meeting the requirements of sound watershed management. In the past, the economic value of some of these benefits and services has been overlooked, despite the fact that it may outweigh that of wood. This partial neglect is primarily due to the difficulty associated with the quantification of some ecological services such as soil conservation, water purification, carbon storage, recreation, and landscape enhancement. The objective of the present study was to perform an economic analysis of the total value of Tunisian forests including non-woody products and uses in environmental conservation, using traditionally available data. It also aimed at providing estimates for some previously overlooked benefits and services.

Methods

The total economic value of Tunisian forest resources was performed in order to account for both direct and indirect use values, using data pertaining to the reference year of 1998. Non-woody products were evaluated at the primary production stage, as their economic value after transformation or export out of the country could not be objectively accounted. Similarly, complete lack of relevant data prevented the inclusion of either the option value or that due to existence and bequest. Negative externalities were, however, considered but only for damages caused by forest fires. Quantification difficulties associated with some uses of forest resources were overcome by the use of indicators for the assessment of their economic value. Indicators included either an increase in productivity due to reduced soil erosion, or a loss of utility, as in the case of dam silting.

Results

The analysis showed that the economic value of non-woody products and services was far greater than that of timber, with $ 65 million for the former and only $ 3 million for the latter. Local forest populations benefited from 82% of the direct use value, while the remaining proportion of 18% was allocated to the state budget. It was also demonstrated that forest grazing opportunities and forest contribution to proper watershed management provided, respectively, 32 and 58% of the total economic value. This indicated that Tunisian forests play prominent roles at the socio-economic and environmental protection levels.

The proposed analysis can be a valuable tool for drawing new forest strategies aiming at the achievement of a greater equilibrium between the economic development of forest areas on one hand, and the sustainability of their environmental protection role on the other hand. Future research is needed for better economic assessment of the benefits associated with the role of forests in watershed management and biodiversity, in addition to the cost of negative externalities such as the impact of widespread overgrazing.

References

Ben Mansoura A., Garchi S., and Daly H. (2001). Analyzing forest users' destructive behavior in Northern Tunisia. Land Use Policy, 18:153-163.

Daly-Hassen H. (1998). Les perspectives de l'offre et de la demande de bois rond industriel en Tunisie à l'horizon 2015. Annales de l'INRAT, Tunis. (Under press).

DGF (Direction Générale des Forêts), (1992). Plan national de protection des forêts contre les incendies. Ministère de l'Agriculture, Tunis, 40 p.

DGF (Direction Générale des Forêts), (1995). Résultats du premier inventaire forestier national en Tunisie. Ministère de l'Agriculture, Tunis, 88 p.

Gregerson H., Arnold J.E.M., Lundgren A.L., and Contreas A.. (1997). Détermination de la valeur des forêts : Contexte, problèmes et orientations. FAO Report No. 127, Rome, 49 p.

Pearce, D. (1991). Forestry expansion: A study of technical, economic and ecological factors. Forestry Commission, London, 21 p.

Figure 1:

The Direct Use Value of Tunisian forests according to usage, in 1998

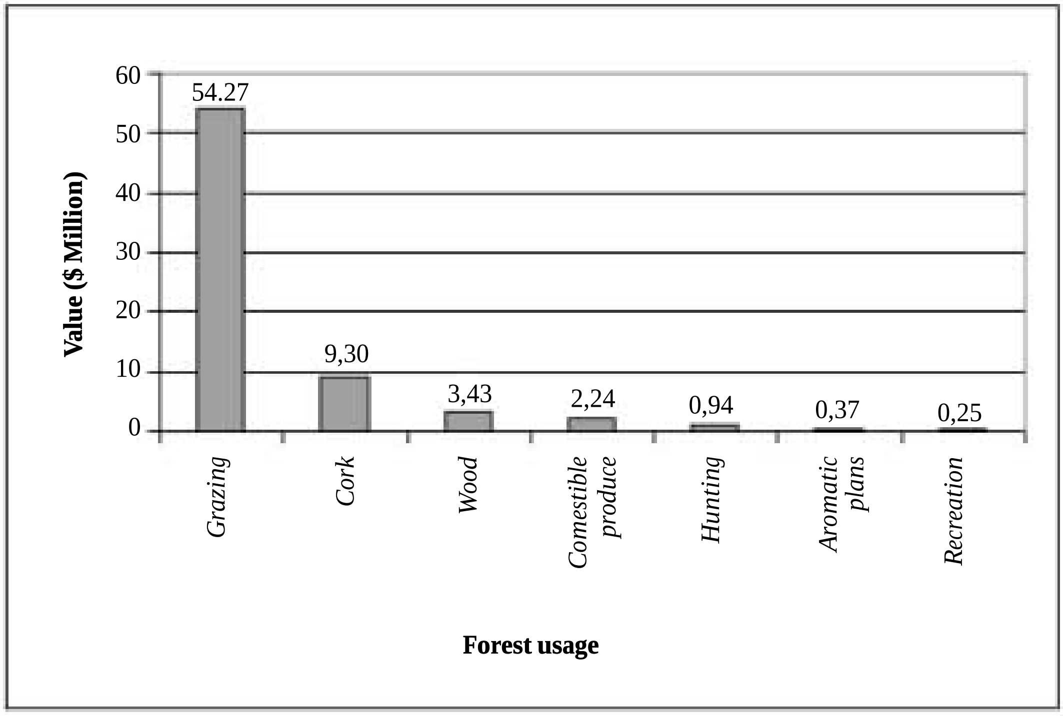
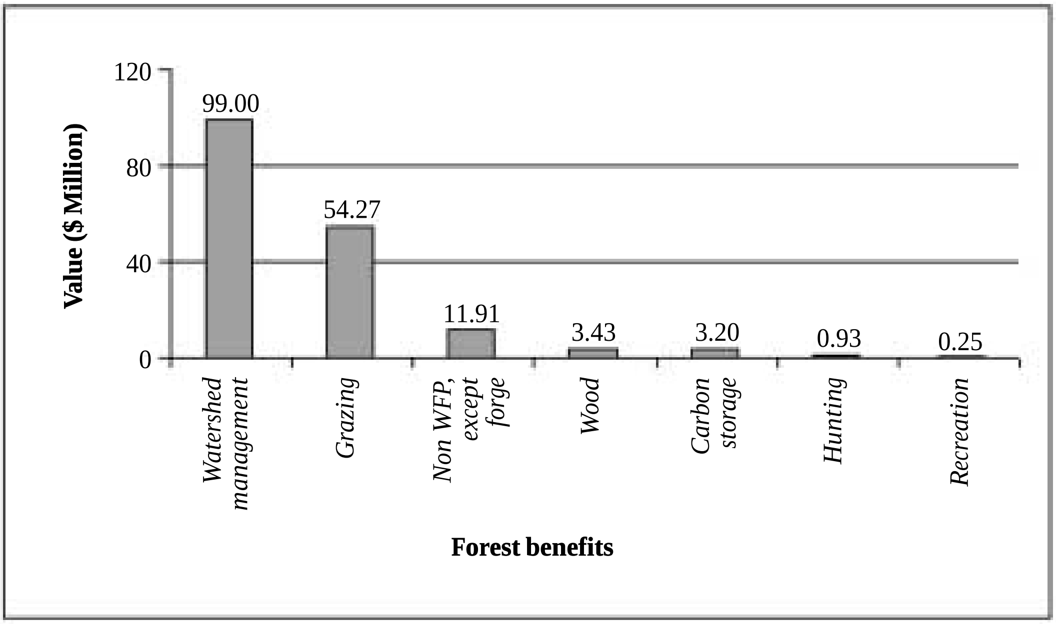


Fig. 2:

The Total Economic Value of Tunisian forest resources according to all benefits, in 1998



37
LINKING C&I AND CODE OF PRACTICES FOR INDUSTRIAL PLANTATIONS

John Poulsen and Grahame Applegate
Center for International Forestry Research
P.O. Box 6596 JKPWB, Jakarta 10065, Indonesia
E-mail: J.Poulsen@cgiar.org

Abstract for poster

Improved sets of criteria and indicators for sustainable management of large-scale plantations are described, by i) suggesting increasing emphasis on landscape scale and conservation and socio-economic issues, and, ii) ensuring that the criteria and indicators are sufficiently linked to practical management, specifically by establishing explicit links between the criteria and indicator sets and codes of practice, the latter used by the plantation companies for planning and management. These results are communicated to key international and national fora. This attempt is intended to improve the practical relevance and applicability of criteria and indicator sets. This will on the other hand hopefully increase the rate of adoption of criteria and indicators by largescale industrial plantation holders.

38
CONSERVATION HOLIC (CONSHOLIC) EDUCATION FOR BIODIVERSITY CONSERVATION

K. Thulsi Rao*, M. Prudhvi Raju
Project Tiger, Srisailam, Andhra Pradesh, India - 518102
E-mail: thulsirao@yahoo.co.in

Keywords: Nallamalais, Non-wood Forest Produce (NWFP), Eco-development committee (EDC), Conservation-holic (Consholic), Protected Area (P.A)

BACKGROUND

Introduction

Nestling in the verdant hill ranges of Nallamalais, Nagarjuna Sagar – Srisailam Tiger Reserve (NSTR) is one of the biggest Protected Areas of India. Spreads over an area of 4531.69 Sq. Km. this sanctuary is an abode for rich bio-diversity, especially many endangered flora and its associated fauna.

Human settlements Bordering the reserve: A total of 190,000 people in 200 villages live in and around N.S.T.R. The people depend on the forests for there, food requirements, day to day needs NWFP, fodder for cattle and land for Agriculture. The degree of dependency of these people for their sustenance on Tiger land is substantial which affects habitat of the Tiger considerably. The inter censual growth rate at 1.3% further alarms the possible encroachment of the habitat for the agricultural expansion. Unscientific tapping and irrational utilization of natural resources especially economic species led the species to the threshold limits of extinction resulting total collapse of tribal economy (Fig-1)

"Forests precede civilization and Deserts succeed it". The Biodiversity of Nallamalais is getting eroded because of increase in the population of the dependent class of people and no sufficient awareness about protecting or rational utilization of resource base around that they are living.

In order to mitigate the dependence of the villagers; a strategy known as Eco-Development has been evolved. "Eco-Development in the *Protected Area* context is: a strategy with a site specific package of measures evolved through people's participation with the objective of balancing socio- economic development of the people and also ecological sustenance.

Existing programmes have identified many conservation needs and constraints but have so far failed to appreciably slow the loss of biodiversity. This loss is causing irreparable damage to the P.A and its basic biological life systems and the resources upon which the rural poor depend. Immediate action is required to slow the rate of loss of biodiversity and to develop a strategy, which allows sustainable utilization of natural resources while conserving biodiversity and the resource base.

Despite many efforts with all developmental programmes that implemented, could not yield desired results initially till we launch ***Conservation Holic Education*** coupled with site-specific developmental activities.

Conservation Holic (Consholic) Education

In the beginning we have organized village level meetings and identified the most resource dependent villages and prioritized into High Impact (HIV), Medium Impact (MIV) and low Impact (LIV) villages and stake holders from the villages.

1. *Process of influencing (Boosting up of Morale)* : The first and fore most task was to boost up the morale of the staff from the state of despair and despondency of the frown situation. Innumerable number of motivation-cum- sensitization classes has been conducted to the staff to energize their power of positive thinking. Classes

were conducted to build up the courage. Infusion of the positive mental attitude towards emotional well-being was taken-up during their interactive classes. Forest staff was sensitized about positive mental attitude towards people by sterilizing their negative attitudes.

Programme planning:

Human Resource Development (HRD) : Even for planning a management strategy, a huge human resource is necessary for a sanctuary of this size. In this regard volunteers and N.G.Os were trained to motivate the local communities. Initially, the recruitment was one to one and gradually, the motivated trainees started bringing different NGO organization for further training. External help from various institutions was also sought to conduct a combined sensitization-cum-conservation classes for the staff, NGO's and the local communities.

Conducted several training sessions and workshops that aimed at motivating the staff, NGOs, EDC members, villagers, and other important stakeholders. In total, 1,140 such training workshops were organized involving 689 staff people of all levels, 434 representatives of NGO's, 130 representatives from other governmental departments, 7,580 villagers, and 4,826 EDC members.

The trainings in Participatory Rural Appraisal (PRA) Techniques and Participatory Mutual Interaction Assessment (PAMIA) were held both within the classrooms and in the villages. This has given a broad prioritized. As a base of trained personnel to conduct PRA simultaneously in all the villages that were result, information started flowing and it was systematically analyzed to draw inputs for P.A.Management strategies..

Special Inputs of trainings

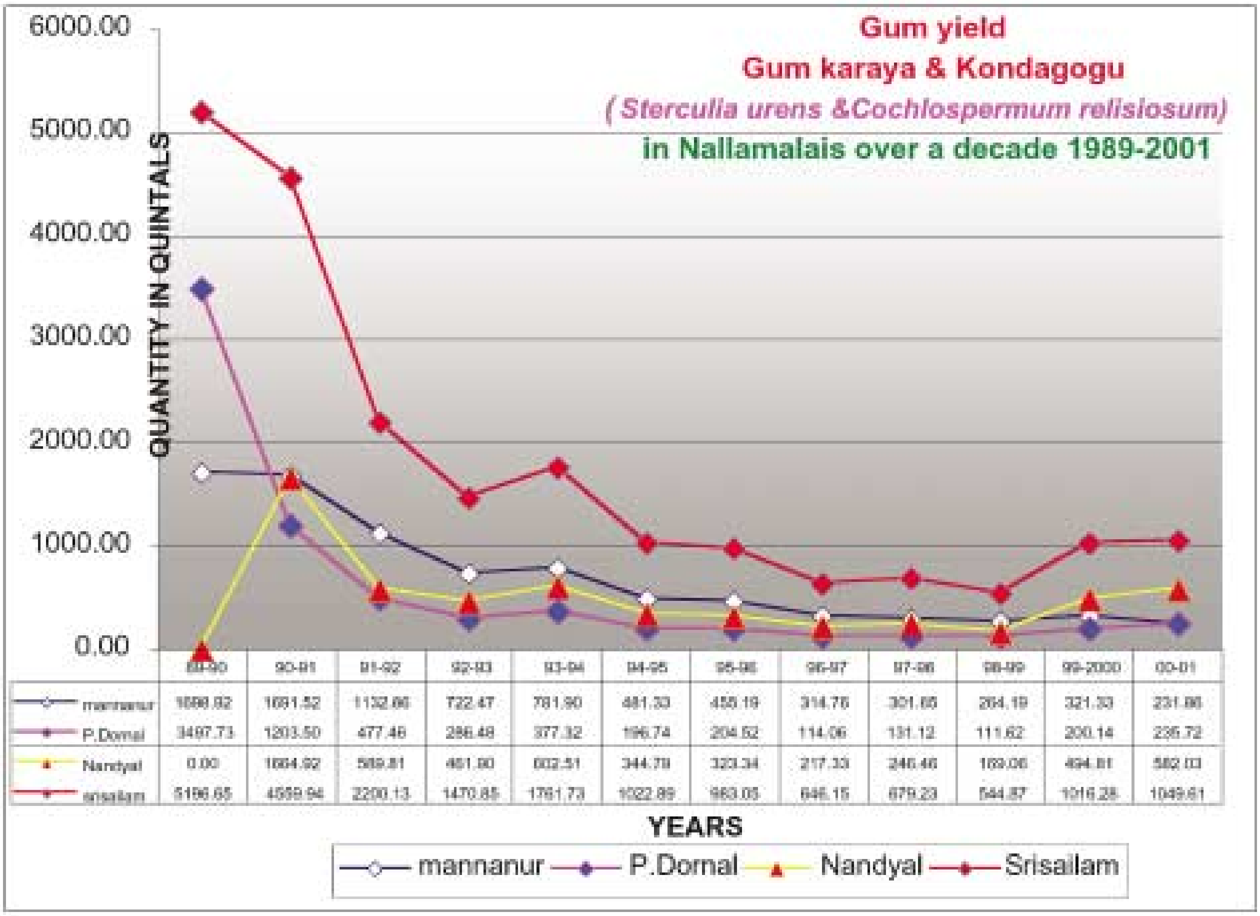
Identified villagers who used to impact the habitat are taken into the forest where they used to cut the trees and given equipment such as binoculars, telescopes to describe the complex activities that can be seen all along the tree. Laid 0.1 Hectare plots to enumerate and to make the inventory and the diversity of organism that live in the plot. Also made them to realize how loss of each organism leads to collapse the whole balance through ecological games. Also made them to document the benefits of each of these organisms in their day-to-day life. Special posters have been designed to sensitize and educate them through capturing the certain human sentiments of local importance. One special Mobile environment exhibition van has been designed and sent to the remote parts of the villages. The models and theme are so designed to articulate to make them realize the need to respect and protect the biodiversity

Key Results:1. Once degraded habitat is restored, 2. Animal Population increased 3.Smuggling routes in the villages have been plugged 4. Village tanks are improved to support irrigation facility that increased crop yield besides providing agricultural employment to local villagers 5. The most important factor is the population of tigers in the habitat increase from 34 to 58 from 1995 to 2000

The poverty alleviation activities along with the ***"Conservation-holic"*** education changed ***the previous hostile attitude the extremist-backed stakeholders to*** strong pro conservationists. The help in improved practices of agriculture and animal husbandry programs uplifted them above the poverty line besides reducing the pressure on the P.A.

Figure 1:

"Figure 1: Decline over a ten-year period in the production of economically important species (leading to decline in income of resource dependants) at Mannanur, P. Dornal and Nandyal. Values presented for Srisailam are the sum of productions in the three towns."



	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-2000	00-01
mannanur	1698.92	1691.52	1132.66	722.47	781.90	481.33	455.19	314.76	301.65	264.19	321.33	231.86
P.Dornal	3497.73	1203.50	477.46	286.48	377.32	196.74	204.52	114.06	131.12	111.62	200.14	235.72
Nandyal	0.00	1664.92	589.81	461.90	602.51	344.79	323.34	217.33	246.46	169.06	494.81	582.03
srisailam	5196.65	4559.94	2200.13	1470.85	1761.73	1022.89	983.05	646.15	679.23	544.87	1016.28	1049.61

39
PARTICIPATORY WILDLIFE QUOTA SETTING PROCESS: LINKING BIODIVERSITY CONSERVATION, SUSTAINABLE USE AND EQUITY ISSUES

Norman Rigava
WWF Southern Africa Regional Programme Office
10 Lanark Road, Belgravia
P O Box CY1409
Causeway, Harare, Zimbabwe
E-mail: nrigava@wwf.org.zw

Keywords: Conservation; semi-arid ecosystems; sustainable use

Biodiversity Conservation in the Past – Centralised Authoritarian and Exclusive

The history of biodiversity conservation has been characterised by centralised planning and authoritarian management (Long *et al*, 2001). In order to create protected areas, rural people were forcibly removed from areas designated for conservation and were subsequently denied access to natural resources (NRs) they had previously relied upon. The rural people did not receive any direct benefits generated by the state from these conservation areas. Conservation became an "exclusive" activity, economically and socially isolated from the surrounding landscape. Outside of protected areas, many states also tried to dictate to rural people how they should, or should not, use the resources upon which they lived and often depended. This "command and control" approach to natural resource management, both within protected areas and on common-land, lead to significant social, ecological and management costs. (Posey, *et al*,1999).

Biodiversity Conservation Today – Decentralised and Participatory

The past few decades have witnessed a significant redefinition of the conservation paradigm. Today emphasis is placed on decentralised structures and on participatory approaches in management of NRs. This new direction entails a "pluralistic approach" to managing NRs based on partnerships, as well as the equitable allocation resource-related benefits and responsibilities (Borrini-Feyerabend, et al, 2000). It incorporates a number of stakeholders, including previously disenfranchised rural communities, in order to integrate conservation into the wider landscape. On common and private land, state natural resource management authorities have devolved proprietorship to resource users and landowners. Implicit in this approach is that conservation is "about people" and therefore must take place within the context of their sustainable development.

The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE)

The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) is an example of decentralised NR management to communal farmers in semi-arid areas of Zimbabwe. The Programme started in 1989 and is characterised by the sustainable use of wildlife and strong emphasis is placed upon creating tangible financial benefits for people involved in the management of the wildlife resources. Today, about 90% of all gross income from CAMPFIRE comes from sport hunting (Bond, 1994). Consequently quota setting is a very important activity in CAMPFIRE both from a biological and financial sustainability standpoint.

Participatory Wildlife Quota Setting

The wildlife quota setting process developed and currently in use in CAMPFIRE, takes account the "fugitive nature of wildlife and the multiple stakeholders involved in its management …" (Taylor, 2001). In doing so, it also attempts to link community based wildlife conservation and use approaches to more equitable power, responsibilities and benefit sharing arrangements. The process used to set sport hunting quotas for elephants and other species is embedded in adaptive management. The development of this method commenced in 1994 and evolved through an iterative process called participatory technology development (PTD). The PTD process brought together technical wildlife specialists and local communities drawing on both scientific and indigenous technical knowledge (ITK) to develop a simple, socially applicable, and technically robust participatory methodology for setting wildlife quotas. In determining the harvest rates, this participatory process uses independent assessments to provide population trends for each major wildlife species. These trends and other qualitative inputs are the basis for quota management decisions.

The World Wide Fund For Nature (WWF) and its partners has been involved in documenting the methodology and using the participatory method in building the quota setting capacity of district and sub-district institutions within CAMPFIRE.

Lessons Learnt

Important lessons have been drawn from the use of the participatory wildlife quota setting process. Participatory wildlife quota setting: -

- is both a conservation and monitoring tool,
- provides incentives for local communities to be involved in other natural resource management activities linked to quota setting such as wildlife counts,
- erves as a conflict resolution mechanism that negotiates consensus involving trade-offs between stakeholders thereby promoting co-management of wildlife resources,
- provides for meaningful decentralisation and the use of adaptive management in dealing with the complexity of socio-economic needs in semi-arid ecosystems that are capable of supporting both biodiversity conservation and sustainable rural livelihoods, and
- creates linkages between responsible investment in resource management and the benefits that result from this/such investment.

References

Bond I. (1994), The Importance of Sport-hunted Elephants to CAMPFIRE in Zimbabwe, TRAFFIC Bulletin Vol. 14 No. 3 (p. 117)

Borrini-Feyerabend, G., Farvar, M. T.,Nguinguiri, J.C. and Ndangang, V. A (2000), *Co-Management of Natural Resouces: Organising, Negotiating and Learning-by-Doing*, GTZ and IUCN, Kasparek Verlag, heidelberg, Germany

Long, A., Steenkamp, C., and Marks, S., (2001). *Community Based Wildlife Management: Review of Selected Case Studies from Around the World*, Safari Club International Foundation, Technical Series Number: 005, Washignton, D.C.

Posey, D.A. and Oxford Centre for Environment and Development (Eds.), (1999). *Cultural and Spiritual Values of Biodiversity*, UNEP, Nairobi, Kenya

Taylor, R. D., (2001). Participatory Natural Resource Monitoring and Management, in Hulme, D and Murphree, M (Eds.), (2001). *African Wildlife and Livelihoods: The Promise and Performance of Community Conservation*.

40
FOREST BIODIVERSITY IN SLOVAKIA AND FRAMES FOR ITS CONSERVATION

Roman Longauer1 and Peter Straka 2
1Forest Research Institute, Research Station SK-960 92 Zvolen, Slovakia
2 Ministry of Environment of the Slovak Republic, Bratislava, Slovakia

Keywords: Slovakia; socio-economic; ownership

Forests, their status and their socio-economic importance

Slovakia occupies the western part of the Carpathian Mountains. About 65% of the territory and thus a large proportion of forests has a mountainous character. The area of forests in Slovakia is 19,990 km^2 what equals 41% of the total country's territory (49,036 km^2). Another 1, 775 km2 of forests are found on abandoned farmlands (Forest Information Center, 2001). The forestry sector is administered by the Ministry of Land Management. The nature and environmental conservation comes under the Ministry of Environment.

Categories of utilization of forest stands are: 73% forests with predominating production function, 15% protective forests, and 17% forests with special functions (watershed areas, nature conservation, recreation forests). The average growing stock is 255 m^3.ha-^{1}. It increased by 50% during the past 50 years. The net annual increment was 13.86 million m^3 in 1996. In spite of these considerable increases, the total annual cut represented 5-7 mil. m3 in the 1990ies.

Restitution of ownership has resulted in **a broad variety of ownership types**, increased number of owners and users. Approximately 44% of forests is owned by non-state bodies or private persons. Restitution of another 8% is in progress. The state-owned forests represent 42%. Approximately 6% of forests remain un-reclaimed, with unknown owner or non-reclaimable upon valid legislation. Medium-size estates with average size 100-700 hectares predominate in the category of non-state forests. A considerable part of forests (489,000 ha or 24% of forest area) is in a shared ownership. Small holdings up to 5 hectares (average size 1.06 ha) cover only 1.3% of forest land.

Contribution of forestry to the gross domestic products decreased from 1.2% in the beginning 1990'ies to 0.66% in 2000. Total contribution to the GDP of forestry, wood processing, pulp and paper industries, is estimated to 8.5%, however. Slovakia is a net exporter of nearly all forest and wood-derived products.

Both quantitative and qualitative indicators, except of those related with forest health due to high air pollution of trans-boundary origin, show that the management of forests is done in a relatively sustainable way. In the scores published by the WWF in 2000, the care of forests in Slovakia was ranked at the third to fifth position among the European countries. In spite of this fact, there are several problems which make promotion of more nature-conforming forestry practices difficult. These are related especially with the high share of incidental felling, which represents more than 50% of the total annual cut throughout the 1990'ies.Their prevalence over planned regeneration felling is an obstacle to regular forest management and systematic forest regeneration.

Forest Vegetation

Large vertical variation and transitional position between the oceanic and continental parts of Europe contribute to the large forest ecosystem diversity. The forest classification which is routinely used in the forest management planning (Zlatnik 1959), recognises 350 forest types grouped into 55 associations and eight forest vegetation zones. Main forest ecosystems include riverain forest vegetation, oak and mixed oak-beech forest, pure beechwoods, mixed fir-beech, spruce-fir-beech and subalpine spruce forests, and the mountain pine dominated vegetation at the alpine tree limit. The share of broadleaves in the overall species composition is 56,9%, with beech dominating (29,6) and oaks second (13,7%). The share of Noble Hardwoods (maples, ash, elms, alders, limes, wild fruit species) is 4.1%. Conifers are represented by Norway spruce (27,5%), silver fir (4,6%) and pines (7,7%)

Of the total forest area, 40-45% are semi-natural forests originating from natural regeneration and differing only slightly from natural forests in terms of species composition. More than 70 fragments of natural and virgin forests with a total area of 18,000-20,000 ha (1% of all forests) are found in Slovakia (KorpeL' 1993).

Frames for Forest Biodiversity Conservation

The first nature reserves in the territory of Slovakia were declared by the forestry authorities at the end of the 19th century. At present, the IUCN nature conservation categories I (strict nature reserves) and II (national parks) cover 19% of the forest land in the country. There are 561 strict nature reserves of which 93.5% (87,623 ha) and 6 national parks of which 80% (283,601 hectares) are forests. Another 460 ths. hectares are included in the IUCN categories III-VI represented mainly by the Protected Landscape Areas.

Establishment of the gene reserve forests has a central role among the systematic forestry activities aimed at conservation of forest biodiversity. With the aim to provide condition for long-term conservation of forest genetic resources, 32 ths. hectares of gene reserve forests were declared or proposed for declaration by January 2000. Minimum area of each gene reserve forest is 100 hectares, which provides relatively good basis for sustainable genetic, species and partially also forest ecosystem conservation. Under adequate management, each gene reserve provides an opportunity to demonstrate dynamic conservation of forest biodiversity but also practical applicability of nature-conforming forestry methods.

National system for conservation of forest genetic resources includes in situ and ex situ measures: approved stands for seed collection (55,221 hectares), plus trees (3,204 registered plus trees), seed orchards (81 units - 203 ha), two clonal archives (comprising approximately 1,000 genotypes) and the Forest seed bank with 350 entries.

In 1998, preparation of a completely new national forestry legislation started. A draft of a new Forest Act was subjected to inter-sectoral discussion in 2001. It includes several new elements, which should help to mitigate discrepancies between the forestry and nature conservation. Promotion of the category of Valuable Woodland Habitats should allow for more efficient biodiversity conservation also in the forests with the priority of wood production function.

INDEX by Authors

INDEX by Keywords