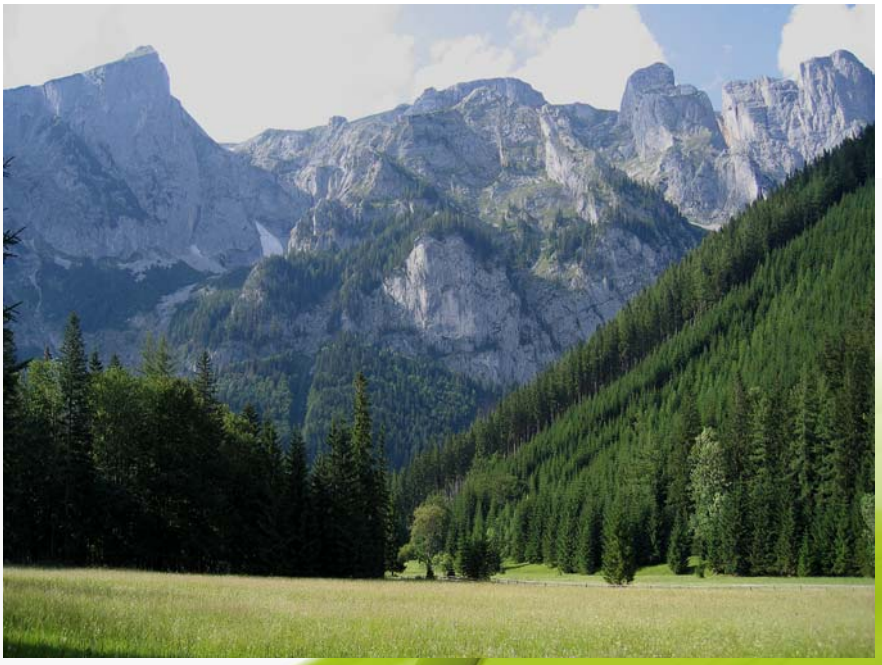
Mountain Forests in a Changing World

Advances in Research on Sustainable Management and the Role of Academic Education

International Conference
April 2-4, 2008
UNI BOKU VIENNA



Book of Abstracts

University of Natural Resources and Applied Life Sciences, Vienna
Department of Forest- and Soil Sciences

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BOKU International Conference

Mountain Forests in a Changing World
Advances in Research on Sustainable Management and the Role of Academic Education

April 2-4, 2008
BOKU – University of Natural Resources
and Applied Life Sciences, Vienna, Austria

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Institute of Forest Ecology, Department of Forest- and Soil Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Hubert Hasenauer
Manfred Josef Lexer
Institute of Silviculture, Department of Forest- and Soil Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Karl Hogl
Institute of Forest, Environmental and Natural Resource Policy, Department of Economics and Social Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Michael Kleine
International Union of Forest Research Organizations – Special Programme for Developing Countries
IUFRO Headquarter, Vienna, Austria

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Institute of Forest Entomology, Forest Pathology and Forest Protection, Department of Forest- and Soil Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

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Institute of Agricultural and Forestry Economics, Department of Economics and Social Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Conference bureau

Georg Gratzer
Iris Kempter

Institute of Forest Ecology, Department of Forest- and Soil Sciences
BOKU – University of Natural Resources and Applied Life Sciences, Vienna
Peter Jordan-Straße 82, A-1190 Vienna, Austria

Phone: +43-1-47654 4100
Fax: +43-1-47654 4129
Email: mountainforestry@boku.ac.at
URL: http://mountainforestry.boku.ac.at

Scientific Committee

Michael Kleine
International Union of Forest Research Organizations – Special Programme for Developing Countries (IUFRO – SPDC), Vienna, Austria

Manfred Josef Lexer
Institute of Silviculture, Department of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

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Renzo Motta
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Gerda Schneider
Institute of Landscape Planning, Department of Landscape, Spatial and Infrastructure Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Werner Schneider
Institute of Surveying, Remote Sensing and Land Information, Department of Landscape, Spatial and Infrastructure Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Axel Schopf
Institute of Forest Entomology, Forest Pathology and Forest Protection, Department of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Walter Sekot
Institute of Agricultural and Forestry Economics, Department of Economics and Social Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Bernhard Splechtna
Center for Environmental Studies and Nature Conservation, Department of Integrative Biology and Biodiversity Management, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Karl Stampfer
Institute of Forest Engineering, Department of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Hubert Sterba
Institute of Forest Growth and Yield Research, Department of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

Jerzy Szwagrzyk
Department of Forest Botany and Nature Conservation, Agricultural University of Krakow, Krakow, Poland

Harald Vacik
Institute of Silviculture, Department of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria

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BOKU International Conference

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Keynote speeches

1. ***Mountain forests in a changing world***
   Gerhard Glatzel, Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Austria
   Wednesday, April 2, 10:30-11:00
2. ***Wood, food, water, fuel – integrated approaches to future land use***
   Sten Nilsson, IIASA – International Institute for Applied System Analysis, Laxenburg, Austria
   Wednesday, April 2, 11:00-11:30
3. ***Stewardship of mountain environments: Learning from locals***
   Tom M. Hinckley, University of Washington, Seattle, USA
   Wednesday, April 2, 11:30-12:00
4. ***Education and capacity building***
   Douglas McGuire, Mountain Partnership, FAO – Food and Agriculture Organization of the United Nations, Rome, Italy
   Wednesday, April 2, 12:00-12:30
5. ***Mountain forests under pressure***
   Steven W. Running, University of Montana, Missoula, USA
   Thursday, April 3, 9:00-9:30
6. ***Ecological genetics and environmental change. Case study of phonological response of trees along altitudinal gradients.***
   Antoine Kremer, INRA – French National Institute for Agricultural Research, Cestas Cedex, France
   Thursday, April 3, 9:30-10:00
7. ***More than production: forests, livelihoods and social significance for mountain people***
   Anna Lawrence, Forestry Commission Great Britain, Surrey, UK
   Thursday, April 3, 13:30-14:00
8. ***Mountain forest and tree resources in Africa: Opportunities, threats and challenges***
   Demel Teketay Fanta, FSC Africa – Forest Stewardship Council, African Regional Office, Accra, Ghana
   Thursday, April 3, 14:00-14:30

CONFERENCE PROGRAM

Wednesday, April 2

Opening addresses; Location: EH01

09:00 – 09:15 **Ingela Bruner** (Rector, BOKU – University of Natural Resources and Applied Life Sciences, Vienna)

09:15 – 09:30 **Gerhard Mannsberger** (Head, Section of Forestry, Federal Ministry of Agriculture, Forestry, Environment and Water)

09:30 – 09:40 **Roque Rodriguez-Soalleiro** (Deputy Coordinator, Mountain Forest Management, IUFRO – International Union of Forest Research Organizations)

09:40 – 09:50 **Douglas McGuire** (Coordinator, Mountain Partnership Secretariat, FAO – UN Food and Agriculture Organization)

09:50 – 10:00 **Pier Carlo Sandei** (Associate Mountain Programme Officer, Regional Office for Europe, UNEP – United Nations Environment Programme)

10:00 – 10:30 *Coffee break*

Plenary lectures I; Location: EH01

10:30 – 11:00 Mountain forests in a changing world (**Gerhard Glatzel**)

11:00 – 11:30 Wood, food, water, fuel – integrated approaches to future land use (**Sten Nilsson**)

11:30 – 12:00 Stewardship of mountain environments: Learning from locals (**Tom M. Hinckley**)

12:00 – 12:30 Education and capacity building (**Douglas McGuire**)

12:30 – 14:00 *Lunch break*

14:00 – 15:00 **Tutorial**: 5 Years MS-Curriculum "Mountain Forestry" at UNI BOKU Vienna (**Hubert Hasenauer and students of the master's course in mountain forestry)**

15:00 – 15:30 *Coffee break*

15:30 – 17:30 **Scientific sessions I and II: parallel**

Session I **Location: EH 02; Chairman: Sten Nilsson**

15:30-15:50 The role of academic education for mountain forest management: A perspective from plantation forestry in southern Europe (**Roque Rodriguez- Soalleiro**)

15:50-16:10 Global scenarios and regional perspectives in biodiversity and sustainable utilization of fragile ecosystems after the Brundtland Report **(Yoseph Assefa Woldeamanuel)**

16:10-16:30 Climate Change & Himalayan mountains: Mitigation and adaptation options for meeting challenges of sustainable livelihoods, biodiversity conservation and ecosystem services (**Vivek Saxena)**

16:30-16:50 The forest resources in the Carpathian mountains: Problems and challenges for the implementation of an international cooperation policy (**Pier Carlo Sandei)**

16:50-17:10 Examining the nexus between depletion of mountain forests and green cover and the deepening water crisis in Uganda**. (Twesigye Morrison Rwakakamba)**

17:10-17:30	Recreation and wildlife management – challenges for forestry: possibilities of conflict identification and conflict management (**Christiane Brandenburg)**
Session II	**Location: EH 04; Chairman: Tom M. Hinckley**
15:30-15:50	Links between mountain communities and environmental services: a case study in the Italian Alps (**Sandra Notaro)**
15:50-16:10	Silvicultural contributions to conservation and rehabilitation of forest resources in the Andes of Ecuador (**Sven Günter)**
16:10-16:30	Species-specific response to disturbance – examples from a spruce-fir-beech forest **(Bernhard Splechtna)**
16:30-16:50	Physiological and morphological response to light of young beech in Slovenian mountain forests (**Matjaz Cater)**
16:50-17:10	Long-term seedling demography in a natural beech-fir-spruce forest: Mechanisms behind species coexistence (**Jerzy Szwagrzyk)**
17:10-17:30	Lessons from old growth natural forests – influences of tree masting on small mammal communities, seed and seedling fate (**Gerald Muralt)**
20:00	*Conference Dinner:* Invitation of the governing mayor of the city of Vienna to a "Heurigen"

Thursday, April 3

Plenary lectures II; Location: EH 04

09:00 – 09:30	Mountain forests under pressure (**Steven W. Running**)
09:30 – 10:00	Ecological genetics and environmental change. Case study of phenological response of trees along altitudinal gradients (**Antoine Kremer**)
10:00 – 10:30	*Coffee break*
10:30 – 12:30	**Scientific sessions III and IV: parallel**
Session III	**Location: EH04; Chairman: Steven W. Running**
10:30-10:50	A global meta-analysis of temperate old-growth forests: Structural characteristics, carbon storage, and management implications for montane ecosystems (**William Keeton)**
10:50-11:10	Climate change and tree species elevation shift in French mountain forests: a contribution from early developmental stages (**Jonathan Lenoir)**
11:10-11:30	Integrated monitoring of air pollution effects in the Austrian Limestone Alps: Long-term trends in forest soils, ground vegetation, bryophytes and lichens (**Thomas Dirnböck)**
11:30-11:50	Soil carbon dioxide emission in the soil warming experiment Achenkirch (**Andreas Schindlbacher)**
11:50-12:10	Addressing climate change in practical silvicultural decision support: A vulnerability assessment to amend decision making in the Austrian Federal Forests (**Rupert Seidl)**
12:10-12:30	Forest restoration in a municipal watershed in the United States (**Bill Richards)**

Session IV	**Location: EH02; Chairman: Michael Kleine**
10:30-10:50	Land-use conflict and forest rehabilitation in Ba Den Mountain, South Vietnam**. (Thi Kim Pung Dang)**
10:50-11:10	Supporting sustainable forest management in community forest user groups in Nepal – a case study from Makawanpur and Chitwan (**Chiranjeewee Khadka**)
11:10-11:30	Silvicultural aspects in high mountain ecosystems in the Black Sea region (**Ibrahim Turna)**
11:30-11:50	Determining functional classification of the subalpine pure Oriental spruce (*Picea orientalis* (L.) Link) stands on mountain forests in Turkey (**Ali Ömer Ücler)**
11:50-12:10	Comparisons of closed and unclosed forest management systems in restoring degraded dry Afromontane forest of northern Ethiopia (**Ermias Aynekulu)**
12:30 – 13:30	*Lunch break*
Plenary lectures III; Location: EH04	
13:30 – 14:00	More than production: forests, livelihoods and social significance for mountain people (**Anna Lawrence**)
14:00 – 14:30	Mountain forest and tree resources in Africa: Opportunities, threats and challenges (**Demel Teketay Fanta**)
14:30 – 16:50	**Scientific sessions V and VI: parallel**
Session V	**Location: EH04; Chairman: Douglas McGuire**
14:30-14:50	Profitability and competitiveness of mountain forest enterprises - empirical evidence from Switzerland and Austria (**Walter Sekot)**
14:50-15:10	From mountain forest to coast: Sustainability and market value of medicinal plants in Northern Peru **(Rainer Bussmann**)
15:10-15:30	Historical deforestation patterns influence the conservation value of church forests in the northern Ethiopian highlands (**Raf Aerts)**
15:30-15:50	Biophysical and socioeconomic importance of farm forests in the mountainous landscapes of central Ethiopia. (**Kindu Mekonnen)**
15:50-16:10	A disturbance to ‚integrated' management: the framing of knowledge in conservation and management of juniper forests in South Kyrgyzstan (**Birgit Habermann**)
16:10-16:30	International Model Forest Network – a case study in a Spanish mountain range (**Sven Mutke**)
16:30-16:50	Indigenous knowledge in natural resource utilization by the hill people: A case of the Mro Tribe in Bangladesh (**Mohammad Shaheed Hossain Chowdhury)**
Session VI	**Location: EH02; Chairman: Antoine Kremer**
14:30-14:50	Effects of silvicultural measures on resistance and elasticity of pure Norway spruce stands (Picea abies [L.] Karst.) in the montane zone of the Bavarian Alps. (**Sebastian Höllerl**)
14:50-15:10	Scots pine stand structure and growth after snow damage under different thinning regimes (**Miren del Rio**)
15:10-15:30	Blue spruce forest stand in small pole stage on the extreme mountain locality and its relation to European beech interplantings prosperity (**Dusan Kacalek)**
15:30-15:50	Gnawers in the process of the ecological stability of forest ecosystems (**Kamil Turek**)
15:50-16:10	Elaboration of density management diagrams for Douglas fir plantations in mountain areas of northern Spain (**Roque Rodriguez-Soalleiro**)

16:10-16:30 An investigation on a methodology about determination of visual quality-preference relationship in mountain forests (**Arzu Kalin**)

16:30-16:50 Gap dynamics in temperate conifer forests in central and western Bhutan Himalayas (**Kinley Tenzin**)

17:00 – 19:00 Poster session with snacks, Location: EH05

Friday, April 4

09:00 – 11:00 Scientific sessions VII and VIII: parallel

Session VII **Location: EH02; Chairwomen: Anna Lawrence**

9:00-9:20 Medicinal plant resources, ethnopharmacology, community management interventions and developments of Nepal Western Himalaya (**Ripu Kunwar**)

9:20-9:40 Impact of changing forest tenure regime on Livelihoods, Income, Forest Condition and Equity (LIFE) in the mid hills of Nepal (**Ganga Ram Dahal)**

9:40-10:00 Sustainability of community based forest management: case study of Margahovit community in Northern Armenia (**Anna Jenderedjian**)

10:00-10:20 Assessment, conservation and management of non-timber forest products (NTFPs) in the Arun Valley, Sankhuwasabha District of Eastern Nepal Himalaya (**Ram B. Bhandari)**

10:20-10:40 Comparison of regeneration, species composition and structure in single-tree and group selection logged and unlogged stands in mixed conifer forests of the Western Bhutan Himalayas. (**Mani Ram Moktan**)

Session VIII **Location: EH04; Chairman: Gerhard Glatzel**

9:00-9:20 Effects of substrate, bamboo competition and grazing on regeneration of *Tsuga dumosa* (**Andras Darabant**)

9:20-9:40 Physiological and growth response of European larch (*Larix decidua* Mill.) in upper timberline (SE Alps) (**Matjaz Cater**)

9:40-10:00 Value-based analysis of trade-offs in rockfall protection forest management. A case study from the Eastern Alps. (**Werner Rammer)**

10:00-10:20 Potential application of Arbuscular mycorrhizal fungi in hill forests (**Amin Uddin Mridha)**

10:20-10:40 Bark beetle dynamics after wind disturbance in Tatra Mountains, West Carpathians (**Peter Zach**)

10:40 – 11:30 *Coffee break*

11:30 – 12:50	**Scientific sessions IX and X: parallel**
Session IX	**Location: EH04; Chairman: Georg Gratzer**
11:30-11:50	Differentiation of current vegetation cover and direct anthropic impact in the Pradìd National Nature Reserve (Hrubý Jeseník Mts., Czech Rep.) by means of remote sensing (**Kamil Kral**)
11:50-12:10	Investigation causes of mountain forest degradation with local community participation. Case study Fandoglu Mountain Forest, Ardebil Province, Iran, July 2007 (**Peiman Yousefyazary**)
12:10-12:30	Land use change and forest carbon sink in the mountainous territory of Veneto Region (NE Italy) in order to apply the Kyoto Protocol. (**Elena Dalla Valle**
12:30-12:50	50 years of land use change in Scots pine forests of the western Italian Alps (**Giorgio Vacchiano**)
12:50-13:10	Understanding people to reduce uncertainty in managing survivable forested land: A case study in karstic mountainous region, Indonesia (**Dwiko Budi Permadi**)
Session X	**Location: EH02; Chairman: Demel Teketay Fanta**
11:30-11:50	Developing concepts for sustainable management of forest resources (SFM) in north western forests of Iran (Arasbaran) **(Morteza Tashakori Ghojdy**)
11:50-12:10	Growth dynamics of fine roots in forest ecosystems (**Hans Persson**)
12:10-12:30	Chestnut orchards in Italy: Combining the satisfaction of needs and the enjoinment of amenities (**Lorenzo Venzi)**
12:30-12:50	Ethnoveterinary medicinal plants at Bale Mountains National Park, Ethiopia (**Haile Yineger**)
13:00 – 14:30	*Lunch*
14:30 – 15:30	**Plenary discussion; Location: EH04** Future challenges in management of forested mountain landscapes.

Saturday, April 5

Post-conference excursion to the Nasswald forestry enterprise of the municipality of Vienna in the northern Limestone-Alps.

08:30	Start at BOKU, Vienna
Morning	Introduction into the forest management units of the City of Vienna
12:00 – 13:30	Invited lunch by the City of Vienna
Afternoon	- Forest and wildlife management for protection of drinking water for the City of Vienna - Historic forest use in the Austrian Alps – the Hubmer Gedaechtnisstätte
18:00	Arrival in Vienna

Abstracts

I. Keynote Speeches

MOUNTAIN FOREST AND TREE RESOURCES IN AFRICA: OPPORTUNITIES, THREATS AND CHALLENGES

D.T. Fanta[1]

[1] *Forest Stewardship Council - African Regional Office (FSC Africa), 4 Asoyi Road, East Legon, UPO LPMB 11, Legon, Accra, Ghana, d.teketay@fsc.org or dteketay@yahoo.com*

Mountain forest and tree resources had fulfilled and continue to fulfill critical economic, environmental, social and cultural functions in Africa. They play significant roles in livelihood diversification and, thereby, poverty alleviation, wood and food security, providing non-timber forest products and animal feed, human and animal health care and many environmental services, including conservation of biodiversity, regulation of watersheds and mitigation of climate change. Despite their importance, these resources have been subjected to deforestation and severe degradation, owing to several and complex natural, anthropogenic as well as socio-economic and policy-related factors. As a result, undesirable consequences, e.g. their disappearance and degradation, wood famine, degradation of land and water resources, decline/loss of biodiversity, aggravated poverty and enhanced global warming that affect the welfare of humans, plants, animals and micro-organisms have been observed. Several challenges could also be anticipated in future efforts to properly manage these resources. There is an urgent need to address the responsible factors to prevent any further deforestation and degradation of these resources before their damage proceeds beyond the possibility of their rehabilitation. This would require appropriate and timely interventions from all stakeholders. The causes and consequences of deforestation and degradation, challenges envisaged in their future management, interventions required and the potential stakeholders responsible for their management are discussed. The role of certification as a potential means to ensure the responsible management of mountain forests is highlighted.

STEWARDSHIP OF MOUNTAIN ENVIRONMENTS: LEARNING FROM LOCALS

T.M. Hinckley[1], S. Breslow, R. Chen, J. Combs, B. Grub, S. Harrell, A. Henck, Z. Ma, R. Olmstead, P. Rigdon, A. Robbins, A. Scanlon, Y. Tang, J. Taylor, L. Urgenson, A. Washines, Q. Yang, Y. Yuan, Z. Zeng

[1] *Division of Ecosystem Sciences, College of Forest Resources, University of Washington, Box 352100, 204 Winkenwerder, 98195-2100 Seattle, United States, hinckley@u.washington.edu*

As a result of specific partnerships with Jiuzhaigou National Park (Aba Tibetan Autonomous Prefecture, Sichuan Province, China), the Yangjuan Primary School (Liangshan Yi Autonomous Prefecture, Sichuan Province, China), and the Confederated Bands and Tribes of the Yakama Nation (Washington State, USA), students and faculty from Sichuan University and the University of Washington have had diverse and unique opportunities to interact and learn from indigenous people living in mountain environments. . This paper explores the cultural, ecological and historical setting of these three places, the nature of the partnership and the types of associated student – faculty engagements and the cross-cultural educational and research outcomes derived from each location. In addition, we describe cross-cultural encounters that often result in transformative experiences for both students and faculty, as well as lessons learned from the effects of major political and ecological disturbances and from current efforts to regain cultural roots and associated stewardship practices. How this knowledge can help inform future managers of different landscapes is discussed using a case study of an interdisciplinary research project in Jiuzhaigou National Park where the combined efforts of anthropologists, archaeologists, ecologists, geologists, social scientists, and soil scientists explored the nature of long-term and near-term human impacts on an environment and how current meadow and pasture 'restoration' may be culturally and ecologically inappropriate.

ECOLOGICAL GENETICS AND ENVIRONMENTAL CHANGE. CASE STUDY OF PHENOLOGICAL RESPONSE OF TREES ALONG ALTITUDINAL GRADIENTS

A. Kremer[1]

[1] *UMR Biodiversity, Genes & Communities, French National Institute for Agricultural Research (INRA), 69 Route d'Arcachon, 33612 Cestas Cedex, France, antoine.kremer@pierroton.inra.fr*

Ecological genetics is at the forefront of the debate about the response of trees to climatic change. There are widespread concerns that forest tree species may not be able to cope with future environmental changes. These concerns arise from the discrepancy between generation period of trees and the time span of climate change, in addition to the general assumption that, according to palaeoecological data, the rate of evolution is slower than the rate of present climate change. 'How fast will a tree population respond to climate change?' remains one of the main questions in this respect. I will show how evolution may be enhanced in trees by their large genetic diversity and their extensive gene flow among populations, and illustrate these predictions by a few examples. Monitoring genetic adaptation in trees is a challenging task, as genetic changes can hardly be monitored over generations on the same sites.

However measuring population differentiation along steep environmental clines offer an attractive alternative for assessing retrospectively adaptation of trees. I will take as an example the phenological response of tree population along altitudinal gradients in the case of oak and beech in the Pyrenees. The genetic variation of bud burst will be decomposed from the gene to the phenotypic level, based on QTL experiments, gene expression studies and nucleotide diversity assessments in candidate genes. I will further show the altitudinal variation observed at this different levels, and infer impacts of natural selection induced by the temperature gradient.

MORE THAN PRODUCTION: FORESTS, LIVELIHOODS AND SOCIAL SIGNIFICANCE FOR MOUNTAIN PEOPLE

A. Lawrence[1]

[1] *Forest Research, The Forestry Commission Great Britain, Alice Holt Lodge, Farnham, Surrey, GU10 4LH, United Kingdom, anna.lawrence@forestry.gsi.gov.uk*

Current discourses of forestry emphasise the need for adaptive and collaborative approaches, and these are especially important in the mountain context, where the close relationship between people and forests requires attention to the cultural and institutional context, and the processes whereby forestry knowledge develops. As concluded in a review of adaptive collaborative management, the principal characteristics of sustainable (adaptive) participatory forest management are: context specificity, tenure and institutional security, reliable and relevant information, and learning processes, leading to adaptive technology, institutions and organisations, underpinned by close attention to ecology. These characteristics form the framework for this examination of the social relationship with mountain forests.
Both forests and people in mountain areas share characteristics of diversity, ecological interdependence, remoteness from markets and socio-ecological fragility. At the same time, both are subject to rapid change: trends of globalisation and urbanisation mean in many cases simultaneous emigration of tradition populations from such areas, combined with increased tourist and recreational pressure. The paper draws on these characteristics to explore the particular challenges for local populations in managing, or co-managing, mountain forests. It draws on case studies to examine the roles of forests in mountain people's livelihoods, emphasising that mountain forests have more than utilitarian value; that local knowledge is important but vulnerable, and often needs support from other forms of knowledge; and that shared meanings and values for nature, in traditional and evolving cultures, affect the types of technology and institutional arrangements that work in these contexts. These observations are developed by exploring examples which take into account institutional and cultural context, drawn from the Philippines, Nepal, Cameroon, Romania and Scotland. The findings have implications for local ecological knowledge, forest management practices, institutional arrangements (e.g. community organisation, relationships with state forestry administration) and technology development (e.g. forest management). The paper concludes by relating these findings back to the key challenges for successful (sustainable) adaptive management: adaptive technology, sustainable harvesting and monitoring; and adaptive organisations and institutions.

EDUCATION AND CAPACITY BUILDING

D. McGuire[1]

[1] *Mountain Partnership Secretariat, UN Food and Agriculture Organization (FAO), Viale delle Terme di Caracalla, 00153 Rome, Italy, douglas.mcguire@fao.org*

Today, global change, including climate change, is impacting mountain communities and ecosystems in unprecedented ways. Mountain ecosystems, including forests, are highly sensitive and often early indicators of change which can cause serious environmental degradation and have negative socio-economic impacts. Drivers of change in mountains, both physical and socio-economic, are not well understood and further research is needed on many fronts. The sound management and conservation of mountain forests – including strategies to confront the risk of climate change – need to be key elements of overall efforts for sustainable mountain development.

Academic education and other types of capacity building are necessary to ensure that professionals and practitioners understand the important multifunctional role mountain forests play in sustainable development of mountain regions. Today, effective management of mountain forests requires not only technical knowledge but a more holistic view, with clear understanding of the "political dimension", including international processes and mechanisms affecting mountain forests. However, most academic curricula provide little or no focus on this issue. Renewed efforts are needed to raise awareness of existing gaps in academic education and to encourage revisions to existing curricula and development of new and innovative forms of training and capacity building at different levels. The MS-Curriculum "Mountain Forestry" at UNI BOKU is one of the only examples of its kind and should be used as a model for the development of similar curricula in other academic institutions.

The Mountain Partnership is a voluntary alliance of some 150 governments, civil society and inter-governmental organizations, working together in collaborative initiatives to achieve common goals and objectives. Given the diversity of its membership, it provides a forum to improve collaboration on issues such as education and research in mountain forests and the role they play in sustainable mountain development. FAO, which hosts the Mountain Partnership Secretariat, has historically played a key role in supporting forest research and improved curricula in forest education and is well positioned to offer significant support and guidance in addressing research concerns and formal and non-formal education regarding mountain forests in particular in a multi-functional context.

MOUNTAIN FORESTS UNDER PRESSURE

S.W. Running[1]

[1] *Numerical Terradynamics Simulation Group, Department of Ecosystems and Conservation Science, College of Forestry and Conservation, University of Montana, Missoula, United States, swr@ntsg.umt.edu*

Mountain forests are coming under significant new pressures. First, as climate changes, winter temperatures are getting milder, summer temperatures hotter, snowpack is retreating, and the seasonal hydrologic balance is shifting. These climate trends may cause either enhanced forest growth from longer growing seasons, or increased tree stress and mortality, depending on local conditions. Second, disturbance patterns are changing, with wildfire occurrence increasing in some regions, and insect epidemics developing in other regions. Third, forest management policy choices are changing, with historical forest product value now being overshadowed by the future potential of forest carbon credits and cellulosic ethanol. All these dynamic forces are converging on mountain forests that are also hosting greater human settlement and more valuable mountain recreational opportunities. This presentation will summarize these trends, with global examples, and suggest what lies ahead for mountain forests.

II. Oral Presentations

HISTORICAL DEFORESTATION PATTERNS AND THE CONSERVATION VALUE OF CHURCH FORESTS IN THE NORTHERN ETHIOPIAN HIGHLANDS

R. Aerts[1,*], R. Pankhurst[2], K. Van Overtveld[1], E. November[3], M. Hermy[1], B. Muys[1]

[1] *Division Forest, Nature and Landscape, Katholieke Universiteit Leuven, Celestijnenlaan 200E-2411, 3001 Leuven, Belgium*
[2] *Institute of Ethiopian Studies, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia*
[3] *Royal Museum for Central Africa, Leuvensesteenweg 13, 3080 Tervuren, Belgium*
** Author for correspondence: raf.aerts@biw.kuleuven.be*

Mountain forest plants have a limited capacity for migration because altitudinal gradients usually set strict limits to plant species' ranges and often present physical barriers against dispersal. Innate 'islands' of biodiversity, mountain forests are therefore particularly vulnerable to the effects of climatic change and habitat fragmentation, both key drivers of global species loss. Conservation of these ecosystems must for that reason rely on protecting not only large fragments but also small habitat patches and relictual vegetation along a wide altitudinal range.
When large fragments in such ecosystems are no longer available, small fragments become an environmental priority. Striking examples of small mountain forest fragments are the church forests of the northern Ethiopian highlands. In a landscape dominated by degraded semiarid savanna, sacred groves represent the majority of all remaining patches of Afromontane forest. Previous studies in the region only covered few fragments and could not adequately estimate the conservation value of these forests. For that reason, we digitized 394 church forests in an area of half a million hectares by systematically scanning high spatial resolution satellite images (pixel resolution 0.8 m) in eight blocks in the northern highlands and calculated area, density, shape, isolation and configuration metrics. Forest cover is only 0.2%, much lower than usually estimated in the literature (4%). Fragment shape and spatial configuration in the north and northeast of the surveyed area (irregular forests on northwestern slopes with churches near the forest edge) are consistent with forest conservation after fragmentation, while forests in the south and west (regular round forests surrounding a central church) indicate conservation prior to widespread deforestation. Fragments are small throughout the region (2.5 ± 0.2 ha) and need expansion, but known vegetation differences between church forests related to the two different historical fragmentation processes call for different strategies for forest conservation and restoration.

COMPARISON OF CLOSED AND UNCLOSED FOREST MANAGEMENT SYSTEMS IN RESTORING DEGRADED DRY AFROMONTANE FOREST OF NORTHERN ETHIOPIA

E. Aynekulu[1,*], M. Denich[2], P.L.G. Vlek[2]

[1] *Mekelle University, P.O. Box 231, Mekelle, Ethiopia*
[2] *Center for Development Research (ZEF c), University of Bonn, Walter Flex Str. 3, 53113 Bonn, Germany*
[*] *Author for correspondence: ermias8@yahoo.com*

The northern Ethiopia which is characterized by rugged and mountainous landscapes was once well covered with dense forest. However, due to various natural and anthropogenic reasons, the forest ecosystems are highly degraded and fragmented leading to local extinction of important tree species. In this study we compared the role of closing the natural forest from human and livestock interference in fostering the natural regeneration of two keystone species (*Olea europaea L. subsp.cuspidata* and (*Junipersu procera*) as a mechanism to restore the degraded dry Afromontane forests of northern Ethiopia. Closed and unclosed sites with similar biophysical settings were mapped and sampled using 32 random quadrats (20m*20m), 16 from each. The result indicated that the closed management system has highly significant (α = 0.05) positive contribution on the seedling bank of *Olea europaea L. subsp.cuspidata* (Chi-square=9.6, df=2, P=0.0019) as compared to the unclosed forest. Contrarily, the seedling bank of *Juniperus procera* is significantly higher in the open management system (Chi-square=7.5, df=2, P=0.0061) and possible reasons were discussed. The structural and floristic compositions of the forest under both management systems were analyzed and better management options that enhance the health of the forest habitats were further discussed.

ASSESSMENT, CONSERVATION AND MANAGEMENT OF NON-TIMBER FOREST PRODUCTS (NTFPs) IN THE ARUN VALLEY SANKHUWASABHA DISTRICT OF EASTERN NEPAL HIMALYA

R.B. Bhandari[1], B.H. Pandit, Y.B. Raya, A. Ghimire

[1] *University of Rome "Tor Vergata", Via della Ricerca Scientifica, 00133 Rome, Italy, rbbhandari@gmail.com*

A survey was carried out from August, 2005 to February, 2006 in Sankhuwasabha district (324m-8,463m), which is unique, diverse and endowed with some of the last remaining pristine forests in the eastern development region of Nepal Himalaya. The district was found very potential in terms of biodiversity and availability of Non-timber Forest Products (NTFPs) especially high altitude medicinal and aromatic plant resources and other economically important NTFPs due to its climatic and altitudinal variations. It was also found that NTFPs serve as the basis of livelihoods of rural people in the study area. During the survey, 104 species of medicinal and aromatic plant resources with other high economic value of NTFPs were recorded. Of the 104 species surveyed, seven high value NTFPs species from upper elevation (above 2000m) namely; Chirayito (Swertia chiraito), Bikhma (Aconitum bisma), Kutki (Picrorhiza scrophulariiflora), Panch Aunle (Orchis latifolia), Lauth salla (Taxus baccata), Pakhanved (Bergenia ciliata) and, Timur (Xanthoxylum armatum) and from

the lower elevation (below 2000m), two species namely, wild asparagus (Asparagus racemosus), and Chabo (Piper chaba) are locally threatened. Some of the local NGOs, civil societies and Community Forestry User Groups (CFUGs) have been involved in conservation of these resources by establishing nurseries and cultivation on private lands and community forests. Despite these efforts, these resources are threatened because of over-harvesting for raw materials, medicinal use and trade in the study area.

RECREATION AND WILDLIFE MANAGEMENT – A CHALLENGE FOR FORESTRY: POSSIBILITIES OF CONFLICT IDENTIFICATION AND CONFLICT MANAGEMENT

C. Brandenburg[1,*], W. Lexer[2], F. Heckl[2], A. Muhar[1], F. Reimoser[3], R. Zink[3], A. Bartel[2], T. Schauppenlehner[1]

[1] *Institute of Landscape Development, Recreation and Conservation Planning (ILEN), Department of Landscape, Spatial and Infrastructure Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 65, 1190 Vienna, Austria*
[2] *Federal Environment Agency – Austria, Spittelauer Lände 5, 1090 Vienna, Austria*
[3] *Research Institute of Wildlife Ecology (FIWI), University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria*
[*] *Author for correspondence: christiane.brandenburg@boku.ac.at*

Forests are subject to different land use demands by various user groups. In particular game management and recreational activities cause manifold impacts on forests and their management. Balancing the production, protection, welfare and recreation functions of forests with their habitat function for wildlife communities and hunting interests poses enormous challenges to multiple-purpose and sustainable forestry. An integrated approach to the management of resulting land use conflicts requires balancing the interests of foresters with those of other land user groups and with public interests, based on a complex regional view of conflict potentials and existing conflicts.
In the presentation, the participatory research project "Integrated Sustainable Wildlife Management in the Biosphere Reserve Wienerwald" will be introduced. Its main objective is to develop cross-sectoral, integrated approaches (assessment and monitoring tools, management strategies) to the management of conflicts between game management, forest management, recreational activities and other land use interests typical of a multiple-use forest landscape in a peri-urban area setting. The design of the stakeholder participation process and the methods of participatory research applied will be explained, research findings on interactions and conflicts between different user groups will be presented, and their implications for conflict management will be discussed. Based on a multidisciplinary stakeholder panel (regional experts, NGOs, land owners, forest managers, active citizens, reserve managers, local authorities etc.), expert interviews and extensive surveys (1300 interviews, questionnaires) of main user groups (foresters, recreational users, farmers), existing conflicts and conflict potentials were identified, and their significance and consequences for sustainable land use in the Biosphere Reserve were investigated. As a main result, a cross-sectoral sustainability assessment framework for interrelations between forestry and recreation and game management was developed.

FROM MOUNTAIN FOREST TO COAST SUSTAINABILITY AND MARKET VALUE OF MEDICINAL PLANTS IN NORTHERN PERU

R. Bussmann[1]

[1] *William L. Brown Center for Plant Genetic Resources Missouri Botanical Garden, P.O. Box 299 63166-0299 St. Louis, MO, United States, rainer.bussmann@mobot.org*

Northern Peru represents the center of the Andean "health axis", and the continuous use of more than 500 medicinal plants has been documented. Traditional Medicine is experiencing increasing demand, as indicated by the fact that the number of herb vendors, in particular in the markets of Trujillo, has increased in recent years, and the markets have an immense economic value. Also, a wide variety of medicinal plants from Northern Peru can be found in the global market. Local healers as well as patients buy a large part of their plant supply in local markets. While limited data exist with regard to market inventories, no information was available on how the plants get to the larger market, if they are cultivated or wild collected, and what kind of income the collectors and venders receive, and if this activity represents a sustainable forest use activity. The presented paper reports on the complete market flow from collection to sale. Herbs are mostly wild collected in the forests and highlands, and both, collection as well as transport to the coastal markets required long distance travel. The collector's income is hardly sufficient to provide for a family. The low income indicates that the herb-trade is very fragile, as collectors might either decide to engage in higher income activities, or higher turnover, which could easily lead to over-harvesting of rare medicinal species in the region. Today the most serious threat to mountain forests and other medicinal plant sources in Northern Peru is habitat destruction. Urban sprawl and the sugar industry have already greatly altered the coastal plains. Climatic change and deforestation are threatening the mountain forest systems that are the source of many medicinal species, and the high Andean ecosystems are in danger of being destroyed by large-scale mining activities.

PHYSIOLOGICAL AND GROWTH RESPONSE OF EUROPEAN LARCH (*LARIX DECIDUA* MILL.) IN UPPER TIMBERLINE (SE ALPS)

M. Cater[1], T. Levanic

[1] *Slovenian Forestry Institute, Vecna pot 2, 1000 Ljubljana, Slovenia, matjaz.cater@gozdis.si*

Climatic change and their consequences request new and applied knowledge for the sustainable approach in forest management. Because of frequent and rapid weather extremes and their consequences, especially raise of temperature and precipitation redistribution, altitude of the upper timberline is being changed.
Extreme growth conditions and relatively short vegetation period might contribute to reduced vitality of adult trees, disturbed natural regeneration and their water retention capacity. Our recent studies show significant correlation between tree-ring width (TRW) and temperatures in June and July and also correlation between TRW and temperatures in May for the period of last 30 years. Shift into early stages of vegetation period represents a serious threat because of possible damages caused by early frosts.

On location with adult larch trees (*Larix decidua* Mill.) on upper timberline, where influence of above-average temperatures in April has been confirmed, same number of vital and physiologically weakened trees have been determined. Within physiological parameters reaction of different light intensity and different CO_2 concentration has been measured and compared with tree ring growth parameters and meteorological data.

PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSE TO LIGHT OF YOUNG BEECH IN SLOVENIAN MOUNATIN FOERSTS

M. Cater[1]

[1] *Slovenian Forestry Institute, Vecna pot 2, 1000 Ljubljana, Slovenia, matjaz.cater@gozdis.si*

More frequent and intensive pressures to which mountain forests are exposed are connected with higher risk-rates of forest management and increasing number of extreme events, especially on marginal and extreme sites. Importance of autochthonous tree species is being emphasized.
In Slovenia, with 60% forests cover, sites of mixed broadleaf species predominate, in particular natural beech forests. Quality of future stands depends also on understanding of tree-response to different light conditions and changed CO_2 environment, especially under mature canopy and in younger development stages.
In view of predicted and evident changes five plots on natural mountain beech forest-sites were selected with young beech trees of the same age (15-20 years) and local provenance. Trees were equally distributed along the comparable light gradient, measured by the hemispherical photos (WinSCANOPY) and were divided according to light conditions into three groups: stand conditions (ISF<20), edge (20<ISF<25) and open area conditions, without sheltering effect of mature stand (ISF>25).
Under same and fixed key-environmental parameters (T, gas flow, CO_2, humidity, light intensity) light saturation curves and A-Ci curves (LI-6400) were established for beech trees in all light categories during the same time period.
To define relation between light intensity and future timber quality also plagiotropic growth of young trees under similar light conditions were compared during three successive vegetation periods, defined as the relation between length and height of studied plants.
Differences in response between beech under shelter, at the forest edge and in the open as well as between different forest complexes were confirmed. Different response of young beech was also confirmed between managed and virgin forest.

INDIGENOUS KNOWLEDGE IN NATURAL RESOURCE UTILIZATION BY THE HILL PEOPLE: A CASE OF THE *MRO* TRIBE IN BANGLADESH

M.S.H. Chowdhury[1,*], A. Halim[2], N. Muhammed[1], M. Koike[1], S. Biswas[3]

[1] *Forest Policy Laboratory, Department of Forest Science, Faculty of Agriculture, Shinshu University, 8304-521 Minamiminowa-Mura, 399-4511 Nagano-Ken, Japan*
[2] *Department of Forestry and Environmental Science, School of Agriculture and Mineral Sciences, Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh*
[3] *Institute of Silviculture, Department of Forest- and Soil Sciences, University of Natural Resources and Applied life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[*] *Author for correspondence: shaheedfeni@yahoo.com*

The Chittagong Hill Tracts (CHTs) region of Bangladesh, covering a considerable portion of 'hill forest type' of the country, is rich in biological diversity; in terms of flora, fauna and ethnicity. A number of aboriginal and tribal communities enrich the cultural heritage of the region. Thanchi Upazilla of Bandarban district in CHTs is the remotest forested area where some tribal groups lead their subsistence life depending fully on natural resources. An exploratory study was conducted there on the indigenous knowledge (IK) practiced by the Mro tribe in their everyday activities highlighting traditional utilization of forests and other natural resources. A total of 36 farms were assessed using different participatory appraisals through semi-structured questionnaire. The respondents were peasants who live in the hilltops in a pristine environment, inside the high ranges of hills and dense forest almost totally beyond the eyesights of the outer civilized society. They developed IK of their own in practicing shifting cultivation (Jhum) and other land use systems along with the utilization of natural resources. In most cases, such IK have become the key factors in the sound management of forest resources with sustainable utilization of biodiversity. But most of the wealth of their IK is being threatened by the settlement of the non-tribal people in the CHTs region. The life style and ethno-forestry perception regulated by the IK governing the daily activities of the ethnic communities need to be explored highly, in order to conserve them as well as to assess the possibilities to conserve the forest resources by utilizing such traditional indigenous concepts.

IMPACT OF CHANGING FOREST TENURE REGIME ON LIVELIHOODS, INCOME, FOREST CONDITION AND EQUITY (LIFE) IN THE MID HILLS OF NEPAL

G.R. Dahal[1]

[1] *Center for International Forestry Research (CIFOR), Bogor Barat 16000, Indonesia, gdahal@cgiar.org*

Nepal's forest tenure has been changing over time. Traditionally forest management and use was a part of various local systems. Until recent decades, state as the owner of all kinds of land barring private agriculture land, used forest as a means of revenue generation and consolidating local and central power position. One communal property right system called kipat in Eastern Nepal survived until the 1960s when the system was abolished by converting the lands to state property (Tamang and Singh, 2004). A major change in tenural arrangements of forest resources occurred when

government after the end of Rana regime adopted Private Forest Nationalization Act of 1957 which nationalized ownership and management of all forest land previously owned and managed by private individuals, such as members and relatives of royal family, and communities. This centralization of all types of tenural rights over forest has had negative consequence on the condition of forest as it led deforestation to a greater scale (Singh and Chapagain, 2007). Because of lack of tenure security, those who previously owned forest destroyed it for immediate personal benefit. Several local indigenous communities, mainly in the hills, who had de facto rights over forest use and management, also lost the sense of ownership which, consequently, adversely affected the condition of forests. As nationalisation of de facto community managed forest increased deforestation, government reversed policy by decentralizing the nationalized forest in 1976 and in 1978 it enacted laws to decentralize forest management to local government units as Panchayat and Panchayat Protected Forests (Aryal and Anglesen, 2007). Since the decentralisation of forest management continued to exclude the traditional users, conflicts started between the Local Panchayat and traditional users and land degradation continued (Tamang and Singh, 2004). Then, a more radical devolution of rights to local community through the formation of Forest Users Groups (FUG) started in the1980s which were backed by the Forest Act 1993 and Regulation 1995. The implementation of the programme has been mainly limited in the Hills and a restrictive approach to high value forest in Terai was adopted. More recently, the concept of CF has been extended in Buffer Zone Management of the PAs. So far more than 14000 FUGs have been formed and CF covers about 20% of total forest area in the country which is about 28% of potential area for CF in Nepal (Adhikari et al, 2007). Against this backdrop, this paper presents the impact of changing forest tenure regime on people's livelihood, income, forest condition and equity (LIFE) in the mid hills of Nepal. The empirical data are drawn from the on going research work in four selected districts in Nepal under the auspices of Centre for International Forestry Research (CIFOR).

LAND USE CHANGE AND FOREST CARBON SINK IN THE MOUNTAINOUS TERRITORY OF VENETO REGION (NE ITALY) IN ORDER TO APPLY THE KYOTO PROTOCOL

E. Dalla Valle[1], S. Lamedica , R. Pilli, T. Anfodillo

[1] *Department of Land Use and Agro-forestry Systems, University of Padua, viale dell'Università, 23 35020 Legnaro (PD), Agripolis, Italy, elena.dallavalle@unipd.it*

The Parties that have signed the Kyoto Protocol must reduce global emissions of Greenhouse Gasses (GHG) during the First Commitment Period (2008 – 2012) by at least 5% with respect to 1990. This share is 6.5% for Italy. The Kyoto Protocol lays down some measures for reducing GHG emissions, which include actions in agriculture and forestry. It will thus be possible to take emissions and absorptions resulting from land use changes into account in the National Balances. Given the widespread forests in Italy, it is very important to have an assessment of the aptitude of this sector to act as a carbon sink. In this study we analysed the variation of forestland cover in a mountain area of the Veneto Region (NE Italy). The analysis was done by comparing aerial photos taken in 1991 with orthophotos reported to 2003, by photointerpretation of points with casual distribution on sample areas, according to a stratified sampling. We estimated a statistically relevant increment of about 0.095% of

forest land only up to 1500 m compared to the estimated forest cover for 1990 (about 42 ha), underlining how this low increase is mainly due to forest management. The second step was to estimate the fixed carbon in the areas where forests increased. This was achieved by collecting biometrical data in the field, and then using allometric functions. The annual carbon sink was estimated as 0.69 Mg ha-1 year-1. Comparing these results with previous studies done in the pre-alpine region we estimate the annual increment of the forest area in the whole Veneto Region to be about 409.94 ha and that the total carbon sink is about 282.86 Mg C year-1. A method for estimating carbon sink in afforestation/reforestation areas is proposed that could also be applied to other sites in Italy.

LAND-USE CONFLICT AND FOREST REHABILITATION IN BADEN MOUNTAIN, SOUTH VIETNAM

T.K.P. Dang[1]

[1] *Tay Ninh Provincial Department of Agriculture and Rural Development, Vietnam / Wageningen University, Bornsesteeg 1-18A-10 6708 GA Wageningen, The Netherlands, thikimphung.dang@wur.nl*

As the highest mountain in the southeast of Vietnam (986m), Baden Mountain is famous for its sacred temples that attract thousands of tourists during the spring festival. During the war, the mountain was bombed and sprayed heavily so its natural forest was damaged, degrading to secondary forests with the dominance of bushes. After the war, the mountain has been recognised as one of the cultural, historical and environmental areas of Vietnam. A study on its fauna observed 59 species of reptiles and 12 species of amphibian in which 14 species were listed in the Vietnam Red Book. In 2005, biologists discovered in the area two new species of reptiles that have never been found anywhere around the world. Therefore, the protection and rehabilitation of the mountain's forest have also been urged by biodiversity concern. Started early in the 1980s, reforestation in the area, however, is still far from successful. Looking at challenges in the attempts to rehabilitate the mountain forest, the study identified 5 types of land-use involving in the conflict. Among others were, reforestation, agricultural activities by local farmers focusing on fruits trees, over-exploitation of forest products and non-timber forest products especially reptiles, granite exploitation and unstainable tourism. Causal factor of conflict was identified as the low governance capacity in land-use management in the three following aspects. *First*, land- use planning was still top down with limited participation of stakeholders engaging in the conflict. As a result, there was significant incongruity in plans and regulations regarding to land use of the mountain between central and local governments. *Second*, land-use in Baden moutain suffered diverging discourses among actors involved and the dominant discourse policy still focused more on short-term economic gains than on environmental values. *Third,* low income from forest plantations and inadequate benefit sharing in forest protection discouraged local farmers to participate in forest rehabilitation.

EFFECTS OF SUBSTRATE, BAMBOO COMPETITION AND GRAZING ON REGENERATION OF *TSUGA DUMOSA*

A. Darabant[1,*], P.B. Rai[2], G. Gratzer[1], K. Tenzin[3]

[1] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[2] *Renewable Natural Resources Research Center, Jakar, Bumthang, Bhutan*
[3] *Renewable Natural Resources Research Center, Yusipang, Thimphu, Bhutan*
[*] *Author for correspondence: darabant@gmail.com*

Management of *Tsuga dumosa* (Himalayan Hemlock) dominated mixed conifer forests in Bhutan poses several challenges, mainly linked to regeneration. We presented two studies addressing regeneration issues of *T. dumosa* dominated forests with focus on substrate requirements, competition and facilitation by understory vegetation and cattle grazing in natural and harvested stands. Research methodology included an inventory encompassing a large forest area, used to derive main factors affecting tree regeneration and permanent sample plots with repeated measurements over time.
The two studies independently confirmed narrow substrate requirements for the small seeded conifers *T. dumosa* and *Picea spinulosa* (Himalayan Spruce). Both species had higher differential survival on decomposed nurse logs and moss pads and were able to shift between these substrates based on their availability. Both species were negatively associated with other forest floor microsites, especially bamboo litter. Larger seeded *Abies densa* (Himalayan Silver Fir) and *Pinus wallichiana* (Blue Pine) were able to regenerate on a wider range of substrates with the exception of bamboo litter. Under strong competition by the palatable bamboo *Yushania microphylla* in small gaps, cattle grazing substantially facilitated conifer regeneration, especially of *T. dumosa*, likely through increased light interception on the forest floor and increased availability of suitable substrates.
The study highlights the importance to revise silvicultural prescriptions. Smaller openings will maintain microclimatic conditions necessary to maintain bryophyte communities and retention of large size logs and snags will create nurse logs necessary for successful regeneration of *T. dumosa* and *P. spinulosa*. In openings with strong dominance of palatable bamboos, vegetation management through moderate cattle grazing should be explored to facilitate conifer regeneration.

SCOTS PINE STAND STRUCTURE AND GROWTH AFTER SNOW DAMAGE UNDER DIFFERENT THINNING REGIMES

M. del Río[1], F. Montes, M. Sánchez, S. Mutke, I. Cañellas

[1] *Forest Research Center, National Institute for Agricultural Research (CIFOR-INIA), Ctra. de la Coruña, km 7.5, 28040 Madrid, Spain, delrio@inia.es*

During the winter of 1996, a heavy snowfall in the Central Mountain Range (Spain) caused heavy damages in *Pinus sylvestris* forests, involving losses of 200,000 m3 of timber (more than twice the annual yield of these forests). This snowstorm affected a thinning trial, which allows analysing its consequences on stand structure and development ten years later under the different thinning regimes. The worst damage

occurred in non-thinned plots, decreasing the importance of the damage as thinning intensity increased.
The thinning trial is located in a even-aged, natural-regenerated stand of medium site quality (site index 23 m top height at 100 years). The experiment began in 1971 when the stand was 35 years old, with a complete random block design (three blocks and four treatments: one control without thinning and three with differing thinning intensities from below). Since 1971 three thinnings had been carried out, the last one at age 55, five years before the snowfall. Stand structure is analysed through spatial pattern and diameter distribution. The Ripley's K function and its Besag transformation L(d) are used to study the spatial pattern in each plot and the treatment-specific mean. The stand development under different treatments is compared through an analysis of variance of the main stand variables.
In spite of the small gaps opened by fallen trees, non-thinned plots present a random spatial pattern, typical of even-aged structures. Thinned plots show regular spatial patterns at short distances (under 4-5 m), more patent in heavier thinned stands. The differences between thinned plots and control plots in relation to the main stand variables are less significant after snow damage, since the damaged trees were mainly from lower crown classes in the control plot and lightly thinned plots, *i.e.* the thinning from below anticipated actually the natural stand dynamics. However, the mean diameter growth in the control plots does not increase considerably after the damage, probably because of the irregular distribution of fallen trees, some damages on standing trees and also the low growth response of the species to thinning at older ages. Basal area growth of non-thinned plots even showed a decrease during the first 5 years after the snowfall comparing to the other treatments.

INTEGRATED MONITORING OF AIR POLLUTION EFFECTS IN THE AUSTRIAN LIMESTONE ALPS: LONG-TERM TRENDS IN FOREST SOILS, GROUND VEGETATION, BRYOPHYTES AND LICHENS

T. Dirnböck[1]

[1] *Federal Environment Agency – Austria, Spittelauer Lände 5, 1090 Vienna, Austria,* thomas.dirnboeck@umweltbundesamt.at

The Long-Term Integrated Monitoring site "Zöbelboden", Austria, was established in the early 90ties as a reference for current air pollution effects in remote mountain forest ecosystems on calcareous bedrock. Within a catchment of 90 ha, air pollutants, climate and a wide array of bioindicators are measured in the long-term across ecosystem compartments. Here we present long-term trends of airborne deposition of pollutants, soil chemical parameters, forest ground vegetation, bryophytes and epiphytic lichens. The soils responded significantlyto the deposition of airborne pollutants. Clear trends were detected for the pH-value, a series of heavy metals (copper, zinc, manganese, chromium, lead), and nitrogen. Excess nitrogen deposition apparently caused soil eutrophication. The detected trends of soil properties were only ambiguously reflected in changes of forest floor vegetation. A weak response predominates under intermediate site conditions, whereas oligotrophic sites did show a clear change towards a nitrogen- and base-rich situation. Terrestrial and epiphytic bryophyte species remained rather stable. Long-term airborne nitrogen and sulphur deposition had a significant impact on epiphytic lichens. Lichen communities show a deteriorating development in response to air pollution and are becoming increasingly

dissimilar from communities typical of clean air conditions. In general, biodiversity declined from the beginning of the 1990s until the year 2005. With only one exception - epiphytic lichens - this trend is consistent for species numbers of the entire study area, and for mean species numbers at the scale of permanent plots. Biodiversity is controlled by a range of interlinked factors with air pollution as a significantly negative contributor.

SILVICULTURAL CONTRIBUTIONS TO CONSERVATION AND REHABILITATION OF FOREST RESOURCES IN THE ANDES OF ECUADOR

S. Günter[1], B. Stimm, M. Weber, R. Mosandl

[1] *Institute of Silviculture, TU Munich, Am Hochanger 13, 85354 Freising, Germany, sven_gunter@yahoo.de*

The tropical mountain rain forests of Southern Ecuador are part of one of the world´s hotspots of biodiversity. Exemplary for many regions in the tropics, the natural forests in the study area are frequently converted into pastures. This process is accompanied by a loss of biodiversity and many environmental services. Our research demonstrates the feasibility of forest and biodiversity conservation by means of scientifically based forest management. Several silvicultural experiments were conducted, including natural succession of abandoned pastures, reforestation with native and exotic species, enrichment planting of *Pinus patula* plantations with native species and natural forest management. There is evidence that natural succession may lead to species rich secondary forests. However, the growth was slow, and species with timber value could not regenerate naturally, even after 40 years of succession. Reforestation trials on abandoned pastures showed that some native species can compete with exotics in growth and survival, but many natives with higher timber value require a tree shelter for better performance. For instance *Cedrela montana* and *Tabebuia chrysantha* grew better in gaps of Pine plantations than on abandoned pastures. These results suggest that underplanting of Pine plantations could be a promising option for the conversion of pure plantations into mixed forests. Experimental improvement thinnings in adjacent natural forests resulted in an enhanced diameter growth for some timber species. These silvicultural interventions had no impact on epiphytes and moths as indicators for alpha diversity. The nutrient availability in the soils was increased, but there were no changes of the pH and electrical conductivity of the stream water. This indicates that sustainable management of natural mountain rain forests may be possible. However, single alternative land use options cannot lead to sustainability on the landscape scale, but concerted actions may be successful in combating the deforestation process in Ecuadorian tropical mountain forests.

A DISTURBANCE TO ‚INTEGRATED' MANAGEMENT: THE FRAMING OF KNOWLEDGE IN CONSERVATION AND MANAGEMENT OF JUNIPER FORESTS IN SOUTH KYRGYZSTAN

B. Habermann[1]

[1] *Commission for Development Studies (KEF), Austrian Academy of Sciences (ÖAW), Dr. Ignaz Seipel-Platz 2, 1010 Vienna, Austria, Birgit.Habermann@oeaw.ac.at*

This paper highlights the experiences made during a project aiming at the development of an integrated forest management plan for the juniper forests in Southern Kyrgyzstan. These unique forests of almost mystic beauty are threatened by a variety of both external and internal influencing factors:
Being located in a politically sensitive transition zone between Uzbekistan and Tajikistan it is an almost politically autonomous region with little influence and legal control by the central government in Bishkek. It is basically an area governed by its own rules and politics, with even higher levels of corruption and nepotism than in other parts of the country.
With proximity of the Walnut-Fruit-Forests in the North-East of the country, a lot of conservation efforts have gone into this direction, as well as the international attention due to the enormous endogenous biodiversity and its economic relevance with regards to the genome potential of these wild fruit trees and valuable walnut timber.
The Soviet system has left deep imprints on forest management and ideas of conservation in Kyrgyzstan. Forest management is highly centralized, heavily under-subsidised, and in opposition to local people in a sense that the general understanding is that forests *need to be protected from* local people. This neglects the fact that the major impact on the forests comes from within forest management, e.g. by means of bad management, lack of expertise on local forests, and corruption leading to turning a blind eye on illegal logging operations by members of politics, powerful elites and the wealthy and influential drug-traders.
Thus, as this paper will show in more detail, the way knowledge is framed is heavily impacted by the above. Scientific knowledge is mostly derived from studies made during the time when Kyrgyzstan was part of the Soviet Union, published in Russian only, and done by non-native Kyrgyz scientists relatively new to the area. Knowledge of lay experts, be it forest officers or semi-nomadic farmers, is said to be non-existent and is seen as being destructive to the forests. The disruption in traditional management may have lead to the loss of knowledge in some aspects of forest management. However, this paper will illustrate how local farmers and foresters have made new experiences and developed their understanding of forest management over the last two decades. Sadly, both the Kyrgyz and the international part of the project in question have not attributed this knowledge sufficient value to enter into integrated management of the juniper forests, putting a question mark on the future of these unique and beautiful forests.

THE DISTRIBUTION OF BLACK SNOW MOULD (*HERPOTRICHIA* SPP.) IN THE DÜRRENSTEIN WILDERNESS AREA (AUSTRIA).

M. Hinker, J. Pennerstorfer, E. Halmschlager[1]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Hasenauerstr. 38, 1190 Vienna, Austria, erhard.halmschlager@boku.ac.at*

Black snow mould (*Herpotrichia juniperi* and *H. coulteri*) is considered a key factor for the survival and growth of its conifer hosts in subalpine forests and at the timberline in the European Alps. These pathogenic fungi have the potential to alter the characteristics of plant populations and communities. In summer 2007 we studied the distribution of black snow mould in an area covering about 1064 ha in the IUCN category I wilderness area "Dürrenstein". The incidence and severity of black snow mould was assessed in three natural habitats (i.e. Tilio-Acerion forests of slopes, screes and ravines, Vaccinio-Piceetea and Mugo-Rhododendretum hirsuti), where susceptible host species (*Picea abies*, *Pinus mugo*, *Juniperus* spp.) were suspected to occur. Fixed-sized, systematic sample plots, 20 m in diameter, were established at 200-m intervals along a regular grid using GPS. Only plots located in one of the three selected habitats were considered for data collection. On each plot disease incidence was evaluated for each host species and disease intensity was rated using a 0-3 classification scale. Site and stand characteristics including elevation, aspect, slope, meso- and microrelief, vegetation type, composition of tree species and stocking degree were also recorded on each plot. Infection of conifers by *Herpotrichia* spp. was found on 184 (approx. 75%) out of 246 plots. Disease intensity was very severe or severe on 44% of the plots. On 131 plots, infection was recorded on only one host (about half on *P. abies* and half on *P. mugo*), while on 52 plots *Herpotrichia* infestations were found on both hosts. There was only one plot, where a *Juniperus* species was additionally affected. The high intensity of black snow mould may suggest that *Herpotrichia* species have a significant impact on regeneration, survival and growth of susceptible conifer hosts in the study area.

EFFECTS OF SILVICULTURAL MEASURES ON RESISTANCE AND ELASTICITY OF PURE NORWAY SPRUCE STANDS (PICEA ABIES [L.] KARST.) IN THE MONTANE ZONE OF THE BAVARIAN ALPS

S. Höllerl[1]

[1] *Institute of Silviculture, TU Munich, Am Hochanger 13, 85354 Freising, Germany, hoellerls@forst.tu-muenchen.de*

There are many pure Norway spruce stands in the mixed mountain forest zone of the Bavarian Alps which are human-caused and considered to be very unstable. These stands mainly cause problems in the area of protection forests, where resistance and elasticity of the forest stand play a major role in alleviating the effects of natural hazard. In the long run forests are most stable and provide best protection, if not only the matured stand is resistant against snow, storm and insects but there is also an advanced tree regeneration which will lead to quick reforestation after natural hazards.

A research project carried out by the Institute of Silviculture (Technical University of Munich) aimed to clarify, to what extend silvicultural interventions could improve the stability of spruce stands in the montane zone. Treated and untreated stands of three age groups have been compared according to different parameters of resistance and elasticity. The results show that silvicultural measures are an appropriate means for reducing the slenderness of trees and increasing the crown length. But the effects on these parameters are not very strong. The reaction of spruces is most intense the earlier measures are taken. The overall effects are best if treatment is carried out on a regular basis. Treated stands show significantly higher levels of very healthy spruces and lower levels of less healthy spruces.
However, hardly any structural improvement can be achieved by treatment of spruce stands, as the structure is already very diverse. For sustainable structural improvements, a conversion to mixed stands is necessary.
The interventions foster advanced mixed regeneration, although mixed tree species are scarce in mature stands. Treated stands show higher elasticity than non-treated stands, as density of advanced regeneration is higher and there are also plants present which are higher than 20 cm (7.82 inch). But only in a few research plots density levels were reached which are considered to be high enough to maintain a protective function. Therefore additional planting is essential. Moreover additional planting supports a wide genetic diversity which cannot be established by occasionally occurring mixed tree species. In any case an excessive population of game has to be reduced in order to enable mixed tree species to grow.

SUSTAINABILITY OF COMMUNITY BASED FOREST MANAGEMENT: CASE STUDY OF MARGAHOVIT COMMUNITY IN NORTHERN ARMENIA

A. Jenderedjian[1]

[1] *Armenia Tree Project (www.armeniatree.org), Arshakunyats Street 57/5, 0026 Yerevan, Armenia, annaj@armeniatree.org*

The research describes the progress achieved so far in the educational and capacity building context within the implementation of a project "Evaluation and Implementation of Sustainable Forestry Models in Northern Armenia" by Armenia Tree Project in partnership with Yale University of Environmental Studies – Global Institute of Sustainable Forestry. The goal of the study is to produce sustainable forestry training models that are replicable and adaptable to local conditions with advanced analytical techniques and community capacity building. Since the adoption of a new Forest Code, the forestry sector of the country is going through major changes: previously government-owned and managed forests are to be transferred to the community management. As a pilot site for community based forest management mountainous village Margahovit was chosen. The survey showed that in order to reach sustainable management of community forests, the capacity building and empowerment are needed, as the local population had no previous experience in managing forests and perceives the forest as a source of their well-being, however considers it as a non-limited resource. Thus, the community needed to not only acquire new skills and knowledge, but also formulate a new perception on/about the environment. An integrated approach was suggested, where the capacity building is reached through creation of a positive learning environment for various stakeholder

groups. The main activities involve: - environmental education program for local community members (youth, schoolchildren, livestock owners); - train local community members on sustainable forest management; - train local community on the use of decision analysis tools and techniques..

BLUE SPRUCE FOREST STAND IN SMALL POLE STAGE ON THE EXTREME MOUNTAIN LOCALITY AND ITS RELATION TO EUROPEAN BEECH INTERPLANTINGS PROSPERITY

O. Spulak, D. Kacalek[1], V. Balcar

[1] *Forestry and Game Management Research Institute, v.v.i. Strnady, Research station at Opocno, Na Olive 550 517 73 Opocno, Czech Republic, kacalek@vulhmop.cz*

Due to air pollution in the Czech Republic in 1970's to 1980's, decline of the forest stands especially in the mountain regions occurred. On climatically extreme localities, plantations of native tree species, mostly Norway spruce (Picea abies (L.) Karst.), died and substitute tree species were planted instead. Blue spruce (Picea pungens Engelm.) was the most extended tree species to be used in the mountains. This species was planted to save forest environment till the (air pollution) situation becomes favorable for autochthonous tree species again. In 1990's first experiments of interplantings of native species into blue spruce forest stands were established. Blue spruce forest stand on the locality Plochý (880 m a.s.l, acidic spruce forest site) in the Jizerské hory Mts. was planted in 1985 to 1990 (repair planting). Situation of climate changes requires experiments investigating the tree species prosperity on the edge of their ecological potential. Therefore research plot of Plochý was established in 1995 to study optimization of interplantings of European beech (Fagus sylvatica L.) into these forest stands. Coordinates of all trees were located; every year parameters measured on the beech were: tree height, health status, damage. In 2006 blue spruce was measured retrospectively (tree height development, tree diameter, crown parameters). During all the growing period, no blue spruce tending on the plot was done and natural mortality was very low (less than 2%). Beech had high mortality (53%) and variable increment which seemed to be related to the position to near standing spruce trees. This issue focuses on the evaluation of the structure of the stand to compare more exactly potential function of the blue spruce individuals to reduce extremity of the locality for the beech planting.

AN INVESTIGATION ON A METHODOLOGY ABOUT DETERMINATION OF VISUAL QUALITY-PREFERENCE RELATIONSHIP IN MOUNTAIN FORESTS

A. Kalin[1]

[1] *Karadeniz Technical University, 61080 Trabzon, Turkey, arzuk@ktu.edu.tr*

The determination of visual quality evaluation in mountain forests within the frame of sustainable management is important in order to define its visual character and manage how to use this character as a visual source value. Meeting the green need with natural life environments having different environmental experiences become more interesting to nowadays people who are getting away from natural environments, especially the green, because of intense urban settlement. This cause to bring the visual source value of mountain forests in the foreground and to raise the importance of researches on visual attractiveness (visual quality)-preference relationship in the sustainable management of mountain forests. The most important problem in such researches taking the visual character of an area, in other words its total visual quality, as the sum of various visual quality values is the ambiguousness related with the case that which scenic value or quality should be taken into account In order to solve this problem the theoretical part of this paper offers an evaluation methodology claiming the usability of a set of qualities (naturalness, continuity, legibility, novelty-mystery, complexity, coherence, meaning) defining from the environment preference and evaluation literature in determination of visual quality-preference relationship in mountain forests. In the application part, the usability of these qualities taken up the ones defining the visual quality-preference relationship as an evaluation methodology was testing on a set of mountain forests having different visual character. As a result it is was seen that the visual quality of any environment can be defined by the various amount of existence and absence of this quality set (naturalness, continuity, legibility, novelty-mystery, complexity, coherence and meaning). The proper and suitable amount combinations of these qualities cause high visual quality value and also high preference. Besides this another important result of this research is that the methodology about evaluation of this visual quality set in any landscape scene can make the ambiguousness in the chosen criteria defining the visual quality of a scenery clear for the sustainable management of mountain forests.

A GLOBAL META-ANALYSIS OF TEMPERATE OLD-GROWTH FORESTS: STRUCTURAL CHARACTERISTICS, CARBON STORAGE, AND MANAGEMENT IMPLICATIONS FOR MONTANE ECOSYSTEMS

W.S. Keeton[1,*], P. Angalstam[2], Y. Bihun[3], J. Chen[4], M. Chernyavskyy[5], B. Commarmot[6], J.F. Franklin[7], A.J. Larson[7], D. Lindenmayer[8], J. Nunery[1], T. Spies[9], M.E. Swanson[10], R. Van Pelt[7]

[1] *School of Environment and Natural Resources, University of Vermont, Burlington, VT 05405, United States*
[2] *Department of Conservation Biology, Swedish University of Agricultural Sciences, Grimsö Research Station, Riddarhyttan, Sweden*
[3] *Shelterwood Systems Co., Jericho, Vermont 05465, United States*
[4] *Department of Environmental Sciences,, University of Toledo, Toledo, OH 43606, United States*
[5] *Department of Forest Ecology and Landscape Architecture, Ukrainian National Forestry University, 79057 Lviv, Ukraine*
[6] *Swiss Federal Research Institute WSL, Section Silvicultural Strategies, Zürcherstr. 111, 8903 Birmensdorf, Switzerland*
[7] *College of Forest Resources, University of Washington, Seattle, WA 98195, United States*
[8] *Centre for Resource and Environmental Studies, Australian National University, Canberra, Australia*
[9] *United States Department of Agriculture, Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, United States*
[10] *Department of Natural Resource Sciences, Washington State University, Pullman, WA 99164, United States*
[*] *Author for correspondence: william.keeton@uvm.edu*

Late-successional and old-growth forests have been extensively studied in many moist temperate regions of the world, but until now researchers have not collaborated on a global assessment of old-growth ecosystem structure and function. Our research goal is to explore ecological characteristics and values shared by and diverging among these systems. We are testing the hypothesis that certain functions, such as a high degree of carbon storage and habitat complexity, are provided universally by old-growth forests. We predict that while some characteristics will vary most strongly with ecoregion, others will relate more directly to similar stand development and natural disturbance processes. The meta-analysis combines datasets from many of the world's major remaining old-growth formations, including the U.S. Pacific Northwest and Northeast; the Carpathian Mountains of Eastern Europe; the Alps in central Europe; Australia; China; and Chilean Tierra Del Fuego. Data on mature forests are included for comparative purposes. A set of structural metrics is standardized among the datasets. These are used in multivariate analyses, such as Non-Metric Multidimensional Scaling, to identify sources of similarity and dissimilarity. We are also employing meta-analysis statistical techniques to account for different effects sizes. Preliminary results appear to support the hypothesis. For instance, aboveground tree biomass is consistently ($p < 0.001$) higher in old-growth coniferous forests in the U.S. Pacific Northwest (620 Mg/ha), northern hardwood-conifer forests in the U.S. Northeast (246 Mg/ha), and *Fagus sylvatica* forests in the Ukrainian Carpathians (381 Mg/ha) in comparison to mature forests (290, 165, and 243 Mg/ha respectively). The magnitude of differences among old-growth ecosystems decreases when structural metrics are normalized as ratios relative to con-specific mature forests. This suggests a universal potential for enhanced provision of late-successional ecosystem services through forestry practices that promote structural development in young to mature

stands. For instance, management for and conservation of high biomass, late-successional forests provide carbon sequestration benefits. We review examples of innovative silvicultural systems developed for old-growth forest restoration and management in several different ecoregions.

SUPPORTING SUSTAINABLE FOREST MANAGEMENT IN COMMUNITY FOREST USER GROUPS IN NEPAL - A CASE STUDY FROM MAKAWANPUR AND CHITWAN

C. Khadka[1], H. Vacik, H.D. Uprety, B. Wolfslehner

[1] *Rural Reconstruction Nepal (RRN), 667 Neel Saraswoti Marg, P.O. Box 8130, Lazimpat, Kathmandu, Nepal, chiranjeewee@yahoo.com*

Supporting Sustainable Forest Management in Community Forest User Groups in Nepal - a case study from Makawanpur and Chitwan Chiranjeewee Khadka, Harald Vacik, Hima Devi Uprety, Bernhard Wolfslehner Community Forestry (CF) has already passed its infant stage of development and now has entered in to its young stage of development in Nepal. Although, the program has been able to restore the degraded landscapes of Nepal since the handing over of the forests to local communities, it is unable to provide a significant contribution to the livelihood of poor and marginalized people and equitable use of forests products within the community. In this context an approach which increases the voice of the local people in order to promote sustainable forest management (SFM), governance and livelihoods of local user groups of community forestry is needed. This process can be made possible by participating diverse groups at Community Forest level for the identification and application of criteria and indicators (C&I) for evaluating sustainable forest management. This paper presents six case studies mainly focusing on the socio-economic, biophysical and policy context of SFM. A content analysis of the constitution and operational plan, a SWOT analysis in hamlet meetings, a local and regional C&I workshop and multi-criteria analysis (MCA) techniques were used to facilitate the development process of a common accepted C&I set. The different stakeholder groups were asked to identify the importance of all criteria and indicators according to SFM. The Analytic Hierarchy Process (AHP) was used to evaluate current management strategies according to varying preference information in order to identify an overall compromise solution. The C&I development process helped to reveal the present situation of livelihood, institutional, social, ecological and human capital. Overall, it has been found that CF management has contributed to the maintenance of biodiversity, ecological integrity, soil-water conservation and forest health. The communities consider equity and gender issues, reduce poverty and promote the livelihood, governance and institutional changes in the context of an integrated resource management. With the help of the C&I process it was made possible to regularly evaluate the management and improve the overall performance focusing on the activities in forest management, forest based enterprises, poverty reduction and income generation activities additionally. It is shown that this process has proven to be an initial step in fostering sustainable community-based forest management in Nepal. Keywords: Criteria and indicators, Multi-criteria analysis, Governance and Livelihood, Community forestry, Nepal

DIFFERENTIATION OF CURRENT VEGETATION COVER AND DIRECT ANTHROPIC IMPACT IN THE PRADÌD NATIONAL NATURE RESERVE (HRUBÝ JESENÍK MTS., CZECH REP.) BY MEANS OF REMOTE SENSING

K. Kral[1]

[1] *Department of Forest Ecology, The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Lidicka 25/27, 602 00 Brno, Czech Republic, kamil.kral@vukoz.cz*

The study was made as one of the groundworks for future management and winter recreation policy planning in the Pradìd National Nature Reserve in a very center of the Jeseníky Protected Landscape Area. Part of the unique mountain area with the alpine-treeline ecotone formed by Norway spruce serves as a popular winter recreation centre, which is in direct conflict with nature conservation purposes. Moreover, at the end of the 19th and at the beginning of 20th century the area was affected by afforestation by allochthonous dwarf pine, which currently branch-out in valuable alpine grasslands. A colour-infrared orthophoto map was classified in a land-cover map employing maximum likelihood spectral classifier, ancillary data, texture analysis and knowledge base classification technique. Seven land-cover classes were distinguished counting anthropogenic surfaces, grassland & unstocked areas, dwarf pine, broadleaves, spruce, dead spruce standing trees and debris and rock outcrops. Total accuracy of the map was about 78%. Using reclassified land-cover map and moving mean filter window a spruce canopy closure map was carried-out. The continuous map of the canopy closure was subsequently reclassified in pre-defined intervals that were used for an objective delimitation and mapping of complex transitional border of alpine timberline. Patches of alpine grassland and belts of the timberline were overlayed with digital elevation model and the land-cover map. Minimum maximum and mean altitudes of occurrence for particular patches were calculated and extent of direct human impact was quantified. Alpine grassland has been most affected by both anthropogenic surfaces (3% of the area) and allochthonous dwarf pine afforestation (ca 14%) on the Malý Dìd Mt., where also the belt of timberline has been seriously disrupted by allochthonous dwarf pine (ca 17%). On contrary, relatively well preserved 'Vysoká hole' Ridge has been harmed by finishing stretches of ski-runs.

MEDICINAL PLANT RESOURCES, ETHNOPHARMACOLOGY, COMMUNITY MANAGEMENT INTERVENTIONS AND DEVELOPMENTS OF NEPAL WESTERN HIMALAYA

R.M. Kunwar[1,*], R.W. Bussmann[2]

[1] *Ethnobotanical Society of Nepal, New Road, 977 Kathmandu, Nepal,*
[2] *William L. Brown Center for Plant Genetic Resources Missouri Botanical Garden, P.O. Box 299 63166-0299St. Louis, MO, United States*
[*] *Author for correspondence: rkunwar@gmail.com*

The Western Nepal Himalaya is rich in ethnic and medicinal plant diversity. Medicinal plants play a pivotal role in livelihood of mountain people especially by providing products and services for health care. The indigenous knowledge and practice of usage of medicinal plants in Nepal is passed down through oral traditions and personal experiences. This ethnopharmacological knowledge is of great

importance for the rural population, but much of the information is empirical, and lacks preclinical scientific validations. At the same time, many species are threatened due to over harvesting resulting from rising demand. Inadequate research and management exacerbate this problem.

CLIMATE CHANGE AND TREE SPECIES ELEVATION SHIFT IN FRENCH MOUNTAIN FORESTS: A CONTRIBUTION FROM EARLY DEVELOPMENTAL STAGES

J. Lenoir[1]

[1] *AgroParisTech-ENGREF Centre de Nancy, UMR1092 Laboratoire d'étude des Ressources Forêt-Bois (LERFoB), 14 rue Girardet, 54000 Nancy, France, lenoir@engref.fr*

Fingerprints of tree species elevation shifts in response to climate change are usually expected to be greater at cold margins. The woodland/grassland ecotone, namely the tree line, is known to be of particular sensitivity to temperature. However, while tree line fluctuations have been widely documented, there have been few studies working bellow this traditionally surveyed expanding/retracting boundary deemed to be the most sensitive to climate change. We aimed at investigating elevation shifts for 17 common tree species at a distance from ecotones, focusing on their entire altitudinal distribution range during 1986-2006. The work spanned the whole French latitudinal gradient from northern temperate forests to southern Mediterranean forests, ranging in altitude from lowlands to the subalpine vegetation belt (50-2,250 m a.s.l.). The relative lack of information about tree species distribution changes beyond ecotones appear to stem at least partly from a failure to gather historical field observations older than tree species life span. Here we set a new and original retrospective approach based on vegetation plots in which simultaneous identification of two different successional life stages was performed so as to obtain 2 exactly paired plots in space belonging to different time periods from the same vegetation plot. The results grant clear fingerprints of tree species shifting toward higher locations over the whole elevation gradient. Further, we show that the magnitude of the distributional shift is not as obvious at the upper margins as the one we observed at the lower ones. This is the first time that the hypothesis of globally coherent tree establishment failure at their warm margins can be tested, suggesting that temperate tree species have already suffered climate-mediated habitat loss. Complementary analyses using modelling techniques confirmed that upward translation of the whole distribution appeared to result from both retraction at low elevations and expansion at high elevations. Studying distribution differences between adult and young trees led to coherent results with climate change allowing for niche stability through species life span.

BIOPHYSICAL AND SOCIOECONOMIC IMPORTANCE OF FARM FORESTS IN THE MOUNTAINOUS LANDSCAPES OF CENTRAL ETHIOPIA.

K. Mekonnen[1,*], G. Glatzel[2], M. Sieghardt[2]

[1] *Ethiopian Institute of Agricultural Research, HARC, P.O. Box 2003, Addis Abeba, Ethiopia*
[2] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190, Vienna, Austria*
[*] *Author for correspondence: kindumeko@yahoo.com*

Farmers in the mountainous areas of central Ethiopia utilize both indigenous and introduced farm forest practices and tree species to manage soil, wood, feed, diversity and cash related problems. The use of green biomass of tree and shrub species is one of the traditional practices that are currently in use to improve soil fertility and thereby increase crop productivity. The foliage, flower bud and flower of woody plants are also important components of livestock and bee fodder where few or no alternative feed resources are available. A research work was conducted from 2004 to 2006 to identify traditional farm forest practices in different niches; prioritize tree and shrub species in farm forest practices for fodder and soil improvement; and evaluates the nutrient content and nutritional value of the foliage of tree and shrub species. Traditional farm forest practices and the tree composition of each practice were identified through participatory rural appraisal techniques (PRA). The fodder and soil improving tree and shrub species were prioritized together with local farmers. The PRA findings were quantified through a questionnaire survey approaches. Soil samples were collected under farmers' top ranked indigenous species and analyzed for various soil attributes. Plant samples were collected to determine macronutrients, fodder nutritional parameters and other green biomass quality indicators. Fodder lots, woodlots, contour hedges, scattered trees on croplands, live fences and home garden farm forest practices were some of the traditional farm forest practices in the study areas. *Hagenia abyssinica,* followed by *Dombeya torrida* and *Buddlejia polystachya* were farmers' top ranked species for animal fodder. On the other hand, farmers selected *Senecio gigas* followed by *H. abyssinica* and *D. torrida* for soil fertility improvement. The green biomass of *S. gigas* was rich in most important plant nutrients. The foliage from *H. abyssinica* and *D. torrida* had a relatively low content of chemicals that affect palatability and dry matter digestibility. The foliage and flower bud of *H. abyssinica*, *B. polystachya*, *D. torrida* and *C. palmensis* can be used as sources of fodder with a proper feeding management scheme. *Hagenia abyssinica, S. gigas and C. palmensis* can play a soil management role in the farmlands of high altitude areas, where soil erosion and nutrient depletion are critical problems.

COMPARISON OF REGENERATION, SPECIES COMPOSITION AND STRUCTURE IN SINGLE-TREE AND GROUP SELECTION LOGGED AND UNLOGGED STANDS IN MIXED CONIFER FORESTS OF THE WESTERN BHUTAN HIMALAYAS.

M.R. Moktan[1], G. Gratzer, T.B. Rai, D. Dukpa

[1] *Renewable Natural Resources Research Centre, P.O. Box 1263, Wangdi Phodrang, Bhutan, mrmoktan@yahoo.com*

In Bhutan, problems with achieving regeneration establishment of desired tree species without compromising species composition after felling operations are the most crucial sustainability issues in conifer forest management. In order to address these issues, the study examined the consequences of single-tree and group selection felling on regeneration, species composition and structure between logged and unlogged stands in mixed conifer forests of the Western Bhutan. A study on single-tree selection systems was conducted at Chamgang, Gidakom, Paro-Zonglela and Haa-East Forest Management Unit using a combination of ecological and social research. A study on group selection systems was conducted at Haa-East and Paro-Zonglela FMU using ecological research methods. Tree species diversity and structure were similar between the single-tree selection logged and unlogged stands. Species diversity was also similar under group selection but tree densities, basal area, standing volume and social position renewal were slow in logged compared to unlogged stands. Pooled tree densities were reduced at Chamgang, Gidakom and Haa-East and consequently broadleaf and total standing volume at Chamgang and broadleaf basal area and volume at Gidakom in selection logged compared to unlogged stands. Bluepine trees that are straight, well-formed with sound timber qualities are logged for rural use. Seedling establishment vary among species, microsites and between stand categories with generally taller seedlings found in logged stands due to sunlight reaching the forest floor facilitated by opening up of trees in groups. Grazing impacts are minimal but seedling establishment is influenced by interspecific competition in group selection felling. We suggest revision and enforcement of silvicultural marking rules to ensure removal of single trees over a period conforming to species frequency and size-class to that in selection unlogged stands. Group selection felling in spruce dominated stands with wide openings in southerly aspect is silviculturally unsuitable in drier sites leading to changes in forest succession.

EXAMINING THE NEXUS BETWEEN DEPLETION OF MOUNTAIN FORESTS AND GREEN COVER AND THE DEEPENING WATER CRISIS IN UGANDA.

T. Morrison Rwakakamba[1]

[1] *Uganda National Farmers Federation, Plot 27, Nakasero Road, P.O. Box 6213, Kampala, Uganda, rwakakamba@yahoo.co.uk*

Uganda, like the rest of the world is grappling with the problem of environmental degradation and its attendant negative adjuncts, notably the deepening water crisis. The paper has the following aims:
To evaluate the effectiveness of government policies on restoration and conservation of water catchments systems; To provide evidence of forest cover depletion in

mountainous are and the link to water crisis and to evaluate the role of the academia in backstopping environmental policy formulation, implementation and monitoring.
This paper observes that the rate at which these resources are encroached upon and consequently depleted is higher than the rate at which they are restored.
The paper reveals that depletion of forests and green vegetation on the mountains of Rwenzori and Muhabura mountains have a direct bearing on the unprecedented floods, droughts and falling water levels of Lake Bunyonyi, River Kagyera, River Nyamwamba and Lake Victoria.
The paper contends that there is a glaring gap between laws and polices in the government/ministries/district board-rooms and the reality of implementation on the ground. The paper reiterates that even though Uganda is one of the few countries in Africa to posses what looks like a supportive legal framework and policy regime on environmental protection, her natural resources continue to dwindle and deplete daily at an alarming rate.
The paper also calls increased participation of the academia in backstopping government environment policy formulation efforts and also for effective implementation and monitoring and evaluation of existing policies and laws without fear or favor.
The paper calls for increased budgetary allocations to environment and meticulous review of the existing environmental policy regime with the view of tailoring, customizing, localizing and genderizing it for practical purposes.

POTENTIAL APPLICATION OF ARBUSCULAR MYCORRHIZAL FUNGI IN HILL FORESTS

A.U. Mridha[1]

[1] *Department of Botany, University of Chittagong, Chittagong-4331, Bangladesh,* mridha52@gmail.com

Bangladesh is predominantly agrarian country, depending mainly on agricultural crops and forest products for its economic development. About 95% of the plant species occurring in tropical hill forests are purely endomycorrhizal. For better nutrient utilization and more effective land use in hilly areas of Bangladesh, Arbuscular Mycorrhizal Fungi (AMF) can profitably be applied in horticultural crops and forest trees in hilly areas. At present, the application of AMF will be suitable for inoculating the plants in a limited area with small amount of inoculum of the fungi especially in nurseries and plantation sites. In addition to the general role of AMF in enhancing the growth and nutrition of most crop plants in Jhum (shifting cultivation) cultivation, mycorrhizal infection is particularly important for legume because of their need for adequate phosphorus supply during nodulation by *Rhizobium* not only for proper growth but also for P energy requirement for nitrogen fixation. Mycorrhizal technology may be applied for sustainable plant production systems, as it plays an important role in soil aggregation and stability, which reduce soil erosion. AM fungi are not only a major component of soil fertility but also play a significant role in the regulation of soil biological activities because of their abundance throughout the uppermost soil layer. Seedlings growing in nurseries, inoculated with AMF may greatly improve the overall growth in the nursery and also to establish and to early growth after transplanting to the permanent site by reducing the transplantation shock and better nutrient and water uptake. AM infection reduces susceptibility, or increases

tolerance of roots to soil borne pathogens like *Phytopthora* sp. *Fusarium* sp. and *Pythium* sp. and nematodes and reduces the incidence of root diseases under nursery and field condition. The practical application of AMF may be integrated into disease management along with other conventional techniques in the nurseries and plantation sites. Mycorrhizal research is needed to stop deterioration of forestlands due to mono cropping, soil erosion, shifting cultivation, clearer felling, burning etc. and also for better land use and sustainable forest management.

LESSONS FROM OLD GROWTH NATURAL FORESTS – INFLUENCES OF TREE MASTING ON SMALL MAMMAL COMMUNITIES, SEED AND SEEDLING FATE

U. Nopp-Mayr[1,*], G. Muralt[1], G. Gratzer[2]

[1] *Institute of Wildlife Biology and Game Management, Department of Integrative Biology and Biodiversity Research, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria*
[2] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[*] *Author for Correspondence: ursula.nopp-mayr@boku.ac.at*

The performance of Central European mammalian herbivore communities and their impact on forest vegetation greatly depend on the availability, the quality and quantity of food supply. Most species show distinct reactions on food availability exhibiting high reproduction rates and population densities during time periods of overabundant resources. Masting of forest trees might be an important impulse generator for population dynamics of small mammals in particular, thereby influencing the survival of feeder plant progenies (i.e. the tree seeds). But also forest stand characteristics like the horizontal and vertical structure and plant species diversity determine the composition and performance of small mammal communities. The last decades have brought significant changes in the phenology of different tree species (e.g., flowering and fruiting time), for which climate change was held responsible. Thus, studying small mammal communities and their impact on regeneration dynamics in old growth natural forests, where only climatic conditions have changed, and comparing them to managed forests provides important knowledge on the interdependency of forest trees and small mammals. In the present study, we surveyed the composition of small mammal communities via live trapping and monitored their relative abundance in old growth natural forests and managed forest stands over several years, including a tree masting event. We conducted seed and seedling removal experiments employing cafeteria experiments and different types of exclosure. Both small mammal abundances as well as removal rates showed different patterns in old growth and managed forests in years of average population densities. In the year after tree masting, small mammals abundances peaked in all areas and simultaneously seed and seedling removal reached a similar extent. Shortly after the last small mammal gradation in 2004, the next peak in small mammal abundances could be observed in 2007, indicating changing patterns of mammal performance and tree-herbivore interactions in the future.

THE INTERNATIONAL MODEL FOREST NETWORK – A CASE STUDY IN A SPANISH MOUNTAIN RANGE

S. Mutke[1,5,*], M. Segur[4], I. Lizarralde[4], F. Pinillos[4], R. Calama[1,5], F. Bravo[3,5], C. Ordóñez[3,5], A. Picardo[2]

[1] *Forest Research Centre, National Institute for Agricultural Research (CIFOR-INIA), Spain Department of Forest Systems and Resources, Crta. La Coruña km 7,5, 28040 Madrid, Spain*
[2] *Junta de Castilla y León, Spain*
[3] *Universidad de Valladolid, Spain*
[4] *CESEFOR (R+D Division), Spain*
[5] *Joint Research Unit INIA-UVa Forest Modelling and SFM, Spain*
[*] *Author for correspondence: mutke@inia.es*

The International Model Forest Network (www.imfn.net) is a voluntary association of partners from around the world working toward the common goal of sustainable management of forest landscapes and natural resources. The IMFN, initiative established after the UNCED Rio 1992, combines the social, cultural and economic needs of local communities with long-term sustainability. A Model Forest is both a geographic area and a specific voluntary, partnership-based approach to sustainable forest management (SFM). Geographically, it must encompass a land-base large enough to represent all of the forest's uses and values - it is a fully working landscape of forests and farms, protected areas, rivers and towns.

Because forests and people cannot be separated, local populations are at the heart of the model forest concept. They are the key factor in the search to define sustainability in tangible ways from the field level to the policy level, with stakeholders continually involved in developing, testing and sharing innovative approaches to SFM. The model forest organization does not exercise decision-making authority over the land-base, but it will include in its partnership those with legal tenure over the land, which are key stakeholders whose participation signals a willingness to consider new and innovative approaches to forest management.

The recently incorporated Spanish "Urbion" Model Forest is the only MF in the Mediterranean area. It includes 35 municipalities (177,000 ha) in the Northern Iberian Mountain Range, with 100,000 ha (56%) covered by native mountain forests, mainly Scots pine, though there are also other forests and woodlands dominated by Maritime pine, black pine, beech, Pyrenean oak, Portuguese oak or incense juniper. Forest property is mainly municipal, though with neighbours' rights on forest uses and products that derive from medieval bylaws. In this MF with 18,500 inhabitants, half of the working population is employed in forestry or forest industries (150 companies). Its pine wood is marketed under the registered regional trademark "Pino Soria Burgos" with PEFC label, mushrooms (incl. truffle) are an important NTFP, and several protected areas and species underline the MF's importance for nature conservation.

The "Urbion" Model Forest Project is structured in five Programmes with 29 activities about Improvement of forest management, Increase of forest value, Conservation, Partnership and communication and Capacity Building. Methodology is outlined in this presentation.

LINKS BETWEEN MOUNTAIN COMMUNITIES AND ENVIRONMENTAL SERVICES: A CASE STUDY IN THE ITALIAN ALPS

S. Notaro[1,*], P. Alessandro[2]

[1] *Department of Economics, University of Trento, Inama 5/I, 38100 Trento, Italy*
[2] *CRA-MPF, Villazzano of Trento, Italy*
[*] *Author for correspondence: sandra.notaro@economia.unitn.it*

Forests and alpine pastures have always played a fundamental part in the economy and culture of Italian mountain communities. But the 20th century saw a decline in traditional activities which together with socioeconomic changes has led to a general abandonment of mountain areas. This study aims to evaluate the importance of mountain communities - with their traditional knowledge of multifunctional management of natural resources - in increasing the value of environmental services and in the revitalization of mountain economies. The reference is to a case study in the Italian Alps, the municipality of Premana (North-west of Italy), where forest covers half of the total surface. This is one of the few areas in the Italian Alps where, because of social reasons, the population chose not to leave. We evaluated forest and alpine pasture environmental services using the Contingent Valuation (CV) method. We interviewed 319 randomly drawn residents (13% of the population, response rate 94%). Money and labour payments were asked. Annual mean willingness to pay was € 94 and 896 working hours respectively. There is theoretical evidence to support the validity of our results, as coefficient estimates of the bid function generally follow economic theory, intuition as well as previous results. CV results together with other data collected with the questionnaire demonstrate that local traditions, particularly common property, and social capital have a key role in multifunctional management of forests and alpine pastures even from a regional development perspective. A model of sustainable tourism development, that can maximise social welfare - internalising forests and alpine pastures positive externalities through their payment – and protect the mountain territory as well, is proposed on the basis of residents' preferences. We suggest that studies such as this one, on benefits evaluation of environmental services of mountain resources, might be used for the formation and implementation of better informed policies which will affect the future for mountain communities.

UNDERSTANDING PEOPLE TO REDUCE UNCERTAINTY IN MANAGING SURVIVABLE FORESTED LAND AN EXPLORATORY CASE STUDY IN *PEGUNUNGAN SEWU,* INDONESIA

D.B. Permadi[1]

[1] *Lab. Forest planning and development, Faculty of Forestry, Gadjah Mada University, Indonesia, dwikopermadi@yahoo.com*

The marginal land in karstic mountainous region in *Pegunungan Sewu,* Indonesia has driven local people to plant wood trees. Community forestry, then, is being stronger due to its ability either to supply raw materials to local wood industries or to sustain their livelihood. It is not the case for the mountain state forests managed by state forest company. Plantation failure and illegal logging are coloring its forest management. The future of survivability in managing community forestry and state forest management are still in question, since each stakeholder involved in confliction

manner in managing forested land. This paper is trying to understand the underlying worldviews of individual actors related to the ten forestry problems under condition of uncertainty, unscientific forest practice unknown future, and lack of consensus among actors. Clutural Theory is used as a framework to analyze the typology of worldviews of the stakeholders to reveal their cultural biases, social solidarity, and myths and ideas of nature. Cluster analysis is employed to classify the individual actors and grouping them who have similar variables of worldviews. Kendall's W test is also used to analyze the level of agreement in judging 10 forestry problems. The result indicates that stakeholders can be grouped in four different worldviews based on four variables proposed by Cultural Theory. Four groups are moderate, dominant hierarchy, dominant individualistic-hierarchy, dominant egalitarian-hierarchy. How different groups make a decision strategy to the ten forestry problems need to be analyzed further, but there is an indication that individual worldview could explain better the level of agreement and disagreement than that of organization. These findings, however, should be read as a preliminary result to understand how complex and uncertain people as much as the problems they faced in managing survivable forested land.

GROWTH DYNAMICS OF FINE ROOTS IN BOREAL FOREST ECOSYSTEMS

H. Persson[1]

[1] *Department of Ecology, Swedish University of Agricultural Sciences, Box 7044, 750 07, Uppsala, Sweden, hans.persson@ekol.slu.se*

The seasonal growth dynamics of fine-root biomass (live), necromass (dead) and standing crop (live + dead) roots for trees and the field layer species (g m-2) and live/dead ratios were investigation at a fresh/moist coniferous fern forest site close to a nuclear power plant at Forsmark in the central eastern parts of Sweden. Our methods of estimating fine-root production and the average amount of fine roots, involved the periodic measurements of live and dead dry weight of the fine roots from sequential core samples of the forest soil. These data give an instant measure of the spatial and temporal distribution of fine roots in the undisturbed soil-profile.
The bulk tree fine-root biomass (< 1 mm in diameter) were found in the mineral soil horizon down to 40 cm, where 89, 82, 83 and 89 % of the total amount of fine roots (live + dead) in the soil profile was found on 4 different sampling occasions. The highest live/dead ratio was found in the upper 2.5 cm of the humus layer for both tree and field-layer species. Both top soil horizons in the humus and in the mineral soil layers were most substantially occupied by live tree fine roots. The live/dead ratio of tree fine roots decreased from the top of the humus layer to the lower part of mineral soil horizon from 8.0-0.3, 0.8-0.2, 4.4-0.4 and 3.3-0.7 (g g-1) for the different sampling occasions, respectively.
The mean fine-root biomass (< 1 mm in diameter) of tree species for the total profile varied on the 4 sampling occasions between 317, 150, 139 and 248 g m^{-2}. The related fine-root necromass varied between 226, 321, 176 and 299 g m^{-2}. The total quantity of fine roots (standing crop) on the 4 sampling occasions amounted to 543, 434, 330 and 546 g m^{-2}. The turnover rate (the rate of construction of new root tissues) for tree fine roots amounted to 0.7 yr^{-1} for biomass, 0.8 yr^{-1} for necromass and 0.6 yr^{-1} for standing

crop. Fine-root data from several other investigations in forest ecosystems suggest turnover rates of the fine-root biomass in the range of 0.1-2.4 yr^{-1}.

VALUE-BASED ANALYSIS OF TRADE-OFFS IN ROCKFALL PROTECTION FOREST MANAGEMENT. A CASE STUDY FROM THE EASTERN ALPS.

W. Rammer[1,*], M. Brauner[2], B. Wolfslehner[1], M.J. Lexer[1]

[1] *Institute of Silviculture, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[2] *Institute of Mountain Risk Engineering (IAN), Department of Civil Engineering and Natural Hazards, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[*] *Author for correspondence: werner.rammer@boku.ac.at*

A particularly important function of forests in the Alps is to provide protection against natural hazards such as avalanches, debris flows and rockfalls. Therefore, many forest stands in the Alps have, next to a site-protection function in which forest cover stabilizes the slope itself, an object-protection function, which means that forest cover can protect objects and infrastructure located further down a slope. Taking into account the increasing pressure from emerging tourism and increasing infrastructure needs in the Alps the object-protection function of mountain forests in Central Europe will only gain importance in future. In designing efficient silvicultural strategies different stakeholders with often conflicting goals like economic revenue from timber production, nature conservation, and rockfall protection effectiveness are to be considered in a rather complex spatio-temporal setting. This contribution aims at the evaluation of alternative silvicultural strategies for a case study rockfall protection forest project in Tyrol, Eastern Alps. The typical spatial scale of such integrated projects extends from a few to as much as hundred hectares including a variety of different sites and stand development phases. To support the involvement of stakeholders and to increase acceptance of proposed solutions scientifically sound projections of the likely consequences of alternative management strategies are required. We use the coupled rockfall and forest ecosystem model PICUS to simulate forest development for the 40 hectare case study area under 4 different silvicultural regimes and to analyse the consequences for timber production and protection function. The simulation tool integrates (a) a 3-dimensional hybrid patch model allowing the simulation of heterogeneous mountain forests including spatially explicit management interventions, and (b) the PICUS-Rockfall module which simulates single rockfall trajectories on project level (up to 100ha) in 3D on a digital terrain model with spatially distributed surface properties taking into account energy dissipation due to surface contact and single tree impacts. A multi-criteria decision analysis approach is employed to identify (a) preferable alternatives from various stakeholder perspectives (forest owner, tourism, forest authority, office for torrent and avalanche control), and (b) search for feasible compromise solutions. In this contribution we introduce the simulation approach, present the alternative management options and the value-based analysis of their consequences. Possible implications for the management of rockfall protection forests in intensively used alpine landscapes are discussed.

A COMPARATIVE ANALYSIS OF COMMUNITY FORESTRY AND JOINT FOREST MANAGEMENT: POLICIES, INSTITUTIONS AND APPROACHES IN THE HIMALAYAN COUNTRIES

M. Karki[1], G. Rasul[1,*]

[1] *International Centre for Integrated Mountain Development (ICIMOD), Lalitpur, GPO Box 3226, Kathmandu, Nepal*
[*] *Author for correspondence: grasul@icimod.org*

Several participatory forest management approaches have emerged in different countries in South Asia in the effort to develop an effective institutional framework and mechanisms for the management of forest resources. These different approaches have different features, characteristics, and degrees of participation by local forest users, and thus different implications for the management of forest resources and the livelihoods of forest-dependent people. This discussion paper makes an attempt to analyse the four participatory forest management approaches adopted in Bangladesh, Bhutan, India, and Nepal on the basis of primary and secondary information The models are compared and contrasted using specific criteria such as level of institutionalisation, tenurial security, degree and quality of local participation, decision-making authority, rights and obligations of stakeholders, benefit sharing arrangements, and actual practices. Measures to overcome weaknesses and to promote participatory forest management are suggested.

FOREST RESTORATION IN A MUNICIPAL WATERSHED IN THE UNITED STATES

B. Richards[1]

[1] *Seattle Public Utilities, 19901 Cedar Falls Rd, Seattle WA 98045, United States, bill.richards@seattle.gov*

The Cedar River watershed in the Pacific Northwest region of the United States is the source for two thirds of the drinking water for the metropolitan Seattle area. Currently owned and managed by the City of Seattle as an ecological reserve with no human habitation, the 37,000-ha municipal watershed has been subject to over 120 years of economic exploitation. The occurrence in the watershed of several species listed under the federal Endangered Species Act triggered the adoption of a 50-year Habitat Conservation Plan (CRW-HCP) in 2000, which effectively ended the harvesting of trees for profit. The CRW-HCP, funded by the City of Seattle and signed by the U.S. National Marine Fisheries Service and the U.S. Fish and Wildlife Service, encompasses 83 fish and wildlife species and establishes habitat restoration programs for streams, riparian areas, and upland forests. Only 16 percent of the forestland within the watershed is currently never-harvested primary habitat. The goal of the forest restoration program is to facilitate the structure and processes of late-seral forests habitat in the second growth that comprise the remaining 84 percent of forestlands. Restoration treatments primarily take the form of variable density tree thinning and tree/shrub planting in the competitive exclusion stage of forest succession to increase structural complexity, maintain tree diameter growth, and increase species diversity. Prioritizing locations for the experimental restoration treatments is based on maximizing the monitored response benefits and improving

connectivity between patches of late-seral forest habitat across the landscape. Forest management in the Cedar River watershed has been certified by the Forest Stewardship Council and plays a role in the City's carbon emissions policy.

ELABORATION OF DENSITY MANAGEMENT DIAGRAMS FOR DOUGLAS FIR PLANTATIONS IN MOUNTAIN AREAS OF NORTHERN SPAIN

R. Rodríguez-Soalleiro[1]

[1] *University of Santiago de Compostela, Higher Polytechnical School, Campus Universitario s/n, 27002 Lugo, Spain, roquers@lugo.usc.es*

Density management is the common option to achieve a desired future stand condition, and one of the most effective methods of design, display and evaluation of alternative density management regimes in even-aged stands is the use of stand density management diagrams. We describe a method for developing thinning schedules for Douglas fir (Pseudotsuga menziesii Mirb. Franco) plantations in mountain areas of northern Spain using a density management diagram. The diagram integrates the relationships among stand density, dominant height, quadratic mean diameter and stand volume in a single graph. The data used in its construction were obtained from 130 sample plots located throughout northern Spain. The diagram is composed of an equation that relates the quadratic mean diameter to the stand density and dominant height and a second equation relating the stand volume to the quadratic mean diameter, stand density and dominant height. These equations were fitted simultaneously using full information maximum likelihood. The relative spacing index is used to characterize the growing stock and the diagram provides isolines for dominant height, number of trees per hectare, quadratic mean diameter and stand volume. The possibility to including the assessment of stand stability or risk of crown fire is discussed.

THE ROLE OF ACADEMIC EDUCATION FOR MOUNTAIN FOREST MANAGEMENT: A PERSPECTIVE FROM PLANTATION FORESTRY IN SOUTHERN EUROPE

R. Rodríguez-Soalleiro[1]

[1] *University of Santiago de Compostela, Higher Polytechnical School, Campus Universitario s/n, 27002 Lugo, Spain, roquers@lugo.usc.es*

The role of academic education from a perspective of the south Atlantic European arch was analyzed, taking into consideration the importance of plantations in this region, where large areas of man-made forests have been established in the last century. In fact, large areas of mountain forests around the world have been in fact man-made, being at present its management conditioned by many social and economic restrictions. The conversion of these plantations to more natural forest conditions is an important trend in Europe, but the sustainable management should also ensure the livelihood of land owners, in a scenario of increasing depopulation of rural areas. An analysis of the academic contents necessary to be included in the curricula of future masters related to forest sciences in Europe is developed. Many

topics related to the productive role of mountain forests, such as agroforestry, nutrition, density management, soil conservation, vegetation management, growth modelling, forest biomass or forest fires are highlighted and compared to each other.

THE FOREST RESOURCES IN THE CARPATHIAN MOUNTAINS: PROBLEMS AND CHALLENGES FOR THE IMPLEMENTATION OF AN INTERNATIONAL COOPERATION POLICY

P.C. Sandei[1,*], T. Anfodillo, D. Pettenella, S. La Medica, E. Giacoma[2]

[1] *United Nations Environment Programme (UNEP), Regional Office for Europe, Vienna International Centre – P.O. Box 500, 1400 Vienna, Austria*
[2] *Dipartimento Territorio e Sistemi Agro-forestali, University of Padua, Italy*
[*] *Author for correspondence: piercarlo.sandei@unvienna.org*

Forest cover is significant in the Carpathians: its extension is about 10 M ha, which means around half of the Carpathians, although it is unequally distributed between the 7 Carpathian countries - from 29.6% cover in Hungary to over 60% in Romania and Serbia.
On 4 January 2006, the Carpathian Convention entered into force as a new international treaty to conserve the rich wildlife, wondrous landscapes and cultural heritage of the Carpathian mountainous region. In order to implement an international cooperation policy in the forestry sector a team composed by researchers of Padova University, under the guidance of UNEP Grid-Warsaw and of UNEP Vienna, Interim Secretariat of the Carpathian Convention and with the support of the European Academy in Bolzano (EURAC) conducted a study on to provide a general overview of the current state of forest resources in the Carpathians and - to highlight the challenges and priorities for adapting the management of Carpathians forests to new environmental and socio-economic conditions.
This paper presents the main findings of this study that has been carried out through a bibliographic research, information requests to experts of each country, field trips and meetings organization.
The main issues that have been defined as a priority in the future development of a cooperation policy are the following: the definition of common SMF criteria and indicators, a cooperative effort in the protection and monitoring of primary forests, the creation of ecological corridors, the development of a system of Model Forests, the cooperation in law enforcement and illegal logging controlling. These and other topics have been considered in the drafting of a first version of a Forest Protocol, that hopefully will be discussed at the next meeting of the Conference.
The work carried out till now represents a interesting example of how science and society can interface in the development of a mountain region.

CLIMATE CHANGE & HIMALAYAN MOUNTAINS; MITIGATION AND ADAPTATION OPTIONS FOR MEETING CHALLENGES OF SUSTAINABLE LIVELIHOODS, BIODIVERSITY CONSERVATION AND ECOSYSTEM SERVICES

V. Saxena[1]

[1] *Ministry of Environment & Forests, Government of India, CGO Complex, Paryavaran Bhavan, Lodhi Road, 110003 New Delhi, India, viveksax1@gmail.com*

Himalayan Mountains known as Hindu-Kush Himalayan (HKH) Region , is home to more than 150 million people, but about 1.5 billion people inhabit water basins and up to 3 billion people live from the food and energy produced by Himalayan rivers. Mountain ecosystems have a greater role to play in meeting the challenges of climate change and in all the policy options and initiatives; it has to be given top most priority in the international development agenda. Persistent poverty, degradation of natural resources, melting of glaciers, depletion of water resources are the challenges of HKH region. Natural resources and accompanying environmental and ecosystem services are increasingly degraded. The HKH region is an integral part of the global ecosystem and is very rich in biological and environmental resources and serves as water reservoir and a regulator of climate for the region and the world. The economic development initiatives have resulted in continuous threat on environmental and ecosystem services and policy makers have challenges to have policy options to mitigate the impacts of climate change and enhance the adaptation and resilience of people of mountain region. The paper analyses the salient features, importance, direct and indirect ecosystem services of the HKH region, strategy for adopting mitigation – cum adaptation strategy, key barriers and policy options for meeting challenges of climate change.

SOIL CARBON DIOXIDE EMISSION IN THE SOIL WARMING EXPERIMENT ACHENKIRCH

A. Schindlbacher[1,*], R. Jandl[1]

[1] *Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Seckendorff-Gudent-Weg 8, 1131 Vienna, Austria*
[*] *Author for correspondence: andreas.schindlbacher@bfw.gv.at*

Global warming has the potential to increase soil respiration (the CO2 efflux from the soil surface), one of the major fluxes in the global carbon cycle. Soil respiration consists of an autotrophic component that is closely linked to carbon gain by photosynthesis and a heterotrophic component that is linked to the decomposition of soil organic matter. For a better understanding of global warming effects on soil carbon pools, it is necessary to distinguish between the warming effects on the two components.
We warmed the soil of undisturbed and trenched (roots cut) plots by means of heating cables 4 °C above ambient during the snow free seasons of 2005 and 2006. Soil warming increased the CO2 efflux from control plots (total soil respiration) by ~ 45 % during both seasons. The CO2 efflux from trenched plots (heterotrophic) increased by ~ 39% during 2005 and ~ 45% during 2006. The similar response indicated that the

autotrophic and heterotrophic components responded equally to the temperature increase.
Mean annual soil respiration at the site was ~ 6.2 t C ha-1 y-1. Thirty five to forty percent or 1 t C ha-1 y-1 of the overall annual increase in soil respiration (2.8 t C ha-1 y-1) was autotrophic. The remaining heterotrophic part of soil respiration (1.8 t C ha-1 y-1) represented the warming induced carbon loss from the soil. Prolonged soil warming will show whether the soil warming effect is lasting or declining with declining supply of labile soil carbon.

ADDRESSING CLIMATE CHANGE IN PRACTICAL SILVICULTURAL DECISION SUPPORT: A VULNERABILITY ASSESSMENT TO AMEND DECISION MAKING IN THE AUSTRIAN FEDERAL FORESTS

R. Seidl[1]

[1] *Institute of Silviculture, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria, rupert.seidl@boku.ac.at*

The sustainable provision of ecosystem services and products under changing environmental conditions is a major challenge in forest management. Areas where sustainable land-use is subject to multiple societal demands, as for instance the European Alps, require particular attention with regard to a timely adaptation to climate change. In order to provide a comprehensive basis for management strategies suitable to cope with climate change a multi-aspect vulnerability assessment with close involvement of forest managers and decision makers is required. In addition a coherent communication strategy integrated into accepted decision support devices is of crucial importance. The aim of the study was to conduct a climate change vulnerability assessment for mountain forests of the Austrian Federal Forests (ÖBf) and to integrate results in the basic silvicultural guidelines ("Silvicultural Handbook") of the company. The assessment framework was developed in cooperation with ÖBf decision makers, including eight vulnerability indicators covering various ecosystem services (e.g., timber production, biodiversity, C storage). Climate change impacts were assessed by employing the dynamic simulation model PICUS v1.4 to regional forest types over a range of climate scenarios. The vulnerability assessment was conducted for the current management practice of the ÖBf over a time horizon of 100 years. Vulnerability profiles for forest types were coherently aggregated into vulnerability classes (e.g., traffic light system) to be included in the silvicultural guidelines. This allows for a mainstreaming of climate change risks in the operational every-day decision making processes of forest managers on a scientific basis.

PROFITABILITY AND COMPETITIVENESS OF MOUNTAIN FOREST ENTERPRISES - EMPIRICAL EVIDENCE FROM SWITZERLAND AND AUSTRIA

W. Sekot[1]

[1] *Institute of Agricultural and Forestry Economics, Department of Economics and Social Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Feistmantelstr. 4, 1180 Vienna, Austria, walter.sekot@boku.ac.at*

Both countries, Switzerland as well as Austria, maintain forest accountancy data networks for monitoring the economic conditions of forest enterprises. A regional classification allows comparing enterprises located in mountain areas with others. The respective results indicate, that a mountainous setting does affect the profitability of forestry as well as the competitiveness of timber production. The paper investigates, to what extent general hypotheses pertaining to the peculiarities of mountain forestry can be backed by empirical data. At the example of small farm forests in Austria it is demonstrated, that other factors may well compensate for the disadvantages associated with a mountainous environment.

SPECIES-SPECIFIC RESPONSE TO DISTURBANCE – EXAMPLES FROM A SPRUCE-FIR-BEECH FOREST

B. Splechtna[1,*], G. Gratzer[2], R. Waagepetersen[3]

[1] *Center for Environmental Studies and Nature Conservation, Department of Integrative Biology and Biodiversity Research, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor-Mendel-Str. 33, 1180 Vienna, Austria,*
[2] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[3] *Department of Mathematical Sciences, Aalborg University, Fredrik Bajers Vej 5, P.O. Box 159, 9100 Aalborg, Denmark*
[*] *Author for correspondence: bernhard.splechtna@boku.ac.at*

Forest dynamics may be described as changes of tree populations due to colonization, growth, and death of trees. Starting from seed distribution, trees germinate, establish and grow until few individuals surviving to tree-size eventually grow into the canopy. It is not until this latter stage that they contribute to canopy composition. Because co-existing tree species may have different life history traits or "strategies", species composition in the regeneration may not reflect the canopy composition. Species-specific differences in response to disturbances regarding establishment, growth, and competitive relationships in gaps may trigger successional change or maintain coexistence. If these mechanisms are known, stand development can be predicted more accurately, even if the disturbance regimes are changing. In the light of an expected increase in weather extremes due to climate change, these mechanisms shall earn even more attention. We studied differences in response to disturbances in the old-growth spruce-fir-beech forest Rothwald, based on tree ring records and spatial analysis. The results indicate differences in regeneration niches in gaps between spruce and the other two species. Fir and beech have a large overlap in their niches, which means that the competitive relationship between the two species is very

important. The tree species differ in their release potential relative to the growth before the release and in the average number of releases to reach the canopy, which are all indicating differences in life-history strategies. In the presentation, we hypothesise how these differences may enable co-existence of the three species even in times of increased coarse-scale disturbance. Despite the obvious limitations of retrospective methods in a world of constant change, they provide empirical evidence of vegetation response to disturbance over long periods of time.

LONG-TERM SEEDLING DEMOGRAPHY IN A NATURAL BEECH-FIR-SPRUCE FOREST: MECHANISMS BEHIND SPECIES COEXISTENCE

J. Szwagrzyk[1,*], J. Szewczyk[1]

[1] *Department of Forest Botany and Nature Conservation, Agricultural University of Krakow, al. 29 listopada 46, 31-425 Krakow, Poland*
[*] *Author for correspondence: rlszwagr@cyf-kr.edu.pl*

We analyzed seed production, germination and seedling survivorship in a network of 16 circular sample plots 6 m in diameter distributed regularly within a tract of natural beech-fir-spruce forest in the Babia Gora National Park, southern Poland, mapped an measured in 1991. The demographic study on natural regeneration spanned the period 1994-2006 and was based upon two measurements per year – one in June, and one in September; seed production was measured from 1995 to 2006. In 40 subplots of a size of two square meters all seedlings were tagged in the beginning of study to follow the fate of individuals, and each year the new germinants arriving in those subplots were tagged, too. Tree stand dynamics was followed by re-measuring canopy trees in 1999 and 2004, and saplings in 2004. European beech was the dominant tree species in terms of tree number (53%), and basal area, while the silver fir and Norway spruce had smaller shares; by the year 2004, the dominance of beech has increased to 63%, and the share of silver fir has declined to 25%. Data on distribution and sizes of trees were employed for calculating four kinds of indices of influence for each subplot for the beginning of the study and for the year 2004; then we compared (using rank correlation tests) the indices calculated for each subplot with local seedling density and local survivorship of seedlings belonging to the 1996 cohort. Light conditions were evaluated on the basis of the analyses of hemispheric photographs made every second year from 1996 on, and on the basis of direct light measurements conducted in years 2004-2006. At the beginning of study the average density of seedlings amounted to 2.5 individuals per square meter; European beech was the most common species (50%), and the share of silver fir was slightly lower (41%). Till the year 1999, the density of silver fir declined to 0.5 ind./m^2. The density of beech increased rapidly in 1997 (to 5.5 ind./m^2), primarily due to the establishment of a very numerous beech cohort in 1996, following a mast-seed year in 1995. From the year 2000 on, the density of silver fir has increased gradually (to 1.0 ind/m^2), and the density of beech has declined (to 1.2 ind./m^2), as a result of seedling mortality (only 10% of beech seedlings survived for 10 years) and almost complete lack of germination after 1996. Other tree species – Norway spruce, rowan and sycamore almost disappeared from the seedling bank between 1994 and 2006. There was a significant relationship between the density of seedlings and local light conditions (Spearman's rank correlation = 0.58, p=0.02). The relationships between influence indices and seedling density were generally weak; we found a significant negative relationship between the influence

coefficient calculated for beech saplings and the density of beech seedlings. The density of beech seedlings in 1997-2006, as well as the survivorship of the 1996 beech cohort were positively correlated with the influence coefficient calculated for the canopy trees of silver fir. Silver fir seedling density showed a negative relationship with the influence coefficient calculated for canopy spruces, and a positive relationship with a coefficient calculated for beeches. Density of spruce seedlings was generally low, but it was negatively correlated with the influence indices for canopy spruces. In general, our results showed some positive and negative feedbacks between presence of tree species in a canopy and its presence in a seedling bank underneath, as well s a negative effect of dense clumps of beech saplings on the presence of beech seedlings. However, the mechanisms behind the profound changes recorded in the density and species composition of the young generation of trees are yet to be revealed.

DEVELOPING CONCEPTS FOR SUSTAINABLE MANAGEMENT OF FOREST RESOURCES (SFM) IN NORTH WESTERN FORESTS OF IRAN (ARASBARAN)

M. Tashakori Ghojdy[1,*], R. Fallah Shamsi[2], A. Shirvany[3], M.J. Lexer[1]

[1] *Institute of Silviculture, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences, Vienna (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[2] *Department of Desert Region Management, Collage of Agriculture, Shiraz University, Iran*
[3] *Department of Forestry and Forest Economics, Natural Resources Faculty, Tehran University, Iran*
** Author for correspondence: mo_tashakori@yahoo.com*

Arasbaran is a rural mountain area in the North-Western parts of Iran. The boundary of the study area lies between 38° 48’ N to 39° 1’ N latitude and 46° 51’ to 47° 14’ E longitude. Semi-arid ecological conditions are characterized by low annual precipitation between 316 mm in the uplands and 686 mm in the lowlands. Rural population depends on forests for lifestock grazing, fuel and construction timber. Husbandry (sheep, cattlle) and dry farming (barley and wheat) are main sources of income and employment. Dominating natural forest types consist of Quercus macranthera and Carpinus betulus. Due to heavy landuse pressure by converting forests to arable land where suitable and intensive lifestock grazing forest area is decreasing drastically. Until its protection 15 years ago forests have been intensively coppiced. Today forests and rangeland are nationalized. These conditions cause (i) forest degradation, and devastation of other natural resources and biodiversity, (ii) villagers and nomads are living in partly miserable economical conditions.
As a prerequisite to improve social, economic and ecological conditions current landuse concepts of four selected villages in Arasbaran are analysed and impacts on sustainability assessed by means of a set of regionally adapted criteria and indicators (C&I). The set of C&I was developed by combining top-down approaches based on existing sustainability frameworks as well as bottom-up approaches employing a systems analysis approach. Regional and local stakeholders including forest and environmental administration, villagers and nomads were consulted to collect local knowledge, to express preferences with regard to thematic issues and to contribute to the design of alternative landuse strategies. The regional set of C&I was employed to

assess and compare current and alternative landuse strategies with regard to the maintenance of forest ecosystems within the frame of sustainable development.
In this contribution we introduce the problem setting, we describe the development of the regional set of C&I including stakeholder interaction and demonstrate its use in comparing the impacts of optional integrated landuse strategies. Knowledge gaps as well as implementation issues are identified.

GAP DYNAMICS IN TEMPERATE CONIFER FORESTS IN CENTRAL AND WESTERN BHUTAN HIMALAYAS

K. Tenzin[1,*], G. Gratzer[3,] M.R. Moktan[4], A. Darabant[1,3], P.B. Rai[2]

[1] *Renewable Natural Resources Research Center, Yusipang, Thimphu, Bhutan*
[2] *Renewable Natural Resources Research Center, Jakar, Bumthang, Bhutan*
[3] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
[4] *Renewable Natural Resources Research Center, Bajo, Wangdiphodrang, Bhutan*
** Author for correspondence: kktenzin@druknet.bt*

Regeneration research in Bhutan focused on larger openings created through Commercial Forest Management while the impact of small forest gaps created by natural tree mortality and by local forest users on tree regeneration had received less attention. A line intersection sampling was used to sample the gaps in the east and western region of Bhutan. A total of 591 gaps were sampled at an altitudinal range of 2600 masl- 3900 masl. 48% of the gaps were created through tree felling, 38% of the gap makers were snapped, 10% were uprooted and 3% of the gap makers died standing. Spruce and Bluepine were the most common gap maker species followed by hemlock, fir and oak. The average gap size was 130 m^2, receiving an average of 45% of open area solar radiation. Spruce was the most dominant gap filler species followed by hemlock, Bluepine, fir and oak. Over all, solar radiation in the gap increased with increasing gap size. Older gaps however and gaps filled with bamboo did not show any relationship of solar radiation with gap size. The overall transition matrix of gap makers and gap fillers showed that self replacement was greater in hemlock, spruce and fir. This underlines stable coexistence of the species and a lack of a sucessional trend of replacement of the more light demanding spruce by the shade tolerant hemlock and fir. Bluepine however was replaced by Spruce and Hemlock indicating a successional trend towards later successional species. Oak as gap maker was predominantly replaced by Bluepine, indicating a trend towards mixed Bluepine and oak forests.

GNAWERS IN THE PROCESS OF THE ECOLOGICAL STABILITY OF FOREST ECOSYSTEMS

K. Turek[1], M. Homolka, J. Kamler

[1] *Mendel University of Agriculture and Forestry in Brno, Zemědělská 3, 61300 Brno, Czech Republic, kamilturek@post.cz*

A project which started in the Czech Republic in 2007 has main aim to gat information about the extent of negative influences of small gnawers on forest regeneration and about the population dynamics and feeding ecology of gnawers in the forest. The presented report is to inform about the first results of the project. The investigation of the density of small gnawers was done on the basis of the catching to the clap traps. Intensity of browsing on the tree bark was observed on the 180 plots in the Czech Republic. On each of them 50 individuals were controlled (all together 9000 trees, 10 different species of trees). In total, 2 420 gnawers were caught, of which 49% were bark gnawed voles. One of the most dominant species of the vole found on clear-cuts was bank vole (63% out of the total amount of voles), less represented was field vole (31%), and short-tailed vole (7%). The density of voles varied in constituent regions-from 11 to 52 individuals per ha. The density of several species of gnawers on clear-cuts was influenced by the age of the clear-cuts and the structure of vegetation. Voles mostly gnawed on the bark of European beech (40% out the total number of observed species), the least they gnawed on Norway spruce (2%). The intensity of browsing of the beech was different in various parts of the Czech Republic (from 17% to 62%). Preliminary studies confirm the fact that small gnawers, mainly on the clear-cuts, significantly retard the regeneration of broad-leaved trees and cause big financial looses. Therefore, it is necessary to concentrate on the study of this problem.
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SILVICULTUREL VIEW IN HIGH MOUNTAIN ECOSYSTEMS IN BLACK SEA REGION

I. Turna[1,*], Z. Yucesan[1]

[1] *Karadeniz Technical University, Faculty of Forestry, 61080 Trabzon, Turkey*
[*] *Author for correspondence: ibrahimturna@hotmail.com*

Effective utilization and conservation of forest resources without jeopardizing the health of forest ecosystems has become paramount with respect to global developments over the last decade. A number of relevant international agreements with legal mandates have appeared to be widespread Management planning as well as regulation close-to-nature or ecosystem without damaging the natural structure in terms of eco-silvicultural perspective has gained momentum.
Turkey could be distinguished into three major phyto-geographical regions as Euro-Siberian, Mediterranean and Irano-Turanian. These regions are one of the richest floristic centres in the World and its floristic structure is extremely complex.
Euro-Siberian region which is separated into two groups as Euxine and Colchis includes whole area of north Turkey (Coastal and interior zone of Blacksea region). Colchis floristic centre is Eastern Black sea Region of Turkey. This region represents one of the most critical areas in Turkey due to high population density per area,

scattered residences over the landscape, ragged areas and heterogeneous ecosystems with the limited areas left for the dwellers. Ecological integrity of the forest has been lost as the forests in these areas are forced to heavy residential developments for eco-tourism and grazing in high plateau for livestock near the timber line or alpine zone. On the other hand Euxine floristic zone has more intensive forestry characteristics. Field structure is more temperate and social press is fewer in Euxine floristic zone. However natural forests are very productive and very rich according to biological diversity.
Consequently, determining appropriate land use patterns, conservation measures and rehabilitation activities on such areas is necessary to restore and sustain the ecological integrity of the area. Otherwise, it takes a long time for the nature to rehabilitate the degraded forest ecosystems. This study presents and documents the eco-silvicultural features of the high mountainous forests along the Black Sea region.

DETERMINING FUNCTIONAL CLASSIFICATION OF THE SUPALPINE PURE ORIENTAL SPRUCE (*PICEA ORIENTALIS* (L.) LINK) STANDS ON MOUNTAIN FORESTS IN TURKEY

A.Ö. Ücler[1,*], Z. Yücesan[1], A. Demirci[1], H. Yavuz[1], E. Oktan[1]

[1] *Karadeniz Technical University, Faculty of Forestry, 61080 Trabzon, Turkey*
[*] *Author for correspondence: ucler@ktu.edu.tr*

In this research 46 sampling plots in total were chosen consciously in natural distribution area of oriental spruce in subalpine zone. Those of 23 sampling plots are in treeline and 23 of them in timberline. In each sampling plot functional characteristics (wood production, erosion control, avalanche prevention, water production, grass productivity-wild life habitat and scenic beauty) were digitized as a scalar value between 1 (the worst) to 5 (the best) by the same working gang according to some observations and exact differences were fixed between the functional characteristics of treeline and timberline stands. Obtained functional values from treeline and timberline were compared by discriminant analysis and 41 of the sampling plots (89 %) were estimated in their real groups.

CHESTNUT ORCHARDS IN ITALY: COMBINING THE SATISFACTION OF NEEDS AND THE ENJOINMENT OF AMENITIES

S. Pierrettori, L. Venzi[1]

[1] *University of Tuscia, Department of Ecology and Economic Sustainable Development (DECOS), via S. Giovanni Decollato,1 01100 Viterbo, Italy, lvenzi@unitus.it*

Chestnut orchards represent in Italy an example of high stand forest management, generally as a set of trees, centenaries old. Usually they are registered and protected trees and their felling could be possible only for phytosanitary reasons. In the majority of cases, the old chestnut orchards belong to Public Administrations that manage them as a luxury feature. The special environment they create is particularly impressive and is a free, remarkable recreational scenery, with some restrictions of access mostly during the period of fruit picking. In the past chestnuts represented the survival and staple food for the population in central Italy, in remote marginal areas and low

mountains and hills. Nowadays, it is a wealthy production, provided the varieties are appreciated on the market and picking operations can be performed at low costs by using mechanized harvesters or cheap labour. It is an healthy environment because, generally, neither pest or fungi treatments nor fertilization are necessary. The chestnut fruit is, therefore, almost a biological product; nevertheless, sometimes bad management created damages, and in so doing pest treatments were necessary. Apart from these cases and the recent problems created by Dryocosmus kuriphil (a very dangerous incoming pest for Italian chestnut trees) these orchards represent a particular and suggestive environment, both for the dimension reached by high trees and for the pleasant context in which they grow. The economic aspects relating to chestnut trees are twofold: first of all production results and, on the other hand, the recreational function, strongly correlated with the age of the trees. The paper will deal with the orchard budgetary economic results and provide, by the use of a questionnaire, the evaluation of the amenities related to the orchards. By doing so, we shall try to add some elements of environmental accounting on the performance of these estates.

GLOBAL SCENARIOS AND REGIONAL PERSPECTIVES IN BIODIVERSITY AND SUSTAINABLE UTILIZATION OF FRAGILE ECOSYTEMS AFTER THE BRUNDTHLAND REPORT

Y.A. Woldeamanuel[1]

[1] *Addis Ababa University, Ethiopia, yosephlassefa@yahoo.com*

During Earth's 5 billion year's of existence there have been 5 major biodiversity extinction events caused by natural phenomena. Evidence points to a sixth extinction now underway – this time mainly due to human activities. Unfortunately, there are accelerating declines and losses in biodiversity, decreasing the capacity of many ecosystems to provide services and undermining local livelihoods. Spatial patterns and temporal dynamics of major landscape have been compromised that has lead to a significant and persistent effect on genetic, species and ecosystem levels. The paper briefly summarizes the drivers, pressures, impacts, state and trend of Biodiversity and ecosystem services for the last couple of decades using GEO data portal and other primary and secondary findings from various case studies. The report traces the development of major issues that were critical in 1987, highlights progress made and draws attention to new challenges that have emerged and make from a systematic analysis of issues at global and regional levels, through a scenario-based outlook of the situation in 2050, to a presentation of urgent but realistic options for action. The assessment report provides indisputable evidence of unprecedented environmental change over the past 20 years. There is now a powerful international agenda and concerted action to combat biodiversity loss. Implementing effective measures depends on national and local action. The three-fold increase in protected areas since the early 1970s is encouraging - roughly 12 per cent of the world's land surface is now under some sort of protection status. Policy frameworks are also beginning to support relatively new concepts such as 'Payments for Ecosystems Services'. Several countries are exploring mechanisms whereby the beneficiaries of services, such as watershed protection, pay a market price for those services to be sustained through appropriate ecosystem management. The paper will also address on opportunities to address the crosscutting issues. An attempt will be made on how scientists from least

developed country could get access to broad collection of harmonized environmental and socioeconomic data sets from authoritative sources at global regional and sub regional levels. The database contains more than 450 variables on climate, forest, freshwater, etc. and socioeconomic issues including education, health, economy, population and policies.

ETHNOVETERINARY MEDICINAL PLANTS AT BALE MOUNTAINS NATIONAL PARK, ETHIOPIA

H. Yineger[1,*], E. Kelbessa[2], T. Bekele[2], E. Lulekal[2]

[1] *Department of Biology, Jimma University, P.O. Box 5195, Jimma, Ethiopia*
[2] *National Herbarium, Addis Ababa University, P.O. Box 3434, Addis Ababa, Ethiopia*
** Author for correspondence: haile_mulu@yahoo.com*

An ethnobotanical study on veterinary medicinal plants of Bale Mountains National Park and adjacent areas was conducted from July 2003 to June 2004. Semi-structured interviews and observations were used to generate ethnoveterinary data from traditional healers residing in the park and buffer zones. A total of 25 animal ailments were reported, of which blackleg, *Darissaa* and hepatitis were the most frequently reported ailments. Seventy four veterinary medicinal plant species that were distributed among 64 genera and 37 families were recorded. The most utilized growth forms were herbs (35 species, 47.3%) followed by shrubs (28 species, 37.84%). Roots (54 species, 41.54%) followed by leaves (47 species, 36.15%) were the most frequently used plant parts for ethnoveterinary medicine. Usually, fresh materials (53 species, 43.44%) were preferred for medicine preparations. The most frequently used route of drug administration was oral (65 species, 42.76%) followed by dermal (55 species, 36.18%). Indigenous knowledge was mostly transferred to an elect of a family member in word of mouth indicating that it was prone to fragmentation or loss.

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INVESTIGATION CAUSES OF MOUNTAIN FOREST DEGRIDATION WITH LOCAL COMMUNITY PARTICIPATION CASE STUDY-FANDOGLU MOUNTAIN FOREST - ARDEBIL PROVINCE, IRAN JULY 2007

P. Yousefyazary[1]

[1] *Islamic Azad University, Research and Science Branch Tehran, No. 131, zartosht-e-gharbi 14156833661 Tehran, Iran, peiman_yosefi@yahoo.com*

Mountain forests have vital role in our life.They are to protect soil and freshwater,maintain biological diversity,mitigate climate change,provide recreation facilities and help alleviate poverty in mountain areas. In this century,degridation of mountain forests have became a major problem in mountain regions. This paper presents our research results on causes of deforestation at FANDOGLU forest which is located in Iran.Research method was based on Participatory Rural Appraisal(PRA)

method and Rapid Rural Appraisal (RRA)with local community participation.Results shows the 31% of local community believes that main reason of deforestation is cutting trees for fuelwood.27 percentage of local community believes that poverty and unemployment is the most important cause of deforestation. 21 % of people think the livestock grazing inside of forest is the reason of degridation and either 10 % believe that changing forestland to farrming is. 7% forest fire and 4% unawareness, describe reason of deforestation. Majority of local community,describe the best solution as below : 1.carring gas (or other source of energy) (37%) 2.development of job opportunity (31%) 3.development of rural road (16%) 4.istruction of local community (11%) 5.conservatin of forests (5%) conclusions shows that the major factor of deforestation in this areas is undevelopment. key words : Mountain forest , forest degridation , participatory rural appraisal , rapid rural appraisal

BARK BEETLE DYNAMICS AFTER WIND DISTURBANCE IN TATRA MOUNTAINS, WEST CARPATHIANS

P. Zach[1]

[1] *Institute of Forest Ecology, Slovak Academy of Sciences, Sturova 2, 960 53 Zvolen, Slovakia, zach@sav.savzv.sk*

Bark beetle dynamics after wind disturbance in Tatra Mountains, West Carpathians Peter Zach, Branislav Krsiak, Jan Kulfan, Katarina Vargova Institute of Forest Ecology, Sturova 2, 960 53 Zvolen, Slovakia Mountain forests play an important multi-functional role in stabilizing landscapes across Europe. They are a component of landscape aesthetics that is of importance for tourism and associated human activities. Not surprisingly, any excessive disturbance to a mountain forest evokes discussion about its known and unknown causes and conseqeunces for nature, man and community. We focus here on highly excessive wind disturbance in the Tatra Mountains, West Carpathians, Slovakia, dated 19th November 2004, resulting in a total of 12,600 ha of strongly modified forest, and consequent bark beetle outbreak. Although damaged timber has been removed from most wind-affected areas, strictly protected areas dominated by Norway spruce (Picea abies), have been left unsalvaged. At the study site in Ticha dolina valley (1,1000 m a.s.l.), a total of approximately 4,000 m3 of wind-damaged timber has been left, and in the surrounding forests (Ticha and Koprova dolina valley) the amount of timber left reached some 45,000 m3. As some bark beetle species were likely to outbreak in the area, we studied their dynamics using not baited flight interception traps. Abundance of bark beetles varied greatly within and among collecting sites over the period 2005 – 2007. We revealed a continuous increase in the abundance of Ips typographus and other nine bark beetle species at all collecting sites, including the control site (no trees damaged by wind). The spruce forest partly modified by wind (30 – 40 % of trees uprooted or broken) yielded much higher numbers of bark beetles than did the strongly modified forest (95 – 100 % of trees uprooted or broken). Availability of food resources, several additional windthrow events and two years of drought (2006, 2007) allowed Ips typographus population in protected areas to reach outbreak levels during three years. Numerous tree deaths are documented from both valleys and timberline. Epidemic situation is expected to be retained for the next several years, and forest decline is likely to extend to areas not affected today. There is nothing wise one can do to stop Ips typographus outbreak in strictly protected areas. On the other hand, it would be

misleading to state strict forest reserves are the only source from which bark beetles can spread over large distances. Long tracks of forest edges (ecotones) outside the reserves formed by wind disturbance in 2004, also, provide favourable conditions for development of bark beetles on the south-facing slopes in lower altitudes. As bark beetle oubreaks play an important role in directing ecological processes and maintaining biological diversity in forest ecosystems, they should be paid great attention in university education, forest management, biodiversity conservation and development of rural areas.

III. Posters

REGENERATION/REHABILITATION OF NATIVE VEGETATION FOLLOWING ESTABLISHMENT OF AREA ENCLOSURES AND OR EXOTIC PLANTATIONS IN NORTH EAST HIGHLANDS OF ETHIOPIA

A. Abiyu-Hailu[1]

[1] *Amhara Regional Agricultural Research Institute (ARARI), Gondar Agricultural Research Center (GARC), 1337 Gondar, Ethiopia, abrhamabiyu@yahoo.com*

The diversity and density of colonizing native woody species (CWS) were compared under two land rehabilitation strategies, plantations of exotic tree species and area enclosure, in Ethiopia. The adjacent grazing land, which was left untreated, was used as a control. The exotic tree species considered include Eucalyptus globulus and Cupressus lusitanica. The plantations and enclosures were established on former agricultural lands 25 years ago. A totally of 33 families and 65 species of native woody species were identified. The most frequent families are Asteraceae, Lamiaceae, Malvaceae and Verbenaceae. Each represented with 4 species. The most frequent species are Juniperus procera, Cupressus lusitanica, Olea europea ssp cuspidata, Maytenus arbutifolia, Clutia abyssinica, Jasminium abyssinicum. There were significant differences in the total number of species recorded, density of individuals of a species, number of seedlings/ha and the basal area of the CWS. In terms of number of species observed, the order from highest to lowest was Enclosure > Eucalyptus Plantation (EP) > Cupressus Plantation (CP) >and Grazing land (GL). The highest density of plants was observed in enclosures, followed by CP, EP and GL. There is significant difference in diversity values of Shannon-Wiener diversity index, Simpson's diversity index, Simpson's evenness index between the land use systems considered.

VISUAL LANDSCAPE CHARACTER OF ORIENTAL SPRUCE (PICEA ORIENTALIS (L.) LINK.) MOUNTAIN FORESTS IN TURKEY

C. Acar[1*], E. Eroglu[1]

[1] *Karadeniz Technical University, Department of Landscape Architecture, 61080 Trabzon, Turkey*
* *Author for correspondence: cengiz@ktu.edu.tr*

In the process of European Union, the countries have been dealt with some pursuits with landscape and landscape character. If the landscape character would be determined by its physical, social, and aesthetical attributes correspond to the spirit of an agreement, it could be possible to get a way in the context of conservation, development and management in forest landscape planning. Oriental Spruce is one of the most important species distributed in the northeastern Black Sea Region of Turkey and Caucasia as colchic element. It forms the main structure of the "forest landscape", affecting the landscape character of the region's mountains regarding with its

distributions and land use. In this proceeding, the visual landscape character of Oriental Spruce mountain forests was tried to be determined in selected areas of the northeastern Black Sea Region of Turkey. The aims of this study focus that; • By which main parameters does the visual character determine? • What methods can be used to determine the visual character of mountain forest landscape? • How can be the visual landscape character assessed in the process of forest functional planning or landscape planning? With these precedences, some landscape areas were categorized by some criteria such as plant species composition, variety, color, mass-void, edge, geomorphologic unites, rocky, roadside, etc. in forest panoramas of the region. A participated approach was conducted to determine landscape character of forests. Using slide show, the preferences were determined by semantic factors (naturalness, variety-complexity, unity, fascination, vividness, meaningful). In this survey method, each descriptors and each slide was rated on a scale from 1 to 7. As a result, the landscape character types of mountain forests were discussed, that is integrated to forest or landscape management regarding to sustainability of forest visual resources as well as ecological and sylvicultural characteristics. In this way, the "landscape aesthetics" attributes were tried to be quoted in forestry applications. This study is important to determine landscape quality as well as management and sylvicultural works in Turkey.

MONITORING PHENOLOGY OF THE EUROPEAN BARK BEETLE, IPS TYPOGRAPHUS, FOR RISK ASSESSMENT OF OUTBREAKS AT THE SITE AND REGIONAL SCALE

P. Baier[1]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Hasenauerstr. 38, 1190 Vienna, Austria, peter.baier@boku.ac.at*

Monitoring phenology of the European bark beetle, Ips typographus, for risk assessment of outbreaks at the site and regional scale P.Baier, J. Pennerstorfer, A.Schopf We developed a model for monitoring phenology and population dynamics of the most important spruce bark beetle in Europe, Ips typographus (Col., Scolytinae) as a basic, GIS-supported tool for risk assessment of outbreaks and decision guidance for management measures. The model provides a spatial and temporal simulation of the seasonal development of the bark beetle. It is based on a digital elevation model used for interpolation of temperature and solar radiation to estimate the microclimatic conditions for the beetles' development inside the bark. For calculating effective temperatures and thermal sums, which are necessary for successful development, we used a nonlinear function. The computed results were validated with locally recorded data from trap trees at various expositions on mountainous and subalpine terrain throughout a four-year study period. The model allows the prediction of the onset of host tree infestation in spring with a mean absolute error of 1.3 days. Using hourly recorded temperature data, the observed onset of emergence of filial beetles in the field was estimated with a mean relative error of 2.9%. Furthermore, the time of re-emergence of parental beetles to develop sister broods and the rate of successful hibernation can be predicted. The model can also be used for the precise monitoring of the actual state of bark beetle development at the specific stand/tree level and for assessing its potential development at regional scale by simulating the maximum

number of generations. Further applications of the model are site-specific hazard rating of bark beetle infestation, retrospective analysis of population dynamics, and visualization of future outbreak scenarios on local and regional level under changing climate conditions.

FARM FORESTRY AND AGROFORESTRY FOR POVERTY ALLEVIATION AND RURAL DEVELOPMENT IN NEPAL: CASE STUDIES FROM FARM FORESTRY PROJECT NEPAL (1983-1997)

R.B. Bhandari[1,*], P.M. Dixit[2]

[1] *Department of Biology, University of Rome "Tor Vergata", Via della Ricerca Scientifica, 00133 Rome, Italy*
[2] *Agro-Farm Forester's Association, Nepal (AFFAN)*
* *Author for correspondence: rbbhandari@gmail.com*

Farm Forestry and Agroforestry form the foundation for all forestry research and development activities in Nepal. The advantages of farm forestry and agroforestry are such positive biological interactions between the various components of the system that results in increased yields and thus increased income. The cost involved in such farming methods is meanwhile reduced. Nepal stands to benefit greatly from the introduction of farm forestry and agroforestry as its natural forest reserves are at present diminishing rapidly. It is a country with widespread poverty, which can be alleviated by applying technologies evolved from long-term observation and experiments in farm and agro-forestry research and development. Thus farm and agroforestry research and development programs needs to be implemented and promoted in Nepal varying across the country with different agro-ecological zones, if the country's target needs to be met for food, fodder, fuel wood, timber and non-timber forest products for poverty alleviation and rural development in a sustainable way. This paper examines the overall project activities and experiences of the Farm Forestry Project/Nepal (FFP/Nepal) and its impacts for poverty alleviation and rural development in selected districts of Nepal. The project was jointly implemented by the Institute of Agriculture and Animal Science (IAAS) and the Institute of Forestry (IOF) of Tribhuvan University, Nepal and supported by the International Research and Development Center (IDRC) of Canada from 1983 to 1997.

SPECIFIC APPLICATIONS OF LARGE DIAMETER TIMBER FROM ALPINE FORESTS - FROM RESONANCE WOOD TO NON-STANDARD PULP.

C. Buksnowitz[1]

[1] *Institute of Wood Science and Technology, Department of Material Sciences and Process Engineering, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria, christoph.buksnowitz@boku.ac.at*

In most alpine regions forest sites have multiple functions reaching from protection of infrastructure and settlement areas over recreational purpose to primary production of timber. Together with difficult logging due to slope and hindered access the product profitability of standard assortments of timber is often critical. Long rotation periods and the need for very stable forest-stands lead to a high proportion of large diameter trees. The results of several research projects on large diameter timber were combined in this study to reveal potential high value application in accordance to specific material properties. A basic material assessment and characterisation of the wood properties on several hierarchical levels provide a large data basis on anatomical, mechanical, chemical, acoustical and optical wood properties of large diameter Norway spruce (Picea abies (L.) Karst.), which served as a predominant example species. Multivariate statistics were applied to reveal the correlations between the measured parameters and to identify the "unique selling propositions" for high value products such as resonance wood for musical instrument making or extra long tracheid fibres for speciality pulp. Based on the wood properties in contrast to fast grown low land Norway spruce with a high proportion of juvenile wood, potential innovative utilisations of large diameter timber shall enable the forest owners in alpine regions to create an added value of their products

PLANT SPECIES COMPOSITION IN MANAGED AND OLD-GROWTH FORESTS: A CASE STUDY FROM CENTRAL ITALY

S. Burrascano[1*], L. Rosati[1], C. Ricotta1, C. Blasi[1]

[1] *Sapienza University of Rome, Department of Plant Biology, P.le Aldo Moro, 5 00185 Rome, Italy*
[*] *Author for correspondence: sabinaburrascano@gmail.com*

Exploitation of forests has left only a few remnants of temperate forest in a near-natural state. Secondary forests, undergoing fragmentation, homogenisation and simplification, are characterized by a reduction in species populations adapted to natural forests. The aim of our research is to investigate the differences in understorey composition and the loss in plant species diversity due to forest history and management. Moreover, our aim is to test to what extent these differences rise to functional, ecological and taxonomic differences. We carried out our study within the Abruzzo, Lazio and Molise National Park. A stand that was known to be an old-growth forest was compared with another stand nearby, usually managed as a shelterwood. Both stands are strongly dominated by Fagus sylvatica, they are within the same altitude range (1600-1850 m a.s.l.), they have the same prevalent aspect and slope. Strong differences characterized the herb layer, as it had a higher percentage cover and a greater diversity in the old-growth stand, where the number of species per

plot was significantly higher. At the same time also the total species richness was higher. The unmanaged stand showed a higher value for Shannon diversity index as well as for eveness. Permutational analysis of variance showed a significant difference between plant species composition in the two stands both in terms of presence/absence and cover data. The same analysis showed that the two sites are significantly different in terms of plant species functional traits, bioindicator values and taxonomic distances. Since sampling design ensured the occurrence of similar environmental and topographical factors, management history should be the main cause of the differences in plant species composition. According to our results old-growth forest understorey displays a higher plant diversity. The occurrence of functional ecological and taxonomic differences confirmed the role of old-growth forests in biodiversity conservation.

A MERCHANTABLE VOLUME SYSTEM FOR SCOTS PINE IN THE MAJOR MOUNTAIN RANGES OF SPAIN

F. Crecente-Campo[1], G. Lobelle-Vázquez[1], A. Rojo-Alboreca[1,*], M. del Río-Gaztelurrutia[1], U. Diéguez-Aranda[1]

[1] *University of Santiago de Compostela, Higher Polytechnical School, Campus Universitario s/n, 27002 Lugo, Spain*
[*] *Author for correspondence: rojo@lugo.usc.es*

A compatible volume system for Scots pine in the major mountain ranges of Spain (Pyrenees, Southern Iberian Range, Northern Iberian Range, Soria and Burgos Mountains, Central Range and Galician Mountains) was developed from data corresponding to 2,964 destructively sampled trees. Several well-known taper functions were evaluated. A second-order continuous-time autoregressive error structure was used to correct the inherent autocorrelation of the longitudinal data used in the present study, allowing the model to be applied to irregularly spaced, unbalanced data. The compatible segmented model developed by Fang et al. (2000) best described the experimental data. It is therefore recommended for estimating diameter at a specific height, height to a specific diameter, merchantable volume, and total volume for the six mountain ranges analyzed. The non-linear extra sum of squares method indicated differences in mountain ranges-specific taper functions. A different taper function should therefore be used for each mountain range in Spain.

UNDERSTANDING OAK DROUGHT STRESS RESPONSE: A WHOLISTIC APPROACH

N. Schulz[1], K. Burg[1], S. Fluch[1,*], M. Oufir[2], J.-F. Hausman[2], E. Wilhelm[1]

[1] *Austrian Research Centers GmbH (ARC), 2444 Seibersdorf, Austria*
[2] *Centre de Recherche Public Gabriel Lippmann, Luxemburg*
[*] *Author for correspondence: silvia.fluch@arcs.ac.at*

Drought periods due to climate changes, as being forecasted for the upcoming decades, will demand specific drought tolerating strategies of trees due to their long life cycle. Selecting trees with the potential to more easily adapt to the changing environmental conditions would be reasonable, especially for afforestation purposes where sustainable forest management is a major issue. Thus, the final goal of this project is to develop easy applicable functional markers for drought resistant oaks from natural populations. These can support plant selection to enhance drought resistance of oaks (quercus spp.). In order to identify informative markers, four approaches are combined. Based on a two-year glasshouse experiment, five year old clonal plants originating from tissue culture are subjected to controlled drought stress conditions in a closed environment. During this time, in order to get a 'full picture' of the response to long-term drought stress on the "whole-plant level", i) the transcriptome (cDNA-Microarray) ii) the proteome iii) physiological parameters such as proline and carbohydrate content as well as iv) phenotypic parameters are monitored and plant material is sampled in regular intervals. During the two years of the experiment, three treatments have been applied: 1) control: soil kept moist (vol. soil moisture > 30%), 2) drought stress: cycles of increasing water stress from 20% to <10% vol. soil moisture for two growing seasons and 3) drought stress in the 1st year but "control conditions" in the 2nd year. During the first growing season not only a delay in leaf development could be observed in the drought stressed plants but also a significant reduction in growth ($p<0.05$) as compared to control plants. This observation was underpinned by the physiological results showing significantly higher ($p<0.05$) sugar and polyol concentrations in the drought stressed plants at each sampling time compared to the controls. Furthermore, a significant accumulation of carbohydrates ($p<0.05$) took place in the stressed plants with persisting drought treatment. In the second year, the plants of both drought stress treatments started earlier with leaf development than the controls. However, while DS-2 resumed growth DS-1 almost stopped growing and did not show a 2nd flush. Microarray and proteome analyses are still running.

FUNCTIONAL DIVERSITY OF AUSTRIAN OAK POPULATIONSBASED ON STRESS GENES

A. Homolka[1], K. Burg[1], M. Berenyi[1], S. Fluch[1,*], N. Schulz[1], E. Wilhelm[1], S. Schüler[2]

[1] *Austrian Research Centers GmbH (ARC), Department of Bioresources, PICME, 2444 Seibersdorf, Austria*
[2] *Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Institute of Genetics, Vienna, Austria*
[*] *Author for correspondence: silvia.fluch@arcs.ac.at*

Forest populations of long-living trees like oaks will face considerable environmental challenge because of the predicted global warming. So far the genetic diversity of these populations was assessed based mostly on neutral genetic markers like microsatellites and AFLP etc. In the present work the genetic diversity of drought/osmotic stress related genes possibly important in response of the forest population to foreseen environmental changes will be assessed in oak populations living under different climatic conditions using the oak DNA sampling collection established at ARC. The diversity assessment will be based on ten selected drought/osmotic stress related genes originating partly from previous work at ARC and partly from running PhD work. These latter genes need new SNP discovery by sequencing alleles originating from different climatic regions and from geographically distant locations. Allelic diversity will be established by three independent SNP loci per gene allowing the theoretical identification of eight alleles per gene locus provided if SNPs yield two variants. The SNP detection will be PCR based using SNP variant-specific primers. The obtained diversity data will be correlated to geographic locations and climatic parameters of the selected populations using proper statistical approaches.

MICROSATELLITE MARKERS FOR NORWAY SPRUCE BASED ON EXPRESSED SEQUENCE TAGS

S. Fluch[1,*], A. Burg[1], A. Weilharter[1], D. Kopecky[1], G. Vendramin[2], K. Burg[1]

[1] *Austrian Research Centers GmbH (ARC), Department Biogenetics, PICME, 2444 Seibersdorf, Austria;*
[2] *CNR Firenze Plant Genetics Institute – Division of Florence, 50019 Florence, Italy*
[*] *Author for correspondence: silvia.fluch@arcs.ac.at*

In order to develop molecular markers to investigate nuclear sequence variation linked to functional units or genes of a genome, expressed sequence tags (ESTs) serve as a good source. The sequence information for ESTs is based on expressed genes in various tissues of an individual, representing low copy number regions of the respective genome. Especially in conifers with their large genomes being composed of a large proportion of repetitive elements, ESTs serve as a valuable information source for marker development. Using 15.000 Norway spruce EST sequences, we performed an in silico analysis in order to identify simple sequence repeats available for marker development. Approximately 10% of the available ESTs contained SSR regions with 48 different sequence motifs. Tri-nucleotide motifs were most common (24) followed by penta- (11), hexa- (5), tetra- (4) and di-nucleotide (4) motifs. PCR primers were planned for the respective repeat motif classes and tested in PCR

reactions for amplification quality. Variability of the selected primer sets will be established in a sample set of DNAs from different Austrian Norway spruce accessions. These newly developed SSR markers derived from expressed genes with known function will further serve for assessing putative functional nucleotide diversity of Norway spruce.

THE DISTRIBUTION OF BLACK SNOW MOULD (*HERPOTRICHIA* SPP.) IN THE DÜRRENSTEIN WILDERNESS AREA (AUSTRIA)

M. Hinker[1], J. Pennerstorfer[1], E. Halmschlager[1,*]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Hasenauerstr. 38, 1190 Vienna, Austria*
[*] *Author for correspondence: erhard.halmschlager@boku.ac.at*

Black snow mould (*Herpotrichia juniperi* and *H. coulteri*) is considered a key factor for the survival and growth of its conifer hosts in subalpine forests and at the timberline in the European Alps. These pathogenic fungi have the potential to alter the characteristics of plant populations and communities. In summer 2007 we studied the distribution of black snow mould in an area covering about 1064 ha in the IUCN category I wilderness area "Dürrenstein". The incidence and severity of black snow mould was assessed in three natural habitats (i.e. Tilio-Acerion forests of slopes, screes and ravines, Vaccinio-Piceetea and Mugo-Rhododendretum hirsuti), where susceptible host species (*Picea abies*, *Pinus mugo*, *Juniperus* spp.) were suspected to occur. Fixed-sized, systematic sample plots, 20 m in diameter, were established at 200-m intervals along a regular grid using GPS. Only plots located in one of the three selected habitats were considered for data collection. On each plot disease incidence was evaluated for each host species and disease intensity was rated using a 0-3 classification scale. Site and stand characteristics including elevation, aspect, slope, meso- and microrelief, vegetation type, composition of tree species and stocking degree were also recorded on each plot. Infection of conifers by *Herpotrichia* spp. was found on 184 (approx. 75%) out of 246 plots. Disease intensity was very severe or severe on 44% of the plots. On 131 plots, infection was recorded on only one host (about half on *P. abies* and half on *P. mugo*), while on 52 plots *Herpotrichia* infestations were found on both hosts. There was only one plot, where a *Juniperus* species was additionally affected. The high intensity of black snow mould may suggest that *Herpotrichia* species have a significant impact on regeneration, survival and growth of susceptible conifer hosts in the study area.

THE FUTURE OF JIUZHAIGOU: LEARNING FROM THE PAST

T.M. Hinckley* et al.[1,2,3]

[1] *Faculty, graduate and undergraduate students from the University of Washington, Seattle, United States*
[2] *Faculty, graduate and undergraduate students from Sichuan University, China*
[3] *Jiuzhaigou National Park Science Department Staff, China*
* *Author for correspondence: University of Washington, WA 98195-2100 Seattle, United States, hinckley@u.washington.edu*

To facilitate improved park planning for sustainable growth we tested in June 2007 a comprehensive, interdisciplinary, and collaborative framework between Sichuan University, Science Department Staff at Jiuzhaigou National Park and the University of Washington for collecting data and monitoring park cultural and ecological conditions. This framework included preliminary investigation of Jiuzhaigou's geology and soils, a comprehensive archaeological survey of the upper villages in Yala valley and ethno-historical review, as well as an ecological assessment of current and historical landscapes. We tested several field methods for accomplishing these goals, while also collecting hard data towards these ends. Our ultimate goal is to establish a set of tools and techniques with park staff for long-term monitoring and management of park cultural and ecological resources that takes into account past human behavior. Our most compelling result was the noted close coupling of the cultural and environmental landscapes. Evidence for this came from (a) the cultural stories and songs of the members of the indigenous people of the valley, (b) analysis of ^{14}C-charcoal samples with dates as old as 2220 BP, and (c) the relatively small proportion of the total landscape in the park in biologically diverse and unique meadows and pastures many of which were found on terracettes formed from loess. The current management practice involving the reforestation of these meadows and pastures was, therefore, questioned based upon our findings.

CASE STUDIES OF SUPPLY CHAINS FOR FOREST CHIPS UNDER MOUNTAINOUS CONDITIONS

C. Kanzian[1]

[1] *Institute of Forest Engineering, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria, christian.kanzian@boku.ac.at*

In Austria the demand for forest fuel is increasing quickly, because of governmental promotion. Usage of harvesting residuals for energy purposes is actually not common in Austria. Some reasons for that are: poor demand of low quality fuel wood; sparse quantities per harvesting site and high costs for comminuting and transport. On the other hand the use of high mechanized systems, where the extraction is done as whole-tree with processing at the landing, produces piles of slash as leftover. Under mountainous conditions three different supply chains where investigated to find productivities, costs and technical limitations. Chipping and bundling processes were recorded during time studies. The transport was monitored by a PDA-GPS-device using a self-developed time-study software. Chipping at the landing directly into a chip truck is expensive, because of the operational delays ("hot chain"). Another

problem in mountainous areas is the traffic ability of forest roads for standard chip-trucks. Chipping at the landing blowing the chips on a pile, grapping the chips with a self-loading truck ("cold chain") is a viable option. Especially if the productivity of chipping is low the self-loading truck is competitive against the direct loading system. Producing bundles at the landing with a truck-mounted bundling unit, hauling to a storage place at the plant and chipping or crushing is the third option. The bundling technology leads to high costs due to the low productivity of the bundling unit, but this system has the most potential for further development.

INFESTATION OF BLUE PINE (*PINUS WALLICHIANA*) BY HIMALAYAN DWARF MISTLETOE (*ARCEUTHOBIUM MINUTISSIMUM*) AND THE LEAFY MISTLETOE *TAXILLUS KAEMPFERI* IN MOUNTAIN FORESTS OF BHUTAN

T. Kirisits[1*], S. Dorji[1], E. Donaubauer[1], M.J. Wingfield[2], D.B. Chhetri[3]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Hasenauerstr. 38, 1190 Vienna, Austria*
[2] *Department of Microbiology and Plant Pathology, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria, South Africa*
[3] *Renewable Natural Resources Research Centre (RNR-RC), Yusipang, Western Region, Council for RNR Research of Bhutan, Ministry of Agriculture, Royal Government of Bhutan, Bhutan.*
[*] *Author for correspondence: thomas.kirisits@boku.ac.at*

Blue pine, *Pinus wallichiana*, is an ecologically and economically important tree species in temperate conifer forests at elevations between 2100 and 3100 m asl. in Bhutan. Two parasitic flowering plants, Himalayan dwarf mistletoe, *Arceuthobium minutissimum*, and the leafy mistletoe, *Taxillus kaempferi* are common on Blue pine in this Himalayan country. *Arceuthobium minutissimum* is widespread and very damaging in dry Blue pine forests in the districts Paro, Ha and Thimphu in Western Bhutan. *Taxillus kaempferi* occurs most frequently on Blue pine, but also infests *Tsuga dumosa* and *Picea spinulosa*. It occurs in the districts Thimphu, Wangdi Phodrang, Trongsa, Bumthang and Mongar. A survey in a 156-hectare-large area of Blue pine forests in the district Thimphu in Western Bhutan, conducted in 2004, has documented high infection levels of *A. minutissimum* and *T. kaempferi* on *P. wallichiana*. *A. minutissimum* occurred in 58 % and *T. kaempferi* in 52 % of the study area, and both mistletoes were found on 30 % of the sample plots. Of the 2282 Blue pine trees evaluated, 29 % were infested with *A. minutissimum* and 5 % with *T. kaempferi*, with both species occurring on 1.5 % of the trees. Incidence of both mistletoes increased with diameter of the host trees. However, *A minutissimum* was also prevalent on small trees, exemplified by the smallest diameter class (0 to 5 cm diameter at breast height), in which 25 % of the trees were infected. The mean dwarf mistletoe (DMR) rating, according to Hawksworth's 0 to 6 rating scheme, averaged 1.1 for the entire study area. Forest management practices in Bhutan have greatly favoured infestation of *P. wallichiana* with *A. minutissimum* and *T. kaempferi*. We recommend incorporating principles of disease management, particularly sanitation in the silvicultural system to treat Blue pine forests heavily affected by these parasitic plants in Bhutan.

MASS MORTALITY OF YIKA SHING (*AESANDRA BUTYRACEA*), A MULTIPURPOSE TREE IN BHUTAN

K. Tshering[1,*], D.B. Chhetri[2], P.B. Chhetri[3], G. Gratzer[4], A. Darabant[3], C. Stauffer[1], T. Kirisits[1,*]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Hasenauerstr. 38, 1190, Vienna, Austria*
[2] *Renewable Natural Resources Research Centre (RNR-RC), Jakar, East Central Region, Council for RNR Research of Bhutan, Ministry of Agriculture, Royal Government of Bhutan, Bhutan*
[3] *Renewable Natural Resources Research Centre (RNR-RC), Wengkhar, Eastern Region, Council for RNR Research of Bhutan, Ministry of Agriculture, Royal Government of Bhutan, Bhutan*
[4] *Institute of Forest Ecology, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria.*
[*] *Authors for correspondence: kadoting@yahoo.com, thomas.kirisits@boku.ac.at*

Yika shing, *Aesandra butyracea*, is a medium- to large-sized, deciduous multipurpose tree occurring in subtropical and warm temperate areas in the Himalayas. Since the early 1990's rapidly progressing decline and mass mortality of this species has been recorded in several parts of Bhutan. In order to document the extent and severity of Yika shing decline, five temporal transects along foot paths, 20 m wide and between 0.8 and 2.2 km long were established in summer 2006 in four administrative blocks (Gangzur, Menbi, Minjee and Khoma) in the district Lhuntse in North-Eastern Bhutan. In each transect the size and health status of all Yika shing trees were recorded. A total of 701 Yika shing individuals, including 341 saplings were registered. The density of Yika shing varied between transects and ranged from 18 trees to 61 trees per hectare. Of the 360 pole-sized, medium-sized and large trees registered, only 25 % were evaluated as apparently healthy, while 21 % were declining and 54 % were dead. A variety of biotic and abiotic damaging agents were recorded on dying and dead Yika shing trees, with a bark beetle species, tentatively identified as a *Scolytomimus* sp. and a lepidopterous shoot borer occurring most frequently. It is, however, doubtful that these insects are the cause of mortality of Yika shing. A socio-economic study, based on interviews of 33 local people has emphasized that all parts of the tree and especially the fruits are used for an array of purposes. Thus, the lives and economy of rural people in Lhuntse are negatively affected by Yika shing decline. Yika shing is clearly threatened in Bhutan and we recommend conducting further studies on the extent and the causes of its decline and mass mortality. Moreover, *ex-situ* and *in-situ* measures to preserve this valuable multipurpose tree should be initiated.

BLUE-STAIN FUNGI ASSOCIATED WITH THE EASTERN HIMALAYAN SPRUCE BARK BEETLE (*IPS SCHMUTZENHOFERI*) AND THEIR PATHOGENICITY TO *PICEA SPINULOSA* AND *PINUS WALLICHIANA*

T. Kirisits[1*], H. Konrad[1,2], M.J. Wingfield[3] and D.B. Chhetri[4]

[1] *Institute of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Vienna, Hasenauerstr. 38, 1190, Vienna, Austria*
[2] *Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Department of Forest Genetics, Seckendorff-Gudent-Weg 8, 1131 Vienna, Austria*
[3] *Department of Microbiology and Plant Pathology, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria, South Africa*
[4] *Renewable Natural Resources Research Centre (RNR-RC), Yusipang, Western Region, Council for RNR Research of Bhutan, Ministry of Agriculture, Royal Government of Bhutan, Bhutan.*
[*] *Author for correspondence: thomas.kirisits@boku.ac.at*

Ips schmutzenhoferi is an important pest in mountain forests of Bhutan. This bark beetle species preferentially infests *Picea spinulosa*, but also *Pinus wallichiana*. Most conifer bark beetles live in association with blue-stain fungi belonging to the ascomycete genera *Ophiostoma*, *Grosmannia*, *Ceratocystiopsis* and *Ceratocystis* and related anamorph genera such as *Leptographium* and *Pesotum*. They cause discoloration in the sapwood of conifers. Moreover, some fungal associates are phytopathogenic and suspected to help the attacking beetles to overcome the defense mechanisms of their host trees. In 2001 we conducted a survey of blue-stain fungi associated with conifer bark beetles in western Bhutan. Eleven fungal species were found to be associated with *I. schmutzenhoferi*. These included *Ceratocystis bhutanensis*, *Ceratocystiopsis minuta*, two *Leptographium* species (sp. 1 and sp. 2). *Ophiostoma* cf. *ainoae*, *O.* cf. *cucullatum*, *O. floccosum*, *O. quercus*, *O.* cf. *piceae*, *Pesotum cupulatum* (*O. setosum*) and *Pesotum* cf. *quercus*. *Leptographium* sp. 1 appears to be the dominant fungal associate of *I. schmutzenhoferi* and *O.* cf. *ainoae* was also common. In 2005, two isolates each of *C. bhutanensis*, *Leptographium* sp. 1, *O.* cf. *ainoae* and *O.* cf. *piceae* were included in pathogenicity trials on *P. spinulosa* and *P. wallichiana*. All four fungi caused only small necrotic lesions in the phloem of *P. wallichiana* trees, with average lesions lengths ranging from 17.9 to 28.2 mm. *C. bhutanensis*, *O.* cf. *ainoae* and O. cf. *piceae* also caused relatively small lesions on *P. spinulosa* (range of average lesions lengths: 29.6 to 34.3 mm). In contrast, *Lepographium* sp. 1 incited very long phloem lesions on *P. spinulosa*, averaging 223.2 and 296.3 mm for the two isolates. This study has shown that *I. schmutzenhoferi* is intimately associated with blue-stain fungi. Moreover, the most common fungal associate of this bark beetle species, *Leptographium* sp. 1 displays high levels of virulence to *P. spinulosa*.

DEPOSITION FLOWS IN MOUNTAIN AREA – THE BESKIDS, CZECH REPUBLIC

J. Kulhavý[1,*], I. Drápelová[1]

[1] *Institute of Forest Ecology, Mendel University of Agriculture and Forestry Brno, Zemedelska 3, 613 00 Brno, Czech Republic*
[*] *Author for correspondence: kulhavy@mendelu.cz*

The mountainous region of the Silesian Beskids in the Czech Republic was an area with high pollution load in the past. The situation has been improving since 1985 but forested parts of the region can be still stressed by pollution. Acid precipitations leach important nutrients - Ca, Mg, K - out of crowns and the leaching of these cations from crowns represents the most important input of these elements into the forest soil. Concentrations of nitrogen, sulphur and magnesium in atmospheric precipitation and throughfall were monitored in a spruce monoculture (*Picea abies* [L.] Karst.) at Bílý Kříž (Moravian Silesian Beskids) during the years 1997-2007. The two studied plots differ in stand densities. Bulk depositions of inorganic nitrogen in the open area amounted to 985 – 1144 mg N per m^2 and year, bulk depositions of sulphur amounted to 739 – 1101 mg S per m^2 and year. The increase of nitrogen and sulphur depositions in throughfall in the stand with lower crown density was about 35 – 71 % in comparison with the bulk depositions in the open area. The increase of sulphur and nitrogen depositions in throughfall was higher in the denser stand where the increase was 59 – 132 % during the studied period. The concentrations of magnesium were significantly higher in throughfall (0.4 mg l^{-1}) than in atmospheric precipitation (0.1 mg l^{-1}).

FIFTY YEARS OF SUSTAINABLE FOREST MANAGEMENT IN A PRIVATE MOUNTAIN FOREST IN CENTRAL SPAIN

J.A. Bravo-Fernández[1], S. Roig[2], S. Mutke[2,*], R. Serrada[1]

[1] *EUIT Forestal-Universidad Politécnica de Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain*
[2] *Forest Research Centre, National Institute for Agricultural Research (CIFOR-INIA), Spain Department of Forest Systems and Resources, Crta. La Coruña km 7,5, 28040 Madrid, Spain*
[*] *Author for correspondence: mutke@inia.es*

The private state 'Cabeza de Hierro' (Rascafría, Madrid, España) is a singular and interesting example of the state of art for Spanish forest management. The forest covers about 1,900 ha at the Spanish Central Range, with Scots pine as main species, though mixed with Pyrenean oak on lower elevations. The private ownership has been harvesting pine timber since acquisition in 1840, combining harvest with the processing in its own sawmill. Since the first Management plan in 1957, mean annual timber harvest has been 5,200 m3, i.e. 92% of the mean annual growth of 5,600 m3 yr-1 (3 m3 ha-1 yr-1). Though total volume has varied only slightly, a more balanced diametric distribution has been obtained. Beside direct productions like timber, fuel wood, big game, pasture or mushrooms, the high socio-economic importance of the forest is based on more services and externalities like recreational use, biodiversity and conservation, landscape scenery or as CO2 sink. The forest also fulfils some scientific and educational functions with several on-going research projects on natural

regeneration, stand structure, wildlife habitat, forest inventory methodologies, externalities valuation, etc.. The results included in the poster show that the applied management techniques have been very successful for accomplish a sustainable forest management that integrate the private interest of the owner, the local use by neighbour villagers and the externalities. Especially remarkable is the presence and even increase of the black vulture colony, the most important in Central Spain, that is not handicapped, but favoured by the stand and habitat structure produced by the intensive timber yield. Nevertheless, the pending inclusion of this state in the future Guadarrama National Park, which will imply the drastic reduction of felling, creates uncertainties that might question the sustainability of the present equilibrium state in the medium and long run.

ASSESSMENT OF LAND USE CHANGE, USING REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM. A CASE STUDY OF RIVER NJORO CATCHMENT IN KENYA.

K.K. Mwetu[1,2,*], B.M. Mutua[2], P.M. Kundu[2], D.M. Olumana[3] and W. Loiskandl[1]

[1]*Institute of Hydraulics and Rural water Management, Department of Water, Atmosphere and Environment, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Muthg. 18, 1190 Vienna, Austria*
[2] *Department of Agricultural Engineering, Egerton University, Kenya*
[3] *Haramaya University, Ethiopia*
[*] *Author for correspondence: kmwetu@yahoo.com*

Recent studies on River Njoro watershed in Kenya have revealed that, indigenous forest cover drastically reduced from 87% to 30% between 1969 and 2005. In the same period, percentage of cultivated land in the upper area increased from 13% to 70%. This rapid land cover and land use changes, has led to a number of adverse negative hydrologic responses. These include; the drying of many boreholes, the increased surface runoff during wet seasons, the originally permanent River Njoro that mainly serves Lake Nakuru has become seasonal and its lower reaches have dried up among others. Hence, there is need to study the effects of land use and land cover changes on catchment response. However, such a study requires continuous hydrologic data for a sufficient long period of time within the catchment. Many catchments in Kenya have very little or no hydrologic data, and River Njoro catchment has been no exception. This ongoing research focuses on quantifying the land use and land cover (LULC) changes, using remote sensing and Geographical Information System (GIS) to overcome data scarcity. To obtain temporal and spatial land cover data, three Landsat-TM images are georeferenced and classified. These images represent a 17– year period during which the catchment underwent a significant land use and land cover change. These provide primary land cover data set for hydrologic parameter simulation. The study provides result that can be utilized in water and land use planning, and management in River Njoro catchment and other similar ones.

CHANGE IN FOREST STRUCTURE AND DIVERSITY AFTER PLANTATION IN THE COOL MONTANE BROAD-LEAVED FOREST, GEDU

L. Norbu[1], N. Pradhan[1], S. Tashi[1]

[1] *Renewable Natural Resources Research Centre (RNRRC) Yusipang, CoRRB, Ministry of Agriculture, Thimphu, Bhutan, lnorbu@druknet.bt, nk_pradhan@moa.gov.bt, tashi_54@druknet.bt*

Four experimental plots were set up in the cool montane broad-leaved forest of Gedu at the end of 2007 and early 2008. The forest was initially logged in the 1990s and again continued harvesting by the Bhutan Board Particle Limited. The logged off forests were mainly planted with two species of Alnus nepalnensis and Cryptomeria japonica. In the present study, two plots were set up in the natural forest as control and other two plots were set up in the adjacent plantation forest to study the impact of human intervention on the forest structure and diversity. Structurally, the natural forest has changed from complex forest to simple forest after plantation. The natural forest was dominated by oak-laural species of Quercus, Persea, Alcimandra, Nyssa, Michelia, and Lindera while plantation forest was dominated by only Alnus and Cryptomeria. The maximum height of trees in the natural forest was 45 m and 37.6 m when compared to 24 m and 26.6 m in Alnus and Cryptomeria plantation. Similarly, maximum diameter at breast height also changed from 71.5 cm, 68.7 cm in the natural forest to 29.5 cm, 52.2 cm in the plantation respectively. More distinctly, the diversity indices such as species richness reduced from 24 (9 dominants), 29 (9 dominants) species to 8 (1 dominant), 9 (1 dominant) species, and Shannon's diversity from 4.1, 3.7 in the natural forest to 0.5, 0.2 in the plantation forest. The vegetation analysis revealed that plantation in the evergreen broad-leaved forest particularly conifer species are disastrous to the broad-leaved forest ecosystem. Our study recommends site specific species for plantation and in-depth study before carrying out any activity or operation in the evergreen broad-leaved forest for sustainable utilization and management of the cool montane evergreen broad-leaved forest.

EFFECTS OF NITROGEN ON THE SELECTION OF FOOD BY PHYLLOBIUS ARBORATOR (HERBST)

A. Peslova[1]

[1] *Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno, Zemědělská 3, 613 00 Brno, Czech Republic, alenapeslova@seznam.cz*

The selection of a nutritive plant and the consumption of food (Betula pendula Roth) affected by differentiated inputs of nitrogen after the repeated application of ammonium nitrate into soil was monitored at Phyllobius arborator (Herbst) under field (polythene greenhouse) and laboratory (Climacell) conditions. In birch leaves, the content of nitrogen increased. The diameter and height increment was stimulated by the application of 0.5 - 1 g, higher doses induced stress and the fall of increment. According to the frequency of feeding marks on leaves and food consumption by weevils of the genus Phyllobius in a polythene greenhouse, birch with the higher content of nitrogen was preferred. In laboratory rearing, females showed higher food

requirements. In short-term rearing, differentiation did not occur in the amount of consumed food in males and females depending on the nitrogen content.

NATURAL AND CURRENT TREE SPECIES COMPOSITION FUNCTIONAL DIFFERENCES OF MOUNTAIN FOREST ECOSYSTEMS ON EXAMPLE OF NATIONAL PARK ŠUMAVA FORESTS

J. Schneider[1]

[1] *Department of Landscape Management, Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry Brno, Zemedelska 3, 613 00 Brno, Czech Republic, jiris@s-atelier.cz*

Natural tree species composition and current tree species composition potential functional abilities were studied on model locality Forest Department Plešný (National Park Šumava, Czech Republic). Tree species mixtures are changing in dependence of forest vegetation degree (usually with increasing altitude) from forest ecosystems with prevailing beech (Fagus sylvatica L.) and admixed Norway spruce (Picea abies (L.) Karst.) to forest ecosystems with prevailing Norway spruce (Picea abies (L.) Karst.) and admixed beech (Fagus sylvatica L.) in natural tree species composition. Norway spruce (Picea abies (L.) Karst.) monocultures and forests with prevailing Norway spruce (Picea abies (L.) Karst.) presentation occur in current tree species composition. Current tree species composition is different from natural in most presented forest stands of model locality. Method Quantification and Evaluation of forest functions (Vyskot, I. et al., 2003) was used for forest potential functional abilities evaluation. The Real potentials of forest functions were determined for forest ecosystems with current and natural tree species composition of model locality. The differences between real potentials of forest functions of natural and current tree species composition were determined (inc. total real all-society potential of forest functions). Less than 10% of valuated forest stands obtained equal values of real potentials of forest functions in current and natural tree species composition. The differences were higher and most often in ecological-stabilizing forest function (as was expected). Natural tree species composition of forest stands was slightly favourable in social-recreation forest function. The differences of potential functional ability between current and natural tree species composition of forest ecosystems were minimal or less than 10% in other forest functions, including bio-production forest function.

BEEKEEPING AS AN ADDITIONAL LIVELIHOOD SOURCE IN MOUNTAIN FOREST AREAS OF SOUTH-WEST ETHIOPIA AND ITS ROLE FOR FOREST CONSERVATION (PROJECT EXPERIENCE)

A.C. Sisay[1]

[1] *Non-Timber Forest Products (NTFPs) Research and Development Project, P.O. Box 365 Mizan Teferi, Bench-Maji Zone, Ethiopia, asfawsisay@yahoo.com*

The forests of South-West Ethiopia are rich sources of Non-Timber Forest Products (NTFPs) supporting the livelihood and economic wellbeing of the local people. However, the forests have suffered due to mismanagement throughout the different administrations of the country. The NTFPs research and development project South-Western Ethiopia was initiated in 2003 to find sustainable forest management and biodiversity conservation approaches with pivotal role of NFTP. It has been working on beekeeping, spice and forest coffee in Bench-Maji, Keffa and Sheka zones of the southern Ethiopia. This paper discusses about beekeeping activities. The traditional way of beekeeping in the forest is not attractive and could lead into destruction of the forest resource in the long run. Thus, trainings were given to farmers on modern beekeeping technologies and sustainable forest management through participatory learning-teaching approach. Following the trainings farmers- led participatory research on farmers` home gardens started in 2006 with some technical and logistic support from the project and government staffs. Five types of beehive (four introduced and one traditional) were tested. The purpose of the trial was to select better bee-hive/s for home garden apiary based on ease of management, yield, effect on the forest, bees preference, and etc. According to the result derived from 32 trial farmers in 2006 and 2007, the following beehives were selected, respectively. Mud beehive (78.12%), stick and mud beehive (56.25%), Kenya top bar (50%) and box bee hive (5%). Including up-scaled farmers in 2006 and 2007, 43 farmers produced a total of 3194 Kg honey. This was sold by average price in that time, a total of USD 4259 has been contributed towards poverty alleviation, and each farmer generates USD 50 per annum. The trial has showed that the modern beekeeping system has helped to manage the forest resource through dependable incentive.

CLUSTER REFORESTATION NEAR THE TIMBER LINE IN KRKONOŠE MTS.

J Soucek[1]

[1] *Forest and Game Management Research Institute, Research Station Opocno, Na olive 550, 517 73 Opocno, Czech Republic, soucek@vulhmop.cz*

Cluster reforestation on the clearcut and under damaged Norway spruce (Picea abies Karst.) stand (canopy 0.8) was realised on the steep slope near the timber line in Krkonoše Mts. (border between the Czech Republic and Poland) in 1993. Sites between the Norway spruce clusters (20 – 30 plants in dense spacing) were filled by prostrate form of dwarf pine (Pinus mugo Turra). Loss after planting did not exceed 10 %. Cluster reforestations in juvenile phase show better growth and health status over uniform planting systems under these harsh conditions. Analysis of height growth confirmed different growth of Norway spruce according to the position in the clusters and light conditions. Trees centrally located in the clusters have better height

growth and health status than ones situated on edges. Positive effect of clusters on growth was shown before the closing of crowns. Height growth of underplantings is reduced; differences in growth within the clusters are similar. Dwarf pine thickened the space among the clusters; spruce will gradually reduce its growth by sheltering. Alteration of microclimatic conditions by reforestation supported natural regeneration of spruce, dwarf pine, rowan and birch. Structural diversity of site conditions increased. Formation of the more resistant stands with suitable spatial design and satisfactory growth suppose additional forest management activity.

DAMAGES BY WILDLIFE ON FOREST STANDS IN BESKYDY MOUNTAINS IN THE CZECH REPUBLIC

K. Turek[1]

[1] *Mendel University of Agriculture and Forestry Brno, Zemedelska 3, 61300 Brno, Czech Republic, kamilturek@post.cz*

During the years of 2005-2007, within the research plan, an evaluation of contemporary and previous extent of damages of forest stands, caused by browsing and bark peeling of the game, was carried out with the help of strip transects and check of stands in Beskydy Mountains. There was also evaluated the forest register of damages on forest stands and of the number of game in the hunting grounds.
The results are as followed: after the winter of 2004/2005 when the snow lasted for 112 days with the maximum height of 105cm, there was 55-60 head of roe deer and 6 head of red deer per 1000 ha of forest. The most damaged wood was Salix aurita – 85,9% and from the coniferous trees Abies alba – 25,6%. There was damage of 35, 7% on those tree species that were attractive for browsing and on less attractive trees of 4,5%. The total winter damage of trees, caused by browsing, was 9%. That time, one deer entity damaged 0, 26% of forest regeneration by browsing and 6 head of red deer damaged 324 stems of Picea abies per 1000ha of forest by bark peeling. The intensity of browsing was declining with the growing altitude and it was significantly higher on the clear-cuts with more solarization (20, 28%) than on the shadowed plots (4,12%).
After winter of 2006/2007 when snow lasted for 31 days with the maximum height of 30cm, there was 30-35 head of roe deer and 6 head of red deer per 1000 ha of forest. The total winter damage by browsing was only 0, 46%. Then the one deer entity damaged by browsing 0, 02% of forest regeneration.
This study was supported by MSM 6215648902.

FLORISTIC COMPOSITION AND STRUCTURE OF THE DRY AFROMONTANE FOREST AT BALE MOUNTAINS NATIONAL PARK, ETHIOPIA

H. Yineger[1,*], E. Kelbessa[2], T. Bekele[2], E. Lulekal[2]

[1] *Department of Biology, Jimma University, P.O. Box 5195, Jimma, Ethiopia*
[2] *National Herbarium, Addis Ababa University, P.O. Box 3434, Addis Ababa, Ethiopia*
[*] *Author for correspondence: haile_mulu@yahoo.com*

The floristic composition and structure of the dry Afromontane forest at Bale Mountains National Park was studied from July 2003 to June 2004. A total of 90 plots were established at three sites (Adelle, Boditi and Gaysay) at an altitudinal range of 3008 – 3408 m above sea level. The cover abundance values, density, and diameter at breast height and list of species were then generated from each plot. About 230 species belonging to 157 genera and 58 families were identified and documented. Analysis of vegetation data revealed 5 homogenous clusters. The density of trees in the diameter class >2 cm was 766 and 458 individuals /ha, respectively at Adelle and Boditi forests. The basal area of Adelle forest was 26.39 m2 /ha whereas it was 23.34 m2 /ha for Boditi forest. About 43.34% of the basal area at Adelle and 56.65% at Boditi forests were contributed by Juniperus procera and Hagenia abyssinica, respectively. Both Adelle and Boditi were found at an earlier secondary stage of development and had more or less a similar trend of development. The population structures of tree species were assessed and these had clearly signaled the occurrence of excessive cutting of selected size classes of ecologically, economically and medically important tree species for various purposes particularly for construction purpose.

HEALTH CONDITION AND CLIMATIC FACTORS EFFECT ON SPRUCE STANDS IN THE ORLICKE HORY (MOUNTAINS)

T. Zid[1]

[1] *Department of Forest Protection and Game Management, Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry Brno, Zemedelska 3, 613 00 Brno, Czech Republic, tom.z@centrum.cz*

The aim of this work was to define present health state of mountain spruce (Picea abies (L.) Karst.) stands in Orlické hory and to clarify observed dieback syndrome. In the stands predominated by spruce and aged over 70 years, 35 sample plots were laid out (in total 700 trees) in the vicinity of Anenský vrch (Hill) at altitudes over 800 m. In the course of the growing season 2005, following parameters were determined: total defoliation, defoliation of the primary structure, the percentage of secondary shoots, the presence and extent of yellowing and browning – habitude tree diagnostics (Cudlín et al, 2003); then in 2007 the extraction of needle samples (mineral needle analysis) on 11 plots and the extraction of soil samples (the mineral soil analysis) on 12 plots were made and the tree-ring analysis at three plots. To model climate-conditioned environment influences tree-ring series were used. To measure the tree-ring width and to synchronize the individual tree-ring curves the PAST4 application was used. The removal of the age trend was done in the ARSTAN application and climatic influences were modelled in the Dendroclim application. The Statistica 7.1

application was used to find out the mutual statistic significance of individual environment factors. More-factor ANOVA was used for evaluation. Moreover, the work contains the determination of the conventional wood density of the analysed trees. Wood density is the determining factor to evaluate the physical, mechanical and technological features of wood which are of fundamental importance for forestry and wood industry. The data, which were determined, will be given into relation with site (lime treatment presence, exposure, altitude, soil type, pH, forest type), climatic (precipitations, temperatures) and stand conditions (age, mean-tree volume, stocking).

IV. Tutorial

Students of the Master's Course in Mountain Forestry (Posters)

COMMUNITY BASED NON-TIMBER FOREST PRODUCTS ENTERPRISE FOR SUSTAINABLE RURAL LIVELIHOODS: WINTERGREEN TRADE IN NEPAL

S. Baral[1,*], S.K.T. Magar[1], B.P. Subedi[2], H. Vacik[3]

[1] *Mountain Forestry Students, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria*
[2] *Asia Network for Sustainable Agriculture and Bioresources (ANSAB), Kathmandu, Nepal*
[3] *Institute of Silviculture, Department of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Peter Jordan-Str. 82, 1190 Vienna, Austria*
* *Author for correspondence: sony_baral@yahoo.com*

Community based natural product enterprise in Nepal has high potentiality to link the sustainable forest management with the livelihood improvement of local community through providing ample innovative opportunities for income generation. These days Community based enterprise has been one of the major sources of income for rural community with limited number of alternative income sources by optimizing the use of locally available resource. This case study of a community based natural product enterprise from Dolakha district lies in mid hill region of Nepal has tried to figure out the range of income distributions of different stakeholders involved in harvesting, value adding and trading its output in national to international market. Informal dialogues with District Forest Offices, District Development Committee, trade associations, Federation of Community Forest Users Nepal, Non Governmental Organizations as well as review of relevant literatures and reports were the basis of the study.

Community based enterprise are formed with the network of the community forestry user groups within the community forest. There are 51 different type of community-based enterprise in Dolakha. Among them Deodhunga Multipurpose Cooperative Ltd. is the essential oil processing community based enterprise. The enterprise use leave of the wintergreen to make essential oil. Wintergreen (*Gaultheria fragrantissima)* is one of the major sources to earn cash income. Collection and trade of non-timber forest products (NTFPs) has played a key role in the economic development the study area, where economic opportunities are severely constrained by difficult socio-economic conditions and poorly developed infrastructures such as communication and transport facilities. The income from Wintergreen contributes 15-25 percent of the total annual household income of the harvesters' income. Local processors have who engage in operating the Wintergreen distillation units whose income accounts for 90-100 percent annually. Traders, wholesalers, and urban distillers and manufacturers also derived nearly 100 percent of their income from NTFPs trade and processing.

NATURAL RESOURCES DEPLETION IN THE HILLY AREAS OF BANGLADESH

S. Biswas[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria, shampa.bd@gmail.com*

Bangladesh has 1.8 million ha hill area or occupy around 12% hill of the total area of the country. Natural resources of hill in Bangladesh are forest resources, biological species, minerals and agricultural products that have been degrading in recent four decades due to excessive cutting of hill forest cover, loss of biodiversity, impacts of increased water flow variability and increased erosion on the hill slope. The hills in Bangladesh are diminishing gradually. The general idea about „Natural Resource Depletion in the hill area of Bangladesh "tries to provide a information base for making awareness of the importance of the mountain or hills of Bangladesh through studying their distribution status, opportunities offered by hills ecosystems and hilly people through linking mountain forestry of Asia. Moreover, most degraded sites in the hill areas are identified and located in map so that immediate actions may start following the identified degraded sites. Some measures and suggestions are trying to develop for the resilience of mountainous people that can foster greater security and well being as well as conservation of the hill heritage, at global, national and local levels to change the relationship between the highlands and lowlands. Key words: Hill Environment, Natural Resource Depletion in hill, Deforestation, Land degradation, Threatened hill degraded site.

AIR POLLUTION INFLUENCE ON FOREST DETECTED BY DENDRO-CHEMICAL ANALYZE (FORESTED AREA NEAR ULAANBAATAR)

S. Byambagerel[1,*], N. Baatarbileg[2]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria*
[2] *Department of Forestry, National University of Mongolia, 210646 Ulaanbaatar, Mongolia*
[*] *Author for correspondence: byambagerel@biology.num.edu.mn*

The accumulation of toxic elements in the environment has been studied in the last 20 years and is still of great concern to many scientists. Among these hazardous elements are the heavy metals. This project focused on the use of tree as biological indicators of heavy metal pollution in the environment. Tree rings and needles of Scots pine (*Pinus sylvestris*) were analyzed for heavy metal concentration and evaluated local environmental pollution. These Scots pines were located in Ortoo-Mukhar, Batsumber region and Bogd Mountain near capital city Ulaanbaatar in Mongolia. For the chemical analysis, we separated tree rings annually for acid digestion and atomic absorption spectrometry (AAS) was used to examine trace element concentration in tree rings over thirty years to assess four heavy metal ions such as cadmium (Ca), nickel (Ni), lead (Pb) and copper (Cu) trends of environmental change. From the concentration difference in tree ring, cadmium (Cd), lead (Pb), nickel (Ni), and copper (Cu) ions in each 5-year interval from 1970 to 2004 by comparing both sites, Ortoo Mukhar and Nukht in Bogd Mountain. Cadmium (Cd) is at a historically lower

concentration than other three metal ions (Ni, Pb and Cu) within both sites of the tree rings in this study.
The main objectives of the needle chemical analyze is 1) to detect deficiencies, disturbances or imbalances in tree nutrition, 2) to provide a basis for future correlative and up-scaling studies between the needle data and other datasets, e.g. crown condition, litter fall and soil. Concentrations of metals were determined by atomic absorption spectroscopy (Analytical Methods for Atomic Absorption Spectrophotometry, 1990) using a Perkin-Elmer 1000 fitted with a flows analysis system. Concentrations of cadmium (Cd), lead (Pd), Nickel (Ni) and copper (Co) were determined in composite sample in year of 2003, 2004 and 2005.
In generally Ortoo Mukhar site is less polluted by these four heavy metal ions, but Bogd Mountain has more pollution that illustrated by chemical analyzes which means it has more air pollution influence in forest. The possible causes of the increase in sensitivity of pine trees that had taken from Bogd Mountain near the Ulaanbaatar are discussed in terms of interactions between ageing and extreme climatic events, aggravated by soil and air pollutions due to smokes of train, vehicle and power stations.

ANALYSIS OF INTERRELATIONSHIPS AND INTERACTIONS BETWEEN HELICOPTER SKIING, FORESTS AND FORESTRY INDUSTRY IN BRITISH COLUMBIA, CANADA

C. Delaney[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria, cris.delaney@gmail.com*

Helicopter skiing in British Columbia, Canada is intricately intertwined with forested landscapes and therefore the forest industry. Helicopter skiing is mainly carried out on forested terrain for many reasons, but mainly due to snow quality and safety. Forested slopes are desirable to skiers because forests have beneficial impacts on the quality of the snow pack. Operators of helicopter skiing businesses depend upon forested terrain to provide stable and therefore safe snow packs. Due to the overlapping nature of land use rights in the province, helicopter skiing must take place on land that is managed for forestry. Forestry is the most influential industry in British Columbia and therefore takes precedence over helicopter skiing in government policies. This is the root of land use problems for helicopter skiing operators since foresters have different interests and management objectives than those held by the helicopter skiing operator. The goal of this thesis is to analyze and describe the interrelationships and interactions between helicopter skiing, forests, the helicopter skiing industry and the forestry industry in British Columbia, Canada and to identify issues with and offer suggestions to improve those interrelationships and interactions.

TAXONOMY AND DIVERSITY OF WOOD DECAY FUNGI IN CHITTAGONG AND CHITTAGONG HILL TRACTS IN BANGLADESH

S. Dewan[1,*], M.A.U. Mridha[2], M.K. Bhuiyan[3]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria*
[2] *Department of Botany, University of Chittagong, 4331 Chittagong, Bangladesh*
[3] *Institute of Forestry and Environmental Sciences, University of Chittagong, 4331 Chittagong, Bangladesh*
[*] *Author for correspondence: sumitra_cht@yahoo.com*

Hill Forest is very important in Bangladesh Forest as it contributes about 45.4% in terms of forest land under forestry use. Many inhabitants are directly or indirectly depend on Hill forest in Bangladesh. The wood decay fungi have a great importance in the viewpoint of ecosystem as they stimulate wood decomposition and help in carbon cycling. They have also negative effect to our economic condition by damaging our valuable wood stocks. Samples of wood decay fungi were collected from wood lots of forest beats, sawmills and plantation of five selected locations (Hathazari, Kaptai, Kalurghat, Rangamati, and Subolong) of Chittagong and Chittagong Hill Tracts for their occurrence and distribution in relation to locations and host plants. The fungi were identified by following the standard keys and manuals. The specimens were preserved in mycological laboratory of Chittagong University and Field Museum of Chicago University, USA. During the present investigation altogether 18 different genera were found from five selected locations and a very rich diversity was found in Rangamati and Hathazari. Considering the importance of wood decay further study can be done based on this preliminary work in this field of research.

EXPECTATIONS OF POOR FROM COMMUNITY FORESTS IN NEPAL – A CASE STUDY FROM MAKAWANPUR DISTRICT, NEPAL

S. Gautam[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria, h0741084@edv1.boku.ac.at*

Community forestry (CF) as a participatory forest management has been practicing since 1970s, and Nepal is understood as a pioneer to initiate the development of partnership between local communities and government. Community forest user group (CFUG), an autonomous entity, is managing forest resources by making own management plan. Up to now, the CFUG does not only success to manage the untapped resources but also able on diversifying forest related benefits and services. The motivation and commitment for actions harmony with the traditional and indigenous knowledge leads them to achieve the common goal, which ultimately contributes to poverty alleviation. Although the contribution of CF at national level found highly significant, its contribution on poor socio-economic strata has still been debated. In this situation, the study tries to explore poor user's expectations and benefit sharing activities in two CFUGs of Nepal. Questionnaire survey, focus group discussions, meetings with executive members and forestry staffs, field observations were the major methods applied in the study. The participatory wealth ranking was

done to stratify the households. Only 138 households (i.e. 15% of poor economic strata) were surveyed. Study shows the expectations varied according with economic status, needs and problems. Regular leaf litter collections, seed money for goat keeping, loan at minimum interest rate and small timber production are the top most expectations. As CFUG management plans are still insufficient to address issues, poor users are facing greater scarcity after CF. The participation of poor users in different activities, except in silvicultural operation, is found less significant. For better performance the production of intermediate and diverse forest products is recommended to fulfill the immediate needs of poor, and also to generate intermediate cash and employment locally. Then, allocate certain percentage of CFUG's income as seed money to uplift poor livelihoods through promoting income generating activities.

REGENERATION ECOLOGY OF BROADLEAF FORESTS OF BHUTAN – EFFECT OF STROBILANTHES COMPETITION ON TREE REGENERATION

N. Gyeltshen[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria, nawang7@gmail.com*

The ecology of broadleaved forests of Bhutan is little understood, predominantly in comparison to the knowledge on conifer forests. Some of the main constraints addressed during the review of the management planning system in these areas have been problems associated with tree regeneration of harvested areas. Success of forest management planning in Bhutan greatly depends on effectively regenerating the harvested areas. This requires a thorough understanding of the regeneration ecology of these forests. This study is conducted in cool moist broadleaved forests in Zhemgang, Central Bhutan; it aims at studying tree-shrub competition dynamics as a factor for tree regeneration problems with specific focus on Strobilanthes sp. as competing undergrowth. Preliminary surveys have indicated that Strobilanthes sp. along with bamboos and ferns are main undergrowth competitors in the study area. Data collection were done along transects with varying Strobilanthes cover percentage. Forest canopy composition and tree regeneration were assessed with recordings of important site parameters. Strobilanthes composition and biomass recordings of the species were done in detail with leaf area measurements. Hemispherical photographs were also taken to study the light growth response of this competing species.
The research is expected to yield results on corresponding effect of Strobilanthes competition with tree regeneration in the study area. The findings shall aid forest management planners and field implementers to draw management schemes and prescriptions. It shall also identify critical issues and recommend future research needs particularly on regeneration problems in broadleaf forests.

STATUS OF ARBUSCULAR MYCORRHIZAL FUNGI (AMF) IN FERNS IN BANGLADESH

R. Nandi[1,*], M.A.U. Mridha[2], M.K. Bhuiyan[3]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria,* [2] *Department of Botany, University of Chittagong, 4331 Chittagong, Bangladesh*
[3] *Institute of Forestry and Environmental Sciences, University of Chittagong, 4331 Chittagong, Bangladesh*
[*] *Author for correspondence: nandi_uma@yahoo.com*

Occurrence and status of colonization of Arbuscular Mycorrhizal (AM) fungi in the roots and spore populations in the rhizosphere soils of different fern species were studied in the present study. Thirteen species under different families were investigated. Roots and rhizosphere soils of different ferns under various families were collected from various locations of hilly areas of Chittagong University Campus in Bangladesh. Arbuscular mycorrhizal colonization was determined by staining of roots of ferns. All the samples found to be colonized by AM fungi except Dicranopteris linearis. Percent root colonization varied widely irrespective of size, locations and substratum. The range of colonization was 15-76%. The highest percent colonization of arbuscular mycorrhizae was observed in Diplazium esculentum (76%) and the lowest percent colonization of arbuscular mycorrhizae was in Aleuritopteris calomelanos (15.22%). The intensity of structural colonization was variable from species to species. The highest percentage infection of mycelium was found in Adiantum philippense (32%) and the lowest in Aleuritopteris calomelanos (15%). Vesicle was found highest in Adiantum philippense (15%). Arbuscule was found highest in Aleuritopteris calomelanos (6.2%). Spore population was found in twelve soil samples out of thirteen samples. The highest population (190) was found from the rhizosphere soils of Pteris biaurita and the lowest (28) was from the rhizosphere soils of Diplazium esculentum. Out of six recognized genera of AM fungi, Glomus, Sclerocystis, Entrophospora, Acaulospora, Scutellospora and other unidentified spores were observed.

BHUTAN'S INITIATIVE TOWARDS THE CONSERVATION OF BIODIVERSITY

S. Tobgay[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria,* [2] *Department of Botany, stwangdius@rediffmail.com*

The diverse geophysical setting of Bhutan with altitudes ranging from 200m a.s.l in sub-tropical forests to over 7000 m a.s.l in alpine mountain ranges interlaced with deeply incised valleys with strong microclimatic variations have endowed the country with a rich repository of biodiversity, both wild and domesticated at the ecosystem, species and genetic levels. Consequently, Bhutan belongs to a global biodiversity hot-spot. In order to maintain this high biodiversity, Bhutan has given high priority to nature conservation. 26% of the countries area belongs to protected areas and 9% were delineated as biological corridors for in-situ conservation. With 3% population

growth and rapid socio-economic and industrial development, however, conservation threats are eminent. Conversion of forest land, use of improved species over traditional indigenous species, industrial development and poor institutional capacity are main threats. To combat these threats, conservation and preservation of biodiversity is underway with strong political commitment and conservation ethics of the Bhutanese people. Bhutan's conservation efforts have been both in-situ and ex-situ.The in-situ conservation of wild biodiversity mainly focuses on nine protected areas, which include four national parks, four wildlife sanctuaries and one strict nature reserve. Conservation efforts outside protected areas include wetland managed for the black-necked crane refuge, orchid garden and a rhododendron garden. At the community level, social forestry and community forestry for the conservation of forest resources are encouraged. Ex-situ conservation includes establishment of Royal Bhutan Gene Bank for conservation and utilization of domesticated indigenous plant and animal genetic resources, Royal Botanical Park and Royal Botanical garden and National Herbarium with 17,000 specimens on the wild flora of Bhutan.

STUDY ON THE IMPACT OF LAND USE CHANGE ON SOIL PROPERTIES IN THE NORTH WESTERN HIGHLANDS OF ETHIOPIA

S. Workneh[1]

[1] *Mountain Forestry Student, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Gregor Mendel-Str. 33, 1180 Vienna, Austria,* [2] *Department of Botany,* seme_w@yahoo.ca

The highlands of Northern Ethiopia are now largely devoid of forest vegetation, with almost all available land cultivated or used as pasture. In this study the effects of these land use types on some soil properties were investigated North Western Highlands of Ethiopia (Addis Zemen Tara Gedam area).Soil samples were collected from the three neighboring geographically similar plots with different land uses namely forest land, cultivated land, and grazing land, at two depths (0-10cm and 10- 30 cm).The forest land serves as reference for comparing changes in soil properties as the result of the land use change. In this diploma work statistical replication at the landscape scale was not possible, therefore the results are data sets to describe the situation and compare with results from other work. The soil in the forest showed significantly higher total C, total N, and pH than cultivated land and grazing land in both depths except for soil pH at 30cm depth where soils in grazing land showed significantly higher pH values than forest and cultivated land. Bulk density is significantly higher for cultivated soil than grazing land and forest soil. Though results showed no significant difference between cultivated land and grazing land for total C, total N, and pH at both depths, soils in the cultivated land have higher values than grazing land soils for total C, and pH at 30cm depth, but for total C only at 10 cm depth.
Higher values registered also for N and pH in the soils of grazing land than cultivated land at 10cm depth, where as only for N at 30cm depth. Bulk density and soil pH increased from 0-10 cm depth to 10-30cm depth. In accordance with general concepts of soil science higher values for C and N were recorded at 10 cm depth than at 30cm depth. Except for bulk density the land use changes resulted in lower values for cultivated land and grazing land in almost all parameters compared to forest land. This emphasizes the fact that changes in land use have caused dramatic losses in soil

fertility due to insufficient soil management, in particular replacement of lost nutrients by fertilization. The need for change in policies and strategies for sustainable land use that will integrate development with sustainable management of the environment is evident.

Participants

1) **Abiyu-Hailu, Abrham,** Amhara Regional Agricultural Research Institute (ARARI), Gondar Agricultural Research Center (GARC), Ethiopia, abrhamabiyu@yahoo.com

2) **Acar, Cengiz,** Dept. of Landscape Architecture, Karadeniz Technical University, Turkey, cengiz@ktu.edu.tr

3) **Aerts, Raf,** Division Forest, Nature and Landscape, Katholieke Universiteit Leuven, Belgium, raf.aerts@biw.kuleuven.be

4) **Alemu, Alene Tesfamichael,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, alenefix@yahoo.com

5) **Aynekulu, Ermias,** Mekelle University, Ethiopia, ermias8@yahoo.com

6) **Baier, Peter,** Inst. of Forest Entomology, Forest Pathology and Forest Protection, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, peter.baier@boku.ac.at

7) **Bhandari, Ram,** University of Rome "Tor Vergata", Italy, rbbhandari@gmail.com

8) **Baral, Sony,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria

9) **Biswas, Shampa,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, shampa.bd@gmail.com

10) **Brandenburg, Christiane,** Inst. of Landscape Development, Recreation and Conservation Planning, Dept. of Landscape, Spatial and Infrastructure Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, christiane.brandenburg@boku.ac.at

11) **Bruckman, Viktor,** Commission for Interdisciplinary Ecological Studies, Austrian Academy of Sciences (ÖAW), Vienna, Austria, viktor.bruckman@oeaw.ac.at

12) **Buksnowitz, Christoph,** Inst. of Wood Science and Technology, Dept. of Material Sciences and Prozess Engineering, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, christoph.buksnowitz@boku.ac.at

13) **Burrascano, Sabina,** Sapienza University of Rome, Italy, sabinaburrascano@gmail.com

14) **Bussmann, Rainer,** William L. Brown Center for Plant Genetic Resources, Missouri Botanical Garden, USA, rainer.bussmann@mobot.org

15) **Byambagerel, Suran,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, byambagerel@biology.num.edu.mn

16) **Cater, Matjaz,** Slovenian Forestry Institute, Ljubljana, Slovenia, matjaz.cater@gozdis.si

17) **Chowdhury, Mohammad Shaheed Hossain,** Forest Policy Laboratory, Dept. of Forest Science, Faculty of Agriculture, Shinshu University, Japan, shaheedfeni@yahoo.com

18) **Dahal, Ganga Ram,** Center for International Forestry Research (CIFOR), Indonesia, gdahal@cgiar.org

19) **Dalla Valle, Elena,** Dept. of Land Use and Agro-Forestry systems, University of Padua, Agripolis, Italy, elene.dallavalle@unipd.it

20) **Dang, Thi Kim Phung,** Tay Ninh Provincial Department of Agriculture and Rural Development, Vietnam / Wageningen University, the Netherlands, thikimphung.dang@wur.nl

21) **Darabant, Andras,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, darabant@gmail.com

22) **Delaney, Christina,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, cris.delaney@gmail.com

23) **del Río Gaztelurrutia, Miren,** Forest Research Center, INIA, Madrid, Spain, delrio@inia.es

24) **Dewan, Sumitra,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, sumitra_cht@yahoo.com

25) **Dirnböck, Thomas,** Umweltbundesamt – Federal Environment Agency, Vienna, Austria, thomas.dirnboeck@umweltbundesamt.at

26) **Fanta, Demel Teketay,** Forest Stewardship Council, African Regional Office (FSC Africa), Accra, Ghana, d.teketay@fsc.org

27) **Fluch, Silvia,** Austrian Research Centers GmbH – ARC, Seibersdorf, Austria, silvia.fluch@arcs.ac.at

28) **Forster, Antonia,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, antonia.forster@bundesforste.at

29) **Gautam, Sishir,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, h0741084@edv1.boku.ac.at

30) **Ghimire, Ananta,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, ghimrea006@gmail.com

31) **Glatzel, Gerhard,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, gerhard.glatzel@boku.ac.at

32) **Gratzer, Georg,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, georg.gratzer@boku.ac.at

33) **Günter, Sven,** Inst. of Silviculture, TU München, Freising, Germany, sven_gunter@yahoo.de

34) **Gyeltshen, Ngawang,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, nawang7@gmail.com

35) **Habermann, Birgit,** Commission for Development Studies, Austrian Academy of Sciences (ÖAW), Vienna, Austria, birgit.habermann@oeaw.ac.at

36) **Hager, Herbert,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, herbert.hager@boku.ac.at

37) **Halmschlager, Erhard,** Inst. of Forest Entomology, Forest Pathology and Forest Protection (IFFF), Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences, Vienna (BOKU), Austria, erhard.halmschlager@boku.ac.at

38) **Hasenauer, Hubert,** Inst. of Silviculture, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, hubert.hasenauer@boku.ac.at

39) **Hinckley, Tom M.,** College of Forest Resources, University of Washington, Seattle, USA, hinckley@u.washington.edu

40) **Hoellerl, Sebastian,** Inst. of Silviculture, TU München, Freising, Germany, hoellerls@forst.tu-muenchen.de

41) **Jandl, Robert,** Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Vienna, Austria, robert.jandl@bfw.gv.at

42) **Jenderedjian, Anna,** Armenia Tree Project (www.armeniatree.org), Armenia, annaj@armeniatree.org

43) **Kacalek, Dusan,** Forestry and Game Management Research Institute, Opocno, Czech Republic, kacalek@vulhmop.cz

44) **Kalin, Arzu,** Karadeniz Technical University, Trabzon, Turkey, arzuk@ktu.edu.tr

45) **Katzensteiner, Klaus,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, klaus.katzensteiner@boku.ac.at

46) **Keeton, William,** School of Environment and Natural Resources University of Vermont, Burlington, USA, william.keeton@uvm.edu

47) **Kempter, Iris,** Inst. of Forest Ecology, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, iris.kempter@boku.ac.at

48) **Khadka, Chiranjeewee,** Rural Reconstruction Nepal (RRN), Kathmandu, Nepal, chiranjeewee@yahoo.com

49) **Kirisits, Thomas,** Inst. of Forest Entomology, Forest Pathology and Forest Protection, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, thomas.kirisits@boku.ac.at

50) **Kleine, Michael,** International Union of Forest Research Organizations – Special Programme for Developing Countries (IUFRO – SPDC), Vienna, Austria, kleine@iufro.org

51) **Klimo, Emil,** Inst. of Forest Ecology, Mendel University of Agric. and Forestry, Brno, Czech Republic, klimo@mendelu.cz

52) **Kral, Kamil,** Dept. of Forest Ecology, The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Brno, Czech Republic, kamil.kral@vukoz.cz

53) **Kremer, Antoine,** UMR Biodiversite, Genes & Communautes, INRA, France, antoine.kremer@pierroton.inra.fr

54) **Kulhavy, Jiri,** Mendel University of Agriculture and Forestry, Brno, Czech Republic, kulhavy@mendelu.cz

55) **Kunwar, Ripu,** Ethnobotanical Society of Nepal, Kathmandu, Nepal, rkunwar@gmail.com

56) **Lawrence, Anna,** Forest Research, The Forestry Commission Great Britain, UK, anna.lawrence@forestry.gsi.gov.uk

57) **Lenoir, Jonathan,** AgroParisTech-ENGREF Centre de Nancy, Laboratoire d'étude des Ressources Forêt-Bois (LERFoB), Nancy, France, lenoir@engref.fr

58) **Lexer, Manfred Josef,** Inst. of Silviculture, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, mj.lexer@boku.ac.at

59) **Magar, Sushila Kumari Thapa,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria

60) **Majer, Christoph,** Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna, Austria, christoph.majer@lebensministerium.at

61) **McGuire, Douglas,** Mountain Partnership Secretariat, UN Food and Agriculture Organization (FAO), Rome, Italy, douglas.mcguire@fao.org

62) **Mekonnen, Kindu,** Ethiopian Institute of Agricultural Research, Addis, Ethiopia, kindumeko@yahoo.com

63) **Moktan, Mani Ram,** Renewable Natural Resources Research Centre, Wangdi Phodrang, Bhutan, mrmoktan@yahoo.com

64) **Morrison Rwakakamba, Twesigye,** Uganda National Farmers Federation, Kampala, Uganda, rwakakamba@yahoo.co.uk

65) **Mosandl, Reinhard,** Inst. of silviculture, TU München, Freising, Germany, mosandl@forst.tu-muenchen.de

66) **Mridha, Amin Uddin,** Department of Botany, University of Chittagong, Bangladesh, mridha52@gmail.com

67) **Mujahid, Mohammad,** Higher Education Commission, UESTP-Federal Coordination Office, Islamabad, Pakistan, m.mujahid@stcatz.oxon.org

68) **Muralt, Gerald,** Inst. of Wildlife Biology and Game Management, Dept. of Integrative Biology and Biodiversity Management, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, gerald.muralt@boku.ac.at

69) **Mutke, Regneri Sven,** Forest Research Centre, National Institute for Agricultural Research (CIFOR-INIA) Dept. of Forest Systems and Resources, Madrid, Spain, mutke@inia.es

70) **Mwetu, Kennedy,** Inst. of Hydraulics and Rural Water Management, Dept. of Water, Atmosphere and Environment, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, kmwetu@yahoo.com

71) **Nandi, Rajasree,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, nandi_uma@yahoo.com

72) **Nilsson, Sten,** International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria, nilsson@iiasa.ac.at

73) **Norbu, Lungten,** RNRRC-Yusipang, CoRRB, Ministry of Agriculture, Bhutan, lnorbu@druknet.bt

74) **Notaro, Sandra,** Dept. of Economics, University of Trento, Italy, sandra.notaro@economia.unitn.it

75) **Permadi, Dwiko Budi,** Faculty of Forestry, Gadjah Mada University, Indonesia, dwiko.permadi@wur.nl

76) **Persson, Hans,** Dept. of Ecology, The Swedish University of Agricultural Sciences, Uppsala, Sweden, hans.persson@ekol.slu.se

77) **Pertlik, Ewald,** Inst. of Forest Engineering, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, ewald.pertlik@boku.ac.at

78) **Peslova, Alena,** Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno, Czech Republic, alenapeslova@seznam.cz

79) **Piussi, Pietro,** Dipartimento di Scienze e Tecnologie ambientali forestali, Universita di Firenze, Italy, pietro.piussi@unifi.it

80) **Pradhan, Naren,** Council for RNR Research of Bhutan, Ministry of Agriculture, Bhutan, nk_pradhan@moa.gov.bt

81) **Rammer, Werner,** Inst. of Silviculture, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, werner.rammer@boku.ac.at

82) **Rasul, Golam,** International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal, grasul@icimod.org

83) **Richards, Bill,** Seattle Public Utilities, Seattle, USA, bill.richards@seattle.gov

84) **Rodríguez-Sollaeiro, Roque,** University of Santiago de Compostela, Spain, roquers@lugo.usc.es

85) **Running, Steven W.,** College of Forestry and Conservation, University of Montana, Missoula, USA, swr@ntsg.umt.edu

86) **Sandei, Pier Carlo,** United Nations Environment Programme (UNEP), Regional Office for Europe, Vienna, Austria, piercarlo.sandei@unvienna.org

87) **Saxena, Vivek,** Ministry of Environment & Forests, Government of India, New Delhi, India, viveksax1@gmail.com

88) **Schekulin, Clemens,** ÖBB Infrastruktur Betrieb AG, Austria, clemens.schekulin@oebb.at

89) **Schindlbacher, Andreas,** Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), Vienna, Austria, andreas.schindlbacher@bfw.gv.at

90) **Schneider, Jiri,** Dept. of Landscape Management, Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno, Czech Republic, jiris@s-atelier.cz

91) **Schön, Bernhard,** Oö. Akademie für Umwelt und Natur, Linz, Austria, bernhard.schoen@ooe.gv.at

92) **Schopf, Axel,** Inst. of Forest Entomology, Forest Pathology and Forest Protection, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, axel.schopf@boku.ac.at

93) **Seidl, Rupert,** Inst. of Silviculture, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU) Vienna, Austria, rupert.seid@boku.ac.at

94) **Sekot, Walter,** Inst. of Agricultural and Forestry Economics, Dept. of Economics and Social Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, walter.sekot@boku.ac.at

95) **Sisay, Asfaw Cheru,** Non-Timber Forest Products (NTFPs) Research and Development Project, Ethiopia, asfawsisay@yahoo.com

96) **Soucek, Jiri,** Forest and Game Management Research Institute, Research Station Opocno, Czech Republic, soucek@vulhmop.cz

97) **Splechtna, Bernhard,** Center for Environmental Studies and Nature Conservation, Dept. of Integrative Biology and Biodiversity Management, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, bernhard.splechtna@boku.ac.at

98) **Spulak, Ondrej,** Forestry and Game Management Research Institute, Research Station of Opocno, Czech Republic, spulak@vulhmop.cz

99) **Stefan, Gernot,** Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna, Austria, gernot.stefan@lebensministerium.at

100) **Sterba, Hubert,** Inst. of Forest Growth and Yield Research, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, hubert.sterba@boku.ac.at

101) **Szewczyk, Janusz,** Dept. of Forest Botany and Nature Conservation, Agricultural University of Krakow, Poland, rljszewc@cyf-kr.edu.pl

102) **Szwagrzyk, Jerzy,** Dept. of Forest Botany and Nature Conservation, Agricultural University of Krakow, Poland, rlszwagr@cyf-kr.edu.pl

103) **Tashakori Ghojdy, Morteza,** Inst. of Silviculture, Dept. of Forest- and Soil Sciences, University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, mo_tashakori(@yahoo.com

104) **Tashi, Sonam,** RNRRC-Yusipang, CoRRB, Ministry of Agricuture, Bhutan, tashi_54@druknet.bt

105) **Tenzin, Kinley,** Renewable Natural Resource Research Centre, Yusipang, Thimphu, Bhutan, kktenzin@druknet.bt

106) **Tobgay, Sonam,** University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria, stwangdius@rediffmail.com

107) **Turek, Kamil,** Mendel University of Agriculture and Forestry in Brno, Czech Republic, kamilturek@post.cz

108) **Turna, Ybrahim,** Karadeniz Technical University, Faculty of Forestry, Trabzon, Turkey, turna@ktu.edu.tr

109) **Ücler, Ali Ömer,** Karadeniz Technical University, Faculty of Forestry, Trabzon, Turkey, ucler@ktu.edu.tr

110) **Venzi, Lorenzo,** University of Tuscia, Dept. of Ecology and Economic Sustainable Development (DECOS), Viterbo, Italy, lvenzi@unitus.it

111) **Wangchuk, Tenzin,** Sakteng Wildlife Sanctuary, Bhutan, twang_2000@lycos.com

112) **Wieshaider, Alexandra,** Österreichische Bundesforste AG, Austria, alexandra.wieshaider@bundesforste.at

113) **Woldeamanuel, Yoseph Assefa,** Addis Ababa University, Addis, Ethiopia, yoseph1assefa@yahoo.com

114) **Workneh, Semahugne,** BOKU – University of Natural Resources and Applied Life Sciences, Vienna, Department of Forest- and Soil Sciencs, Institute of Forest Ecology, Austria, seme_w@yahoo.ca

115) **Wu, Ping-Lian,** School of Forestry and Resource Conservation, National Taiwan University, Taipei, Taiwan, b95605091@ntu.edu.tw

116) **Yineger, Haile,** Jimma University, Jimma, Ethiopia, haile_mulu@yahoo.com

117) **Yousefyazary, Peiman,** Islamic Azad University, Research and Science Branch Tehran, Iran, peiman_yosefi@yahoo.com

118) **Zach, Peter,** Inst. of Forest Ecology, Slovak Academy of Sciences, Zvolen, Slovakia, zach@sav.savzv.sk

119) **Zid, Tomas,** Dept. of Forest Protection and Game Management, Faculty of Forestry and Wood Technology, Mendel University of Agriculture and Forestry, Brno, Czech Republic, tom.z@centrum.cz

UNI BOKU VIENNA
University of Natural Resources
and Applied Life Sciences, Vienna
Department of Forest- and Soil Sciences
Peter Jordan-Straße 82
A-1190 Vienna, Austria