

MEETING AGENDA

| PRE-CONFERENCE WELCOME – Monday, August 4th | |
|--|--|
| 5:00 pm | Registration opens; Poster room open |
| 7:00 pm | Registration and Social Evening in Conference Centre |

| DAY ONE – Tuesday, August 5th | |
|--------------------------------------|--|
| 8:30 am | <p>Welcome and Opening Remarks</p> <ul style="list-style-type: none"> • <i>Dr. Tom Dickinson, Conference Organizing Committee, TRU, Canada</i> • <i>First Nations Representative</i> • <i>Mr. Alan Vyse, Chair of Conference Organizing Committee, TRU, Canada</i> • <i>Mr. Jean-Michel Carnus, IUFRO Representative, France</i> • <i>Dr. Nancy Van Wagoner, Associate VP for Research and Graduate Studies, TRU, Canada</i> • <i>Ms. Madeline Maley, Regional Staff Manager, BC Forest Service, Kamloops, BC, Canada</i> <p>Acknowledgement of Sponsors</p> |
| 9:00 am | <p>OPENING ADDRESS</p> <p>"Muddling Through" in Forest Landscapes: Reducing deforestation and degradation of the world's forests.</p> <p><i>Dr. Chris Elliott, World Wildlife Fund, Vancouver, Canada</i></p> |
| 9:50 am | Refreshment Break |
| 1st Conference Session | |
| 10:20 am | <p>Effects of land cover on indigenous forest birds in Canterbury, New Zealand.</p> <p><i>Dr. Ecki Brockerhoff, New Zealand</i></p> |
| 10:40 am | <p>Life-history traits indicate species sensitivity to landscape fragmentation for birds, carabid beetles and butterflies in plantation forests.</p> <p><i>Dr. Luc Barbaro, France</i></p> |
| 11:00 am | <p>The difference of nest web of cavity nesters between <i>Cryptomeria japonica</i> stands and deciduous forests in Jeju Island, South Korea.</p> <p><i>Dr. Chan Ryul Park, South Korea</i></p> |
| 11:20 am | <p>A sensitive question: biodiversity conservation with the local population. A case study in central Menabe, Madagascar.</p> <p><i>Lanto Herilala Andriambelo, Madagascar</i></p> |
| 11:40 am | <p>Biodiversity conservation: Making a case for assessments highlighting governance realities in tropical forest landscapes.</p> <p><i>Dr. Jean-Laurent Pfund, Indonesia</i></p> |
| 12:00 noon | LUNCH |
| 2nd Conference Session | |
| 1:30 pm | <p>The future of tree diversity in Swiss forests: effects of management legacies and climatic change.</p> <p><i>Dr. Harald Bugmann, Switzerland</i></p> |

Day One, 2nd Conference Session, continued

| | |
|---------|--|
| 1:50 pm | Addressing biodiversity in a stakeholder-driven climate change vulnerability assessment. <i>Dr. Rupert Seidl, Austria</i> |
| 2:10 pm | Using bioclimatic envelopes to identify temporal corridors in support of conservation planning in a changing climate. <i>Dr. Phil Burton, Canada</i> |
| 2:30 pm | Effects of climate change on lentic habitats and associated biota in mountain forest ecosystems of the US Cascade Range. <i>Dr. Nobu Suzuki, USA</i> |
| 2:50 pm | Refreshment Break |
| 3:20 pm | Pilot-study on genetic monitoring in populations of wild cherry trees (<i>Prunus avium</i>). <i>Dr. Celine Jolivet, Germany</i> |
| 3:40 pm | Response to disturbances in a montane cloud forest: Decrease in biodiversity and change in functional characteristics. <i>Dr. Alicia Ledo, Spain</i> |
| 4:00 pm | Impact of glyphosate herbicide treatment on species diversity, tree growth, and forest health in a sub-boreal spruce plantation in central BC. <i>Dr. Chris Hawkins, Canada</i> |
| 6:30 pm | CONFERENCE DINNER |
| 7:30 pm | EVENING SPEAKER: <i>Dick Cannings, Author, Bird Studies Canada</i> |

DAY TWO – Wednesday, August 6th

3rd Conference Session

| | |
|----------|---|
| 8:30 am | KEYNOTE LECTURE Tolerance of indicator species to harvesting intensity as a guide to set conservation targets. <i>Dr. Marc-Andre Villard, Canada</i> |
| 9:20 am | Measuring Effects of Changes in Land Uses on Ecosystem Stability of Mountain Forests Based on Forest Fragmentation Index in South Korea. <i>Dr. Joosang Chung, South Korea</i> |
| 9:40 am | Dynamics of forested landscapes: Pattern assessment scheme and results over Europe. <i>Dr. Christine Estreguil, Italy, presented by Dr. Tor-Björn Larsson, Denmark</i> |
| 10:00 am | Refreshment Break |
| 10:30 am | Landscape-level habitat supply modeling to develop and evaluate management practices that maintain diverse forest values. <i>Dr. Walt Klenner, Canada</i> |
| 10:50 am | Direction and speed of natural beech forest dynamics: A matter of scale? <i>Caroline Heiri, Switzerland</i> |
| 11:10 am | Effects of ungulate browsing on forest composition and function. <i>Marcus Didion, Switzerland</i> |

Day Two, continued

| | |
|-------------------------------|---|
| 11:30 am | LUNCH |
| 4th Conference Session | |
| 1:00 pm | KEYNOTE LECTURE Biodiversity Monitoring: Is anybody really doing the job? <i>Dr. Stan Boutin, Canada</i> |
| 1:50 pm | The long-term biodiversity data collection related to European forests. <i>Dr. Tor-Björn Larsson, Denmark</i> |
| 2:10 pm | Biodiversity and Sustainability Impact Assessment of Forestry-Wood Chains in Europe. <i>Jean-Michel Carnus, France</i> |
| 2:30 pm | Refreshment break and Poster Session |
| 4:30 pm | Poster session ends. IUFRO Biodiversity Section meeting: <i>Jean-Michel Carnus</i> |
| 7:00 pm | DINNER in University Gardens (behind Horticulture Building) |
| After dinner (times TBA) | Tour of the University Gardens and Arboretum: <i>TBA</i> Tour of TRU Birding Hot Spots: <i>Dr. Tom Dickinson, Thompson Rivers University</i> |

DAY THREE – Thursday, August 7th

In-conference FIELD TOUR

| | |
|--|---|
| 7:45 am <i>Tour departs Conference Centre</i> | Conference attendees will examine dry grassland and forest conditions and responses to practices on an elevation gradient from 400 to 1300 m, see the impact of the mountain pine beetle epidemic, and visit the long-term Opax Mountain study. Participants should wear appropriate footwear for walking on uneven ground and be prepared for inclement weather. |
| 5:30 pm | Return to Conference Centre. The evening is open. A shuttle bus will be available to transport visitors from the Conference Centre to the downtown area and return. Details will be announced at the Conference. |

DAY FOUR – Friday, August 8th

5th Conference Session

| | |
|----------|---|
| 8:00 am | KEYNOTE LECTURE Incremental silviculture and biodiversity: Whither the future for managed forests? <i>Dr. Tom Sullivan, Canada</i> |
| 9:00 am | Carabid beetles in some forested ecosystems in British Columbia, and response to harvesting. <i>Dr. Geoff Scudder, Canada</i> |
| 9:20 am | Invertebrate community response to afforestation of native grassland communities. <i>Dr. Steve Pawson, New Zealand</i> |
| 9:40 am | Biodiversity indicators of ground-dwelling spiders in Irish plantation forests and native woodlands. <i>Dr. Anne Oxbrough, Ireland</i> |
| 10:00 am | Refreshment Break |

Day Four, 5th Conference Session, continued

| | |
|-------------------------------|---|
| 10:30 am | Managing dead wood to conserve biodiversity in plantation forests. <i>Dr. Hervé Jactel, France</i> |
| 10:50 am | The effect of ecological forest gradients on macrolichens and bryophytes on coarse woody debris in central BC. <i>Craig DeLong, Canada</i> |
| 11:10 am | Stand diversity after MPB attack: The forest is alive. <i>Kyle Runzer, Canada</i> |
| 11:30 am | Is tree species diversity a good indicator of understory vegetation diversity? A case study in some French lowland deciduous forests. <i>Dr. Frédéric Gosselin, France</i> |
| 11:50 am | LUNCH |
| 6th Conference Session | |
| 1:00 pm | KEYNOTE LECTURE Taking Nature's Pulse: The Status of Biodiversity in British Columbia. <i>Dr. Geoff Scudder, Canada</i> |
| 1:50 pm | Dry forest restoration and understory plant diversity: The importance of community heterogeneity and species co-existence. <i>Dr. Erich Dodson, USA</i> |
| 2:10 pm | Management of Mediterranean forests for biodiversity conservation. A multifunctional project in Sierra de Cardena y Montoro Natural Park (Spain). <i>Pedro Lara Almuedo, Spain</i> |
| 2:30 pm | Impact of fires in 2007 on forest spatial pattern and functional networks in the Peloponnese peninsula (Greece). <i>Dr. Monica Rodriguez Freire, Italy</i> |
| 2:50 pm | Refreshment Break |
| 3:20 pm | Impact of repeated fires on functional biodiversity: Mediterranean forests. <i>Dr. Michel Vennetier, France</i> |
| 3:40 pm | The role of riparian buffers and thinning in linkage areas to retain forest biodiversity. <i>Dr. Deanna Olson, USA</i> |
| 4:00 pm | Mycorrhizal networks and Douglas-fir stand dynamics. <i>Dr. Suzanne Simard, Canada</i> |
| 4:20 pm | CLOSING REMARKS |

POST-CONFERENCE FIELD TOUR – Saturday, August 9th

| | |
|--|---|
| 7:30 am <i>Tour departs Conference Centre</i> | Participants will visit the long-term Sicamous Creek study site to discuss ecosystem responses to logging in high-elevation forests. The site is two hours east of Kamloops. Participation is limited to 35 people. Participants should wear appropriate footwear for walking on uneven ground and be prepared for inclement weather. |
| 6:00 pm | Return to Kamloops |

POSTERS

| | | |
|-----------------------|--------------------|---|
| <i>Armleder, H.M.</i> | <i>Canada</i> | Mountain Caribou and Biodiversity in Managed Forests of the Quesnel Highland, B.C. |
| <i>Arsenault, A.</i> | <i>Canada</i> | Pattern and process in old-growth rainforests of southern British Columbia |
| <i>Black, S.</i> | <i>Canada</i> | Plant Community Response to Post-wildfire Management Activities in Interior Douglas-fir Forests of Southern BC |
| <i>Campbell, E.</i> | <i>Canada</i> | The influence of surrounding forest landscape composition on spruce budworm outbreak severity in spruce/fir stands and projections of future outbreak impacts |
| <i>Chung, J.S.</i> | <i>South Korea</i> | Regionally-specialized habitat use patterns of the white-backed woodpecker in Jeju island of South Korea |
| <i>Dhar, A.</i> | <i>Austria</i> | The Population Genetic Consequences for Conservation of an Endangered <i>Taxus baccata</i> L. population in Austria |
| <i>Ganteaume, A.</i> | <i>France</i> | Fuel ecological description in calcareous Provence (Southern France): Effects of wildfire recurrence and vegetation types |
| <i>Ganteaume, A.</i> | <i>France</i> | Comparison of disturbed litter flammability collected on calcareous and acidic soils in Southern France |
| <i>Gosselin, F.</i> | <i>France</i> | The French National Research Program on Biodiversity and Forest Management. Towards the co-evolution of managers and researchers? |
| <i>Gupta, S.</i> | <i>India</i> | Determination of Climate Change-associated Vulnerability of Plant Biodiversity |
| <i>Hazandy, A-H</i> | <i>Malaysia</i> | Impacts of trampling and camping on Mount Tahan vegetation |
| <i>Kwon, J.</i> | <i>South Korea</i> | Vegetation Landscape Characteristics and Biotope Diversity on the Isolated Urban Forests in the Six Korean Metropolitan Cities |
| <i>Laarman, D.</i> | <i>Estonia</i> | Biodiversity assessment through individual tree mortality analysis on permanent sample plot data in Estonia |
| <i>Lehtomaki, J.</i> | <i>Finland</i> | Setting conservation priorities for state-owned forest reserves in Finland |
| <i>Lewis, D.</i> | <i>Canada</i> | Trends in Salvage Logging Practices in Mountain Pine Beetle Affected Landscapes: Implications to Biodiversity Conservation |
| <i>McAfee, B.</i> | <i>Canada</i> | Implementing ecosystem-based approaches to management in Canada's forests |

POSTERS (continued)

| | | |
|-------------------------------|--------------------|--|
| <i>McLean, J.</i> | <i>Canada</i> | Beetle diversity in forest and pastoral areas, Whangamata, Coromandel Peninsula, New Zealand |
| <i>Oaten, D.</i> | <i>Canada</i> | Cavity-nesting bird communities within the dry interior forests of British Columbia, Canada: The role of aspen in contributing to biodiversity |
| <i>Orcherton, D.</i> | <i>Canada</i> | TEK (Traditional Ecological Knowledge) and Biodiversity Conservation: Strengthening Community-Based Approaches (CBA) to conservation and building equitable partnerships in practice with indigenous peoples |
| <i>Pearsall, I.</i> | <i>Canada</i> | Fragmentation and Variable Retention: What can Carabid Beetles Tell Us About Effects On Biodiversity? |
| <i>Rubio, A. and Ledo, A.</i> | <i>Spain</i> | Species dynamics in the <i>Pinus sylvestris</i> L. <i>Quercus pyrenaica</i> Willd. ecotone in central Spain |
| <i>Seol, A.</i> | <i>South Korea</i> | Regionally-Specialized Habitat Use Patterns of White-backed Woodpecker in Jeju Island, South Korea |
| <i>Starlinger, F.</i> | <i>Austria</i> | Changes in ground vegetation of managed forests in Austria: Diversity indices and species richness |
| <i>Sutherland, G.</i> | <i>Canada</i> | Potential impacts of climate change on habitat supply and modeling their demographic outcomes for the Northern Spotted Owl |
| <i>Todd, M.</i> | <i>Canada</i> | Monitoring ground arthropod functional communities to evaluate the effectiveness of structural retention for forest biodiversity conservation. |
| <i>Vennetier, M</i> | <i>France</i> | A new bioclimatic model to quantify climate change impact on forest flora diversity |

BOOTH EXHIBITORS

| | | |
|---|---------------|---|
| <i>BC Forest Practices Board</i> | <i>Canada</i> | http://www.fpb.gov.bc.ca/ |
| <i>BC Ministry of Forests and Range</i> | <i>Canada</i> | http://www.gov.bc.ca/for/ |
| <i>FORREX Forest Research Extension Partnership</i> | <i>Canada</i> | http://www.forrex.org/ |

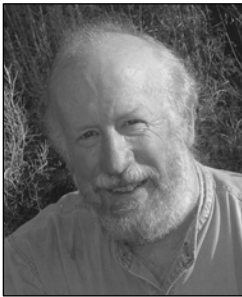
Keynote Speaker Biographies

Dr. Stan Boutin



Dr. Boutin is Professor of Biological Sciences at the University of Alberta, Edmonton. His research interests include forestry-wildlife interactions in the boreal mixed woods of northeastern Alberta; the cumulative effects of disturbance and integrated landscape management; population ecology of boreal mammals with emphasis on the relationship between behaviour and resources; parental investment and dispersal; management of boreal communities; and predator-prey relationships.

Dick Cannings



Dick Cannings is Program Coordinator for Bird Studies Canada in British Columbia. Dick is currently working as a consulting biologist in Naramata. He works half-time for Bird Studies Canada, organizing Canadian Christmas Bird Counts, eBird Canada and the British Columbia Owl Survey and serve as the chair of the Birds subcommittee for the National Committee on Endangered Wildlife in Canada (COSEWIC). He also teaches a field ecology course for the University of British Columbia every year, held in such diverse places as Ecuador, Costa Rica, Arizona and the Yukon. His main research interest is the breeding biology of birds, particularly small owls. In addition to his professional and research interests Dick has had a long career in public education, producing regular radio items on natural history themes for the Canadian Broadcasting Corporation, teaching continuing education courses on birding and nature and leading natural history tours to destinations around the world, particularly in the New World tropics. He has written a number of books, including *The Birds of the Okanagan Valley, British Columbia* with his brothers Sydney and Robert Cannings; *British Columbia: A Natural History* with Sydney Cannings, *The BC Roadside Naturalist*, *The Rockies: a Natural History*, and most recently, *An Enchantment of Birds*.

Dr. Chris Elliott



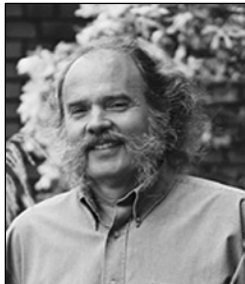
Dr. Elliott joined WWF–Canada in October 2005 as Regional Vice President for the Pacific. He has previously worked for WWF International in a variety of capacities over the last twenty years, initially as China Programme Coordinator working on the WWF panda project and most recently as Director of WWF's Global Forest Programme. Chris was closely involved in major forest conservation initiatives in the Congo Basin and the Amazon and led the development of a global partnership with IKEA. Before joining WWF he worked in the field of organic agriculture for several years and at the World Bank in Washington, DC focusing on forest policy. He has a BSc from London University in plant science, a MES in forestry from Yale University and a DSc degree in forestry and ecosystem management from the Swiss Federal Institute of Technology.

Dr. Geoff Scudder



Dr. Scudder is a Professor Emeritus at the University of British Columbia, having served as Head of the Department of Zoology (1976-1991) and Interim Director of the Centre for Biodiversity Research (1993-1995). He is a zoologist, with special interest and experience in entomology, biosystematics, biogeography, biodiversity, conservation biology and evolution. He is a world expert in the systematics of seed bugs. He has published over 250 scientific papers, and has edited two books. He currently serves on the Board of Directors of the Nature Trust of British Columbia, and advisory committees of Environment Canada, the Entomological Society of Canada, and the BC Ministry of Environment as a member of the B.C. Conservation Lands Forum Conservation Planning Tools Committee, which has recently published a biodiversity conservation strategy status report for the province. He is a fellow of the Royal Society of Canada, and a member of the Order of Canada, and continues to be actively involved in research and public education. As a member of the Science Committee of the South Okanagan-Similkameen Conservation Program, he is involved in research on ecosystem renewal, conservation area design, and the identification of landscape connections for biodiversity conservation in the southern interior. He serves on a number of species at risk recovery teams, and as a member of the zoological expert advisory committee for the Nature Conservancy's Ecoregional Planning for the Okanagan, is involved in conservation planning for the Okanagan Valley in both British Columbia and Washington State.

Dr. Tom Sullivan



Dr. Sullivan is Professor, Agroecology, Faculty of Land and Food Systems and Department of Forest Sciences, Faculty of Forestry at the University of British Columbia. His studies are concerned with integrated management of wildlife resources within agricultural and forest environments. He has concentrated on the evaluation of biodiversity and sustainability in a landscape mosaic of agro-ecosystems and natural habitats based on the measurement of vegetation, small mammal communities, and habitat structure. These research activities are conducted in the southern and central interior of BC.

Dr. Marc-André Villard



Dr. Villard holds the Canada Research Chair in Landscape Conservation at the University of Moncton, New Brunswick. His research is focussed on studying the response of different organisms to silvicultural practices used in New Brunswick, northeastern North America and the boreal mixedwood forest of Canada. His work is based on the principle that we need to assess species' tolerance to different levels of intensity of forest exploitation and management. Forest managers can then use this information to adjust this intensity according to the conservation objectives they set themselves. In addition he is working on the ecological effects of peat extraction.

Presentation and Poster Abstracts

(alphabetically by lead presenter's last name)

ANDRIAMBELO, Lanto Herilala (MADAGASCAR)

A sensitive question: Biodiversity conservation with the local population. A case study in central Menabe, Madagascar

Madagascar is a well-known biodiversity hotspot. About 80% of its fauna and flora is endemic. The Island represents a little continent according to its forest formation type, from rainy forest formations in the Eastern part to various types of dry forest and bush in the Western part. In order to protect this unique biodiversity, the Malagasy government wants to increase the area under protection from 1.7 million to 6 million hectares. One of the new protected area is on the way to be established in Central Menabe, on the West coast of Madagascar.

Farmer's households depend a lot on forest. They clear forest for its soil (arable land and pasture) and collect various timber and non-timber products for energy, infrastructure, alimentation, medicine. Wood is the unique source to meet the requirements for domestic fuel. The houses are mainly built using poles, planks, leaves, bark and fiber collected in the forest. Due to the high pressure, forest is rapidly disappearing or degrading. It shows how it is important to look the balance between forest based livelihoods and biodiversity preservation.

The present research aims to look this balance but focused on the tree species mainly used by the local households. An inventory of the tree resources has been done to on a total of 120 plots shared between 4 types of forest landscape types. A specific understanding of stakeholder requirements and strategies has been done to identify the need of villagers about tree resources and their capacity to manage the forest resources. 202 questionnaires made in 7 villages, 11 interviews with actors using wood in their everyday activities, 12 interviews with members of forest managing association in 5 villages, 6 interviews with society transforming wood to furniture and 3 interviews with NGOs about conservation or development have been done.

Email: lanto_herilala@yahoo.fr

ARMLEDER, Harold and WATERHOUSE, Michaela (CANADA)

Mountain Caribou and Biodiversity in Managed Forests of the Quesnel Highland, B.C.

Mountain caribou (*Rangifer tarandus caribou*) are recognized as threatened under the Canadian federal Species at Risk Act. In the Quesnel Highland, over 100 000 hectares (ha) of habitat are designated as no harvest areas for caribou, but several thousand ha are available for modified harvesting. The Quesnel Highland project was initiated in 1990 to test group selection silvicultural systems that could be used to maintain mountain caribou habitat while allowing for timber harvesting. The primary feature of the trial is to test whether group selection silvicultural systems retain arboreal lichens—critical winter forage. However, the success of silvicultural systems is contingent on many other factors that the Quesnel Highland project is also investigating. These include: survival and growth of natural and planted regeneration, treefall, stand structure, micro-climate, and snow distribution and melt rates. Additionally, the impact on biological diversity is being addressed by examining the effects on various species of breeding birds, small mammals, and vegetation.

We measured the response of arboreal lichen to harvesting of 30% of the forested area using three partial cutting treatments, which created small (0.03 ha), medium (0.13 ha), and large (1.0 ha) openings, and a no-harvest treatment. The short-term loss of lichen associated with removal of approximately one third of the trees was partially offset by a significant ($p=0.01$) increase in lichen abundance on trees in the caribou feeding zone (up to 4.5 m) in the three partial cutting treatments relative to trees in the uncut forest. Bird, small mammal and vegetation communities are fairly resilient to the group selection treatments. Species composition is similar pre- and post-harvest, although there are shifts in abundance and pattern of use. Our results support the growing body of knowledge that group selection, when conducted in subalpine forests, maintain important ecological processes and diversity better than large clearcuts.

Email: Harold.Armleder@gov.bc.ca

Pattern and process in old-growth rainforests of southern British Columbia

The Opax Mountain Silviculture Systems Project is located in the Interior Douglas-Fir biogeoclimatic zone, approximately 30 km north of Kamloops, BC. It is divided into six treatment units replicated twice at 2 different elevations. The units represent varying amounts and patterns of tree harvesting, including 20% removal of merchantable volume using individual tree selection (ITS), 50% ITS, 50% ITS with uncut reserves, 20% removal using a mixture of patch cuts of 0.1, 0.4 and 1.6 hectares, and 50% removal with patch cuts of a similar nature as the 20% removal. Logging took place in the winter of 1993-1994. Patch cuts were subsequently planted with saplings of Douglas fir, lodgepole pine and ponderosa pine. Total epiphytic lichen flora includes 308 species. The crust lichens constitute 58% of the species, while 30% are macrolichens, and 11% are calicioids. Species diversity did not seem to be closely associated with treatment type. However trees in the unlogged perimeter of the patch-cuts had much greater richness, 196 species, compared to 57 and 18 for epiphytes growing on advanced regeneration and planted trees inside patch-cuts. Mean species richness followed the same pattern for macrolichens and crusts increasing with increasing substrate age. Calicioid lichens were only found in unlogged perimeters of patch-cuts. This study reveals for the first time that Interior Douglas-fir forests have a highly rich and diverse epiphytic lichen flora. These findings have implications for retention of key lichen habitats in managed landscapes. The concept that ecosystem restoration "improves biodiversity" should be evaluated looking at the forest with lichenological lenses.

Email: andre.arsenault@bc.gov.ca

Life-history traits indicate species sensitivity to landscape fragmentation for birds, carabid beetles and butterflies in plantation forests

The use of life-history traits as a tool for the analysis of species sensitivity to forest fragmentation has been rarely tested for several taxa at the landscape scale. Here, we aimed at linking species life traits of three taxonomical groups to landscape configuration in pine plantation forests of south-western France. We sampled bird, carabid beetle and butterfly communities with standardized methods, and recorded abundance data for 52 bird species in 287 point-counts, 45 carabid species in 244 pitfall traps and 42 butterfly species in 162 line transects. For each species, a set of 12 traits were documented from the literature to characterize rarity, biogeography, body size, trophic guild, dispersal power, reproductive potential and phenology. We performed a three-table ordination method (RLQ analysis) to match species traits and landscape metrics through the link provided by the species-sites data table. For all taxa, the first ordination axis of RLQ analysis was a gradient of overall landscape fragmentation from homogeneous mosaics dominated by large patches of pine plantations to heterogeneous mosaics with meadows, deciduous woodland patches and high edge density. The most threatened species of birds, beetles and butterflies showed negative responses to the fragmentation of grasslands and shrublands at the landscape scale. Life-history traits associated with such a high sensitivity to fragmentation were low productivity, intermediate body mass, restricted geographic range, late phenology and ground gleaning for birds; intermediate body size, spring adult activity, northern distribution and summer breeding period for carabids; restricted range, overwintering as eggs or larvae, low mobility, monophagy and short flight periods for butterflies. Such life trait combinations allow predicting which species may go extinct in case of increasing habitat fragmentation and homogenization of forested landscapes.

Email: luc@pierroton.inra.fr

BLACK, Scott, ARSENAULT, André, and BRADFIELD, Gary E. (CANADA)

Plant Community Response to Post-wildfire Management Activities in Interior Douglas-Fir Forests of Southern BC

Conservation of biodiversity in managed forests requires a better understanding of the impacts of forestry practices on the species-rich herbaceous layer. Post-wildfire treatments such as salvage logging and grass seeding occur over a large part of the forested land base in British Columbia. However, there is surprisingly little research on the effects of multiple disturbances such as these on plant community composition and species diversity. I examine vascular and nonvascular plant community responses 4 years after wildfire and post-wildfire management treatments in Interior Douglas-Fir (IDF; *Pseudotsuga menziesii* var. *glauca*) forests of Southern BC. I describe the short-term effects of disturbance on community reassembly in forest ecosystems affected by the 2003 wildfires near Kamloops, BC. Initial analysis of the 105 sites sampled (in two fires) suggests that native species richness decreases with disturbance/management intensity but that grass seeding has less of an effect on diversity than salvage logging. Conversely, weedy annuals and invasive species increase in areas with secondary or tertiary disturbances. This study begins to evaluate the impacts of post-wildfire management in BC and provides vegetation indicators for monitoring sustainable forest management in IDF forests. This is of particular importance given the predicted northward shift of IDF ecosystems and associated grasslands.

Email: stblack@interchange.ubc.ca

BOUTIN, Stan (CANADA)

Biodiversity Monitoring: Is anybody really doing the job?

Biodiversity has become a "catch all" for virtually any component of genes, species, populations, ecosystems, or landscapes that one can imagine. As a consequence it has proven difficult to mobilize new and effective ways of monitoring biodiversity. Instead, there has been endless debate over the use of surrogates, umbrellas, and keystones. For the most part, we have continued to monitor a very small subset of species that are either charismatic, exploited for human use (hunted or fished), or endangered and we do so in a largely ad hoc manner. As a consequence, it has proven difficult to document all but the obvious changes in biodiversity in most forested ecosystems. I will outline a few examples of programs that have taken a very different approach emphasizing some of the challenges to monitoring and reporting on biodiversity change in a broader context. In so doing, I hope to bring to people's attention to the need for a radical shift in how we design, implement, and maintain biodiversity monitoring programs around the world.

Email: stan.boutin@ualberta.ca

BROCKERHOFF, Eckehard, DECONCHAT, Marc, BARBARO, Luc, PAUL, Thomas, LUECHT, Sabrina, MUIR, James, and HENLEY, David (NEW ZEALAND)

Effects of land cover on indigenous forest birds in Canterbury, New Zealand

Forest loss and fragmentation are significant concerns for biodiversity, and they are partly responsible for the decline or extinction of numerous forest birds. In New Zealand, Banks Peninsula, the Canterbury Plains, and parts of the Southern Alps have lost most of their natural forest cover, although there has been considerable regeneration of shrubland on Banks Peninsula and much planting of exotic trees throughout. Since 2005 we have conducted about 900 point counts in 25 sample landscapes measuring 5 by 5 km that varied in forest cover from almost none to over 80%. Land cover types we surveyed included native forest or shrubland, exotic forest, pure grassland, and mixed farmland with open areas and some tree cover. Preliminary analyses indicate that the richness of native forest bird species was highest in native forest and shrubland, followed by plantation forests in areas where native forest is present. On the Canterbury Plains, some native forest birds were present in plantation forests, mainly fantails, grey warblers and shining cuckoos, whereas mainly exotic birds were found in pure grassland (pasture). The results will be discussed with regard to bird conservation in regions that experienced considerable forest loss.

Email: eckehard.brockerhoff@scionresearch.com

The future of tree diversity in Swiss forests: Effects of management legacies and climatic change

Management practices and climatic variables have a strong impact on long-term tree diversity in forest ecosystems. However, it is difficult to assess these effects based on measured data alone, and experimentation is nearly infeasible due to the long time scales involved. Thus, dynamic models have an important role in this regard.

In this presentation, we employ the succession model FORCLIM, whose local accuracy has recently been improved considerably, to investigate the impacts of management legacies and anticipated anthropogenic changes of the climate on structural and species diversity of forests in central Europe. First, in many Swiss forest reserves considerable changes of stand structure and species diversity have been observed after the cessation of management (see presentation by Heiri *et al.*). We use FORCLIM to explore possible further changes in these variables in the absence of management and assuming no changes in climate. Second, mountain ecosystems are expected to be particularly sensitive to future climate change. Therefore, we apply FORCLIM to assess the likely changes in the species composition of near-natural forests along an elevational gradient in the Swiss Alps under state-of-the-art climate scenarios derived from the IPCC's 4th Assessment Report.

The simulation results suggest that in the long term, strong changes in tree diversity are to be expected, but changes in average climatic conditions will take many decades to translate into changes in forest properties such as species-specific basal area. These findings are compared with results from other studies that adopted similar (e.g., other forest succession models) but also rather different approaches (e.g., static bioclimatic niche modeling). Implications for forest management as well as further research needs are outlined.

Email: harald.bugmann@env.ethz.ch

Using Bioclimatic Envelopes to Identify Temporal Corridors in Support of Conservation Planning in a Changing Climate

A changing climate means that protected areas may no longer be able to sustain the biological features they are expected to protect through time. To address this issue, we identified temporal corridors that are expected to exhibit a continuity of climatic attributes sufficient to sustain identified bio-ecological values for the foreseeable future. This analysis is based on the development of bioclimatic envelope models developed for biogeoclimatic zones and subzones, terrestrial ecological systems, and the current documented locations of rare (Conservation Data Centre red-listed) plant communities and plant taxa. The Climate-BC interpolation tool (Wang *et al.* 2006, *Int. J. Clim.* 26:383-97) was used to estimate the historic minimum and maximum (range) and 25th to 75th percentiles (core) of 19 climate attributes for those documented point locations, or for polygon targets gridded to a 1 km resolution in British Columbia and nearby jurisdictions. Locations projected to support the same range or core of all attributes now, in 2020, 2050, and 2085 under various global circulation models (GCMs) were then mapped, and the overlap (GIS intersection) of all four timeslices constitute temporal corridors.

Preliminary analysis suggests (for example) that the area of land with climate suitable for the Ponderosa Pine (PP) and Interior Douglas-Fir (IDF) biogeoclimatic zones is expected to increase, but there will be no temporal corridors for the PP zone, while 63% of the current IDF zone should persist within its current range. Likewise, the area with climatic conditions suitable for the rare lichen *Nephroma occultum* is predicted to increase by 17% and the temporal corridor suitable for its persistence in interior British Columbia approximates its current distribution. We explore the level of agreement among alternative GCMs, alternative methods of presenting the degree of certainty in climatic envelopes, and the level of agreement among temporal corridors for various conservation targets. Temporal corridors represent locations that could be set aside with the expectation that conditions will remain suitable to meet conservation goals. The concept and application of temporal corridors could be an important component of protected area planning and biodiversity conservation in an era of rapid change and environmental uncertainty.

Email: pburton@nrcan.gc.ca

The influence of surrounding forest landscape composition on spruce budworm outbreak severity in spruce/fir stands and projections of future outbreak impacts

Forest landscapes homogenized by past forestry activities can make them more vulnerable to native insect outbreaks, increasing the potential for catastrophic socioeconomic and ecological losses. Fifty-eight mature balsam fir-dominated (*Abies balsamea*) stands were sampled in eastern Canada to study relationships between the severity of a past spruce budworm (*Choristoneura fumiferana* Clem.) outbreak and the composition of surrounding forest landscapes. While all stands were affected, budworm-caused radial growth reductions and deaths of balsam fir decreased significantly (up to 40%) with an increase in the percentage of hardwood-dominated stands in landscapes ($p < 0.01$), which was positively correlated ($p < 0.001$) with forest landscape diversity. Forest landscape hardwood content was also significantly negatively correlated with the amount (ha) of balsam fir-dominated forests contiguous with sampled stands ($p < 0.01$). To determine which of these two opposing aspects of forest landscape composition was the probable cause of variations in outbreak severity, we tested for differences in balsam fir growth reductions among mature stands: i) in landscapes of contiguous host forests, ii) on true islands and iii) in habitat islands (i.e., stands surrounded by hardwood-dominated landscapes). Growth reductions were about the same in landscapes of contiguous hosts and on true islands but significantly lower ($p = 0.005$) in habitat islands. This suggests that forest composition has an active influence on budworm outbreak severity, probably mediated through differences in budworm parasitism rates related to forest landscape hardwood content, and not just a passive effect manifested by host availability. This finding has important implications for how foresters might alter the landscape to minimize the impact of future outbreaks. It also suggests that decision support tools should incorporate the effect of surrounding landscape hardwood content into model projections of stand vulnerability; we found volume losses (m^3/ha) in a mixedwood boreal forest management area were overestimated by ~25 % if they were not.

Email: elizabeth.m.campbell@gov.bc.ca

Biodiversity and Sustainability Impact Assessment of Forestry-Wood Chains in Europe

Forests play a major role in the global carbon cycle, the conservation of biodiversity, the protection of soils and water, and the continued supply of those main environmental services is a key component of Sustainable Forest Management (SFM). Some of these services are directly concerned by international agreements (UN Convention on Biological Diversity, Kyoto protocol ...) and European policies (Water Framework Directive, Soil Protection, Habitat Directive), and will contribute to any post-Kyoto accord. However, there are external pressures on forest ecosystems, e.g. climate change, air pollution, and unsustainable exploitation that may hamper the fibre production and the other environmental and social benefits; there are also potential conflicts among sustained fibre and wood production and forest environmental services, as well as among the environmental services.

As part of the EU integrated research project EFORWOOD (2006-2009) and related development of a quantitative decision support "Tool for Sustainability Impact Assessment" (ToSIA) of the European Forestry-Wood chain, the question of how current and future forest management strategies influence the provision of main environmental services including biodiversity conservation is addressed through review and analysis of existing data and development of quantitative indicators. In the first phase of the project, forest production processes and operations have been mapped and described in the context of present and future FWCs in Europe and their impacts on four main environmental services (biodiversity, carbon, water, soil) have been reviewed and analysed using (i) a common framework of silvicultural operations and forest management alternatives from intensive dendrobiomass production to unmanaged forest nature reserve; and (ii) a set of direct or indirect environmental indicators further developed from MCPFE and included in ToSIA. Results from this initial work will be provided with emphasis on biodiversity aspects and examples given from representative regions of Europe; further development of the project will be also presented.

Email: carnus@pierroton.inra.fr

CHUNG, Joosang, SONG, Jungeun, LIM, Sangseop, and NELSON, John (SOUTH KOREA)

Measuring effects of changes in land uses on ecosystem stability of mountain forests based on forest fragmentation index in South Korea

South Korea, where more than 60% of whole country is covered by mountainous forests, suffers radical changes in forest land uses due to the nationwide development plan for industrialization and urbanization as well as agricultural activities. Development in mountainous areas often causes serious changes in forest cover types and spatial distribution patterns that disturb the stability of forest ecosystems or degrade the ecological environment. In order to quantify the effects of such development activities on ecosystem stability, multiple regression analysis was used in this study. Forest fragmentation was chosen as a measure to represent the sensitivity of ecosystem stability according to changes in forest land use. Correlations of forest fragmentation index (FFI) with land use types and topographic characteristics were then determined. The whole forest area, % area of the ecotone or edge cells and landscape division index (LDI) were estimated based on digital forest-cover maps. FFI by the administrative spatial units of South Korea was then determined. In multiple regression analysis, the social, economic and topographic factors were used as the explanatory variables for the spatial variation of FFI. The results of this study indicate that the mountain forests in the south-west coastal region and the metropolitan city areas are more heavily fragmented than those in other regions. FFI has a positive correlation with the population density, the road length, the number of houses and the area of farm lands and a negative correlation with such topographic factors as elevation and slope. According to the results of the multiple regression analysis, the explanatory variables explained about 78% of the total variance in estimating forest fragmentation in South Korea.

Email: jschung@snu.ac.kr

CHUNG, Joosang, SEOL, A Ra, CHUNG, Jin Heon, PARK, Chan Ryul, and NELSON, John (SOUTH KOREA)

Regionally-specialized habitat use patterns of the white-backed woodpecker in Jeju island of South Korea

The white-backed woodpecker (*Dendrocopos leucotos*) at the Hannam experimental forest in Jeju-island is a species needing a regionally-specialized conservation strategy. According to the literature, the bird only inhabits deciduous forest stands in Europe. However, it was found that the bird in the study site prefers nesting areas in the *Cryptomeria japonica* plantation forest over the natural deciduous forests. Many nest holes are found only in *C. japonica* plantation forest stands surrounded by natural deciduous stands. Within the natural deciduous forest, the *C. japonica* plantation forest stands are scattered with a nearest neighborhood distance of 60m-to-128m and a high edge contrast index of 94%. The deciduous forest seems to provide a foraging habitat for the bird where it is easy to find pecking traces on dying and dead trees. In addition, it was also found that the bird builds nests on relatively large DBH trees ($45.1 \pm 7.4\text{cm}$) in swampy forest stands; the bird prefers making nest holes at the branch stub on the trunk, where the wood is of less strength and more vulnerable to fungus-infection compared with that of the sound trunk. Most of the bird nests were found along stand edges ($25.7 \pm 20.2\text{m}$) or along forest roads ($68.8 \pm 51.2\text{m}$), which might be related to microclimate and higher rates of fungal infection of trees. According to the results, the primary conservation strategies for the bird would be a longer harvest rotation to protect stand edges in *C. japonica* plantation forest stands, and effective deadwood management in deciduous forest stands.

Email: jschung@snu.ac.kr

DELONG, Craig and BOTTING, Rachel (CANADA)

The effect of ecological forest gradients on macrolichens and bryophytes on coarse woody debris in central BC

Coarse woody debris (CWD) in forests forms an important habitat for mosses, liverworts and lichens with many species restricted to CWD substrates. The influence of coarse woody debris characteristics on lichen and bryophyte species has not been well examined for sub boreal spruce forests in central British Columbia. Wildlife tree patches are maintained on the landscape after clearcut logging with the intent of conserving wildlife habitat, however, the ability of these patches to maintain other species assemblages including lichen and bryophyte communities has not been well examined. With the rapid changes occurring to forests throughout British Columbia through harvest, fire and insect damage it is imperative to understand the habitat requirements of these specialized species in order to take conservation efforts to reduce species loss. We examined how a variety of ecological factors, especially those which are most often modified by disturbance, influenced the species richness and abundance of lichen and bryophyte species. The factors examined were CWD characteristics (diameter, height, % bark coverage, decay class, CWD species) and forest stand gradients (moisture, and nutrient regime, site series, size of forest patch and time of isolation of forest patch). Regression analysis and non metric multidimensional scaling ordination indicate the particular importance of CWD decay class, height from ground and diameter on the diversity of macrolichen and bryophyte species. The species of CWD also affects macrolichen and bryophyte species composition. Distinct trends with patch size were not evident, however, moss and liverwort species diversity and cover declined steadily over the time since a patch was isolated. Our results highlight the importance of maintaining a variety of coarse woody debris on the landscape and suggest that in their current size and configuration, many wildlife tree patches may not be conserving sensitive lichen and bryophyte species over time.

Email: craig.delong@gov.bc.ca

DHAR, Amalesh, RUPRECHT, Herwig, KLUMPP, Raphael, and VACIK, Harald (AUSTRIA)

The Population Genetic Consequences for Conservation of an Endangered *Taxus baccata* L. population in Austria

The English yew (*Taxus baccata* L.) is a native evergreen non-resinous gymnosperm long lived dioecious, conifer tree species in central Europe. At present it has come into prominence throughout the world due to its anti-cancer substance Taxol and it has recognised as an endangered tree species in Austria as well as most of its ranges. Structure of the yew relict population was illustrated in respect of different tree attributes. The genetic variation is described by using isozyme gene markers. It represents a core population of yew, which has 135 individual trees with a DBH range from 5.5 to 31.5 cm. Genotyping of individual trees has been carried out by analysis of bud materials with starch gel electrophoresis. For isozyme analysis 9 isozyme gene loci and 24 alleles were investigated. English yew showed high level of genetic variation with a mean number of alleles per locus (A/L) of 2.7, and 78 % of loci were polymorphic. The average expected heterozygosity was (He) 0.299 and mean observed heterozygosity (Ho) 0.270. Considering the high genetic diversity this population represents a valuable gene pool. So, conservation of English yew in forest level may require well-managed reserves and long-term rotations between harvest events, protection from the herbivore and reduction of competition, which will enhance the long-term viability of the species.

Email: amalesh.dhar@boku.ac.at

DIDION, Markus, KUPFERSCHMID A.D. and BUGMANN H. (SWITZERLAND)

Effects of ungulate browsing on forest composition and function

Forest attributes such as species and age class diversity have been incorporated into forest management as indicators for forest health. However, forest management can only to a certain degree control the state of these attributes. Disturbances such as fire, windthrow, and herbivory are difficult to predict in their severity, frequency, and spatial scale, and they can, despite best management practices, have detrimental effects on the state of a forest. For example, browsing by ungulates is known to alter forest species composition and to hamper forest regeneration.

In this presentation, we employ the stand succession model FORCLIM to examine the potential effects of herbivory on the composition and function of mountain forests. By means of a sensitivity analysis, we are investigating a) browsing thresholds at which forest health and function are compromised, b) effects of fluctuating browsing intensities as a proxy for the dynamics of ungulate population density, and c) interactions of browsing with other drivers of forest regeneration such as seed production. The sensitivity analysis revealed that browsing thresholds are site-specific and differ by the examined indicator. For example, the species and diameter class composition as a proxy for the protective function of a forest against avalanches and rockfalls may be disrupted at relatively low browsing levels. Our results indicate that the effect of fluctuating browsing intensities is not linear and that feedbacks between drivers of forest regeneration are cumulative rather than additive. We discuss the implications for forest management and identify further research needs.

Email: markus.didion@env.ethz.ch

DODSON, Erich and PETERSON, David W. (USA)

Dry forest restoration and understory plant diversity: the importance of community heterogeneity and species co-existence

Widespread application of fuel reduction treatments in western coniferous forests has motivated interest in the effects of these treatments on biodiversity, including understory plant species diversity. However, assessments of treatment effects on species richness often focus on fine-scale responses with limited attention paid to community heterogeneity and species dynamics. To assess the effects of thinning and prescribed fire treatments on understory plant biodiversity, we surveyed vegetation on permanent plots before and after treatments on twelve management units in dry Douglas-fir and ponderosa pine forests in the eastern Cascade Mountains. We employed a nested sampling design and additive partitioning of species richness to assess the relative contributions of point species richness (alpha diversity) and community heterogeneity (beta diversity) to unit-level plant species richness, before and after treatments. We also examined treatment effects on species accumulation, colonization and local extirpation rates.

Community heterogeneity was high among management units and among Whittaker plots within treatment units prior to treatment. Individual plots contained, on average, less than 30% of the total species pool. There was no evidence that thinning, prescribed fire, or thinning and prescribed fire together reduced species richness or increased local extirpation of species. In contrast, thinning and prescribed fire together significantly increased species richness at the unit-level, primarily by increasing compositional differences among quadrats and plots within treatment units (beta diversity). The combined treatments also promoted increased species colonization, and increased rates of species accumulation with increasing area sampled.

Our results suggest that restoration treatments present few negative impacts on understory plant biodiversity. Rather, treatments can increase understory community heterogeneity and promote species co-existence by facilitating colonization without increasing local extirpation.

Email: edodson@fs.fed.us

ELLIOTT, Chris (CANADA)

“Muddling Through” in Forest Landscapes: Reducing deforestation and degradation of the world’s forests

Despite significant successes in establishing new forest protected areas over the last three decades, many of the remaining areas of natural forests in temperate, boreal and tropical zones are under intense and competing pressures. Conservationists want to protect these valuable forests, while the agricultural and forest industries are hungry for land, and local communities and indigenous people are gaining control of increasing areas. As the scarcity of natural forests becomes more acute, the effectiveness of existing approaches to their conservation and management is coming under question. I will discuss a number of alternative approaches and discuss their advantages and shortcomings.

Email: celliot@wwfcanada.org

ESTREGUIL, C., MOUTON, C., VOGT, P. (ITALY)

Dynamics of forested landscapes: pattern assessment scheme and results over Europe.

This paper summarizes recent methodological progress and first results on the implementation of two indicators for European policy reporting: (1) ‘landscape-level forest spatial pattern’ from the Ministerial Conference on the Protection of Forests in Europe (MCPFE 4.7) and (2) ‘Fragmentation and Connectivity of ecosystem’ from the EU Headline Biodiversity Indicators (SEBI-2010).

Mathematical morphology (in house software at Joint Research Centre) was first applied on available European forest masks (the 25 m JRC forest mask and the 100m raster Corine Land Cover data) for the years 1990 and 2000. Multi-scale and multitemporal European forest spatial pattern maps were generated with six pattern classes: core forest (i.e. forest area patches minus forest area influenced by forest edge dynamics), and five no core forest classes (i.e. islets, edges, perforation, connectors, and branches). Customized indices based on those maps were then developed to document the dynamics of the forested landscapes. Three spatial pattern processes associated with fragmentation were captured: (1) the loss/gain of core forest units per ranges of unit’s size (sample index), (2) the reduction/gain of core forest area (area weighted core index), and (3) the creation/loss of forested edges at the external border of the core units (external fragmentation index) or resulting from the perforation of core forest units (internal fragmentation index). Change of pattern within stable forested area was also investigated as well as the pattern of the forest area loss and of the forest area gained within the 90-2000 period. The landscape context of forest expansion and of fragmentation processes (created forest-non forest edge interfaces, small forested islets and perforations in the otherwise intact core forest) was further documented using a tri-polar space analysis with artificial, agriculture, natural/semi-natural dominated landscapes in a 50 ha window.

Information on the three forest pattern processes, the landscape context and the pattern of forest loss and gain was aggregated at country and administrative NUTS3 regional level and reported on the basis of European maps and tabular data. Contrasting to the relatively stable national forest area statistics over 10 years, regions with quite significant core forest dynamics were identified (for example, core forest loss due to either temporary fragmentation (clear cuts) or permanent forest conversion). Potential impacts on forest biodiversity were discussed.

Email: christine.estreguil@jrc.it

GANTEAUME, Anne, JAPPIOT, Marielle, BORNIET Laurent, LAMPIN-MAILLET, Corinne, THOMAS, Curt, MARTIN, Willy, ESTÈVE, Roland, and N'DIAYE-BOUBACAR, Aminata (FRANCE)

Fuel ecological description in calcareous Provence (Southern France): effects of wildfire recurrence and of vegetation types

Knowledge about fuel vegetation is a fundamental part of the fire management that is necessary to both conserve biodiversity and reduce the negative impacts of wildland fires. On the framework of the European programme *FireParadox*, live and dead fuels were described in Calcareous Provence (Southern France) to assess if their characteristics were influenced by the past fire regime, influencing in turn the vegetation dynamics.

The sampling was performed on three types of vegetation representative of the ecosystems of Southern France (*Pinus halepensis* stands, pine-oak mixed stands and garrigues) according to four fire modalities (no fire since 1960, 1 to 2 fires old and recent, and 3 or more fires). The ecological description took into account as well individualized trees or shrubs as vegetation patches of a same species or vegetation layers including different species of a same height, underlining so that these various structures are also part of the landscape diversity. Thickness and coverage (%) were the variables recorded on the dead fuel while variables such as the height and coverage of the vegetation were recorded on the live fuel.

Results show that both fire modalities and vegetation types have a significant influence on the thickness and the coverage of the dead fuel.

Concerning the live fuel, the type of vegetation has a significant influence on:

- (i) height of shrubs, vegetation patches and layer
- (ii) coverage of the different vegetation height strata
- (iii) coverage of the trees, shrubs and vegetation patches
- (iv) tree density per hectare

and the fire modalities on:

- (i) height of trees and vegetation layer
- (ii) stratum coverage
- (iii) tree coverage
- (iv) tree volume per hectare

Vegetation types and fire modalities induce variations of these parameters, and so influence the structure of stands. As diverse fire regimes within ecological limits are essential for maintaining biodiversity, this variation of structure may play a part in the diversity at local and landscape scale.

Email: anne.ganteaume@cemagref.fr

GANTEAUME, Anne, JAPPIOT, Marielle, LAMPIN-MAILLET, Corinne, THOMAS, Curt, SCHAFFHAUSER, Alice, BORNIET, Laurent, ESTÈVE, Roland, MARTIN, Willy, and BAUDEL, Jonathan (FRANCE)

Comparison of the disturbed litter flammability collected on calcareous soils and acidic soils in Southern France

Knowledge about fuel vegetation is a fundamental part of the fire management that is necessary to both conserve biodiversity and reduce the negative impacts of wildland fires. On the framework of the European programme *FireParadox*, flammability characteristics of dead fuels were described in Southern France on both acidic and calcareous soils according to fire modalities (no fire since 1960, 1 and more fires old and recent), to assess if they were influenced by the past fire regime, influencing in turn the vegetation dynamics.

Samples of disturbed litters have been collected in representative ecosystems of southern France: (i) on calcareous soils, in high stands of *Pinus halepensis* and of mixed oak-pine, in medium-sized stands of *P. halepensis* and mixed oak-pine with understorey and in garrigue (shrubland); and (ii) on acidic soils, in high *Quercus suber* stands, high maquis and lower maquis. The low and medium-sized stands come from a post-fire succession, the highest biodiversity, in terms of specific richness occurring between 4 and 11 years after the fire.

To assess the flammability of these litters, several series of tests were conducted in laboratory, using a glowing firebrand and a wind speed of 10 km.h⁻¹. The main parameters recorded were time to ignition, flaming duration, flame propagation.

For the low (garrigue and low maquis) and the medium-sized (pure pine or mixed pine-oak stands with understorey and higher maquis) stands where biodiversity is maximum, the comparison between litters collected on calcareous soils and on acidic soils shows no significant difference for all the parameters. For the high mature stands, where biodiversity is the lowest, especially in Pine stands, the comparison between the both sets of litters shows that there is a significant difference only for the time to ignition which is much higher on acidic soils (73s) than on calcareous soils (17s). These results suggest that the *Quercus suber* litter collected on acidic soils is less flammable than the litter collected on calcareous soils.

Email: anne.ganteaume@cemagref.fr

GOSSELIN, Frédéric, BARBIER, Stéphane, CHEVALIER, Richard, LOUSSOT, Philippe, BERGÈS, Laurent and BALANDIER, Philippe (FRANCE)

Is tree species diversity a good indicator of understory vegetation diversity? A case study in some French lowland deciduous forests

Tree species is one of the main attributes of forest ecosystems, that modifies resources levels (light, nutrients, water), and so, indirectly, understory vegetation composition and diversity. Furthermore, forest managers often apprehend biodiversity through the diversity of tree species. This may explain why two biodiversity indicators based on tree species diversity are used, without strong prior scientific validation, in Europe and France respectively: (1) tree species richness as a positive indicator, and (2) relative abundance of the main species ("dominance") as a negative indicator. We developed Bayesian statistical models to test these indicators for the richness of ecological groups of understory vegetation species, classified according to their successional status and/or their shade tolerance. We compared these models with other ones, based on tree species composition and abundance. We worked in 49 stands of adult lowland forests in the center of France (Bassin Parisien), in a controlled site type.

Tree species richness was not a good indicator of understory vegetation species richness, and dominance of the main tree species had either positive or null effects, *i.e.* effects that tend to be in the opposite direction to the one assumed in the indicator system. There were better indicators than tree species richness or dominance, such as the abundance of tree species successional groups (pioneers, oaks, shade tolerant trees). Which indicator provided the best statistical model and the magnitude of the effects however varied among ecological groups of vascular plants. We discuss the meaning and limitation of our results in the light of possible extensions of this approach to bigger data sets.

First, the positive responses of parts of understory diversity to dominance of the main tree species might be idiosyncratic to the identity of the two dominant tree species (oaks and hornbeam) and the associated stand structure. Second, the best model is a multivariate model which is more difficult to communicate to forest managers or policy-makers than an indicator simply based on tree species richness. Lastly, our approach deals only with plant biodiversity; other taxa should also be considered.

Email: frederic.gosselin@cemagref.fr

GOSSELIN, Frédéric, and BGF Program Team (FRANCE)

The French National Research Program on Biodiversity and Forest Management. Towards the coevolution of managers and researchers?

The French National Research Program on Biodiversity and Forest Management (<http://www.gip-ecofofor.org/publi/page.php?id=53&rang=0>) was launched in 1997. It was launched by the French Ministries of the Environment and of Agriculture, and managed by a national institution (the GIP ECOFOR) regrouping forest managers and scientists interested by Forest Ecosystems. The general aim was to create a dynamic mixed community, at the interface between science and management, to promote the development of new knowledge and its diffusion. Three research calls have been organized to date: they varied in emphasis from developing

tools useful to managers through mixed and very applied programs to developing knowledge on the relationship between biodiversity and various ecological processes; lastly, socio-economic approaches have also been promoted. Periodic meetings are organized; they allow strengthening of the interactions between scientific teams as well as the between scientists and managers. The program has also produced a bibliographic synthesis on the subject for French managers (Gosselin & Laroussinie 2004). Finally a reflection on biodiversity indicators in forests is under way. We propose to present some of the achievements (through examples such as Dupouey *et al.* 2002, Jactel *et al.* 2002 as well as the synthesis of the program in 2004, Millier *et al.* 2004) and characteristics of this program on a poster.

Email: frederic.gosselin@cemagref.fr

GUPTA, Sudhanshu (INDIA)

Characterization of Forest Fragmentation

Forest fragmentation and resulting loss of forest cover is growing in India and worldwide. India's landscape enveloped by forest cover can be viewed as a mosaic of forested polygonal fragments of dense and open forest. Forest fragmentation is a process whereby a continuous forest is separated into two or many fragments. In context of present study process whereby bigger patch of forests are likely to be broken down into smaller patches of forest, or forests having tendency to form patches/patchiness resulting in loss of forest cover has been called forest fragmentation. The fragmentation of a forest into small pieces may disrupt ecological processes. It may reduce species potential for dispersal and colonization and may diminish availability of area of habitat. To study forest fragmentation in forest areas through remote sensing, patch/polygon of forest is considered a unit in the present study. In addition to area coverage, Fragmentation index, Fragmentation Edge Complexity Index and Polygon Density are important characteristics for evaluating the processes. Patch in terms of present study is a polygon of contiguous pixels (in remotely sensed data) of minimum mapping units. Forest Survey of India (FSI) is an organization under the Ministry of Environment and Forests, Government of India that interprets and classifies the satellite data for assessment and mapping of forest cover. Based on FSI data, a national index of fragmentation, polygon density, and fragmentation Edge Index Complexity could potentially be used for assessing and predicting fragmentation on the basis of forest cover data of two different cycles. In the present study 10 states of India have been compared at 1:50,000 scale, which were interpreted digitally in 1999 with Forest Cover Data of 2001. The methodology includes utilizing the digital data, converting into polygons of dense and open forests assessing the total forest cover in 1999 and comparing with the polygons of dense and open forests with digital data of 2001 to characterize Forest Fragmentation of different States of India on the basis of Mean Patch Size, Patch Density, and Fragmentation Edge Complexity Index.

Email: sudhanshu64@rediffmail.com

GUPTA, Sudhanshu (INDIA)

Determination of Climate Change-associated Vulnerability of Plant Biodiversity

Depletion of species on account of climate change and other related factors is bringing many species to the threshold of extinction. There is practically complete absence on any protocol for determining of threshold limit of wild plants below which they become critical or vulnerable. The study determines Rapid Vulnerability Index (RVI), a limit below which loss of species because of various adverse factors becomes critical at a given site. The innovative technique utilizes General Algebraic Modeling System (GAMS) to mathematically determine optimum limit, in an adaptable, accurate, speedy, economic and scientific manner in a case study relating to reserved forests of Dehradun, India.

Email: sudhanshu64@rediffmail.com

HAWKINS, Chris, LANGE, Jennifer and BAKER, Cindy (CANADA)

Impact of glyphosate herbicide treatment on species diversity, tree growth, and forest health in a sub-boreal, spruce stand in central BC

In central British Columbia, forest management practices have altered natural stand development pathways by eliminating non-commercial tree species and competing vegetation with the objective of maximizing crop tree growth: potentially decreasing stand diversity. Our recent work suggests the approach does not always enhance tree growth. The study site had about 24 ha treated with glyphosate in 1996 (8 years old) to remove birch (*Betula papyrifera* Marsh.) and 65 ha were not treated. Interior spruce (*Picea glauca* (Moench) Voss X *P. engelmannii* Parry ex Engelm.) densities were 975 and 1095 sph in the herbicide - treated and untreated areas respectively. The untreated area had 4325 sph of birch while the treated area has 375 sph. White pine weevil (WPW: *Pissodes strobi* Peck) attack was significantly reduced in the untreated area. There was no difference between spruce dbh and mean stem volume by treatment.

Understory vegetation was surveyed in 2002, 2003, 2004, and 2006. Species richness and the Shannon diversity index (alpha diversity) were similar between treatments. Beta diversity (Sorensen quantitative index (CN): also called the Bray - Curtis index) was relatively low indicating little change in diversity between the treatment areas over time. There were a total of 92 species in 2006. Understory vegetation in the herbicide treatment, while not significantly different in diversity from the untreated area, did vary in species composition: greater occurrence and abundance of weedy and pioneer species. Overall, herbicide treatment did not affect species diversity but it removed a significant amount of birch though not all. Reduced stand structural diversity exacerbated WPW attack on spruce and resulted in reduced spruce height growth.

Our findings suggest a move away from broadcast vegetation control to spot control. Where warranted, this could result in better tree growth, improved forest health and reduced impact on other stand attributes, particularly diversity.

Email: hawkinsc@unbc.ca

HAZANDY, Abdul-Hamid, MOHD-ZAKI, Hamzah, AZITA Ahmad-Zawawi, and MOHD-KHAIRIL-SAUFI, Zulkeppli (MALAYSIA)

Impacts of Trampling and Camping on Mount Tahan Vegetation

This study examines the impacts of recreation activities on Mount Tahan (2187 m a.s.l.); the highest mountain in Peninsular Malaysia by assessing tree diameter, height, leaf area, sapwood area, chlorophyll fluorescence (CF) and anatomical structure of selected species. Vegetation cover was also determined by counting the number of species. Two most dominant tree species in the study plots, i.e., *Vaccinium* sp. and *Leptospermum flavescens*, were selected as representative to assess the impacts on the vegetation growth. Both tree species dominated over 50% of total vegetation in both areas. Meanwhile, CF was determined on *Vaccinium* sp. since this species was only broadleaf tree species found in both areas. Four plots sized 20 m X 20 m representing each disturbed and undisturbed were established in camping and trampling areas. The total number of plant species recorded was 31 in both camping and trampling areas but was found less in disturbed plots. Impacts of trampling and camping on all the parameters at higher altitude in disturbed plots were significantly differed from those in the undisturbed plots. For trampling, all growth parameters taken in disturbed plots were found lower than in undisturbed plots. For camping, however, the mean values of vegetation cover was found lower in disturbed plots compared to undisturbed plots but the mean values of tree diameter, height, leaf area and sapwood area were found greater in disturbed than in undisturbed plots. In contrast, all CF parameters were found higher in disturbed plots for both trampling and camping. Furthermore, the diameter of each xylem conduits of *Leptospermum flavescens* in undisturbed plots was found greater, well arranged but less in number compared to disturbed area for both camping and trampling areas.

Email: hazandy@gmail.com

Direction and speed of natural beech forest dynamics: A matter of scale?

For a long time, management has been the most important factor driving forest dynamics in European beech forests (*Fagus sylvatica*). Since the mid-19th century, many landowners stopped managing their forests due to financial constraints, and as a consequence natural processes have become more important for forest succession. However, long-term empirical data on the natural dynamics of beech forests are rare, and little is known about the direction and speed of forest development after management ceased. As public awareness of forestry and its importance for wood production, biodiversity and nature conservation has increased in the last decade, a profound understanding of natural forest dynamics is required.

In this study, we use a unique long-term data set covering almost 40 years of forest inventories from six forest reserves in the Swiss lowlands, which have not been managed for at least 60 years. The recurrent inventories in each reserve were done at three spatial scales: permanent plots (0.1-0.7 ha), compartments (0.7 - 4 ha) and the forest reserve area (2 - 13 ha). We investigate the patterns and differences of forest dynamics on these scales, and we evaluate how they influence the interpretation of forest structure and dynamics. Ultimately, we aim to determine the appropriate scale for forest dynamics research in temperate beech forests.

We demonstrate that in the absence of disturbances the six reserves show an increasing dominance of shade-tolerant tree species, particularly beech, and a loss in tree species diversity (mainly loss of light-demanding tree species). On the smallest scale, however, structure and composition can differ strongly from those of the entire forest reserve.

We conclude that the appropriate scale for forest dynamic research depends on the questions asked. For biodiversity assessments and overall trends in forest development, full cruises of several hectares are most valuable as they capture most of the rare species. At this scale, we can study the general patterns of forest dynamics. However, if we want to study processes such as successional replacement, gap-diversity or regeneration issues, a larger number of smaller plots (e.g. less than one hectare) with individually marked trees is more appropriate.

Email: heiri@env.ethz.ch

Managing dead wood to conserve biodiversity in plantation forests

Deadwood is a major component of forest biodiversity providing habitat for a large proportion of forest species. However little is known about patterns of deadwood accumulation and associated saproxylic species diversity in plantations at a time when these forests contribute to more than 30 % of wood production worldwide. We sampled downed woody debris, stumps and snags in 145 maritime pine plantations, from 10 to 60 years old, in south-western France. In a sub-set of 41 pine stands, two interception traps per stand were activated to sample saproxylic beetles continuously from spring to autumn. Deadwood abundance had typical occurrence pattern in maritime pine plantations, with an average volume of 15 m³/ha, mainly composed of downed woody debris of small diameter. It predominantly originated from thinning operations. The accumulation curve along the forestry cycle showed a convex shape with a peak in stands of ca. 30 years old, after the third thinning. A total of 240 saproxylic beetle species was collected with a mean of 35 species per stand. At the stand level, beetle species richness was significantly correlated with the volume per ha of deadwood from anthropogenic activity. An empirical growth model evaluating the volume of deadwood produced by successive thinnings was combined with a logistic decay function that estimated the loss of deadwood with time to successfully predict the dynamics of deadwood from anthropogenic origin. It provides a promising tool to test the impact of alternative silvicultural practices on saproxylic beetles diversity in plantation forests.

Email: herve.jactel@pierroton.inra.fr

JOLIVET, Celine and DEGEN, Bernd (GERMANY)

Pilot-study on genetic monitoring in populations of wild cherry trees (*Prunus avium*)

Conservation of genetic resources is an important issue in managed forests. Adaptability of trees to environmental factors such as climate change or to outbreaks of pests and diseases depends on genetic variation. Thus, preventing erosion of genetic diversity is crucial for the maintenance of forests. According to new guidelines on genetic monitoring of forest trees (<http://www.genres.de/fgrdeu/genetisches-monitoring/en/index.htm>) we conducted a pilot study on the genetic diversity and demo-genetic processes in five populations of wild cherry in Germany. Genetic inventories were done at DNA-markers in three ontogenetic stages (adults, seedlings, seeds) for each population. Further the spatial position, diameter, natural social class and flowering phenology have been measured for the reproductive trees and the quality of seeds has been tested.

Our results show significant differences for the level of diversity, genetic differentiation and spatial genetic structure. We got estimates of pollen and seed dispersal as well as on proportion and spatial extension of vegetative regeneration for each stand. We integrated the genotypes of the adult populations and the estimates of population genetic processes into the simulation model Eco-Gene. The simulations predicted the dynamics of genetic structures and helped to define thresholds for critical changes in the genetic composition of the cherry populations. The results of the genetic monitoring assist to observe critical changes due to forest practise and climate change and thus provide important information for gene conservation and sustainable forest management.

Email: celine.jolivet@vti.bund.de

KLENNER, Walt, and WALTON, Russ (CANADA)

Landscape-level habitat supply modeling to develop and evaluate management practices that maintain diverse forest values

We used the TELSA (Tool for Exploratory Landscape Scenario Analyses) landscape projection model to examine the long-term consequences of applying different stand density and fuel management regimes on indicators of wildlife habitat and biodiversity, forage productivity, crown fuel hazard, understory fuel hazard, treatment costs and timber yield. The TELSA model was calibrated with information from TASS (Tree and Stand Simulator) model projections, field data collected at nearby research sites and from published literature. We used a case study landscape of approximately 100,000 ha near Kamloops, BC that was dominated by dry-belt forest types to illustrate the consequences of stand density and forest fuels treatment options on maintaining biodiversity and other values in relation to different management scenarios and assumptions about natural disturbance (wildfire and insect attack). Simulations were run for 100 years.

Our work illustrates two key principles: (1) one stand management treatment does not adequately create the diversity of conditions required to maintain biodiversity or the multiple values expected from forests, and (2) natural disturbances strongly affect forest conditions and need to be considered in strategic planning to ensure wildlife habitat and commodity expectations are realistic. We conclude that landscape modelling can and should be used to assess the consequences of current or new management initiatives prior to their application to ensure expectations are realistic.

Email: walt.klenner@gov.bc.ca

KWON, Jino, CHO, Hyun-je, OH, Jeong-Hak, CHO, Jae-Hyoung, CHOI, Myong-Sub and KIM, Young-Kul (SOUTH KOREA)

Vegetation Landscape Characteristics and Biotope Diversity on the Isolated Urban Forests in the Six Korean Metropolitan Cities

Urban forests in South Korea became isolated islands on urbanized matrices as the result of simultaneous urbanization. Most of them can be characterized as remnant forests which are survived from urbanization because the forests are locating on mountains. To have better urban forests in future we are

focusing on what are the vegetation landscape characteristics of the isolated forests in six metropolitan cities; Busan, Daegu, Daejeon, Incheon, Gwangju and Ulsan. Furthermore, to understand the value of urban forest in Korean peninsula, we also assessed the urban forests as biotope in cities. Six cities are characterized 5 groups in geographical position; southern coastal city, southeastern coastal city, two southern inland cities on both eastern and western side, central inland city and one city on the middle western coastal area. Fifteen urban forests (two sites from each city except Daegu-5 sites) are divided into two groups by size; small (5.8ha-46ha) and large (101.3ha-1,447ha). Between 2003 and 2007, the classification of biotope types and evaluation for functions of forest structure were carried out and produced two types of cell maps with raster data. The process to classify and evaluate the biotope type and the functions of forests are modified from Grabherr (1997) and Sukopp (1993). Numbers of biotope types classified according to the sub-community are approximately 15 communities up to 20 communities depending on the size of urban forests. Most of forests except one site in Daejeon show that larger forests have not only more sub-communities and species in diversity but also have a larger individual sub-community in size. Majority of biotope grades were dominating by lower rank grades which means no-good for the biotic community such as wildlife. These results mean that most of urban forests in the 6 major cities are forests disturbed by men or still in the shape of plantation forests which were planted during last century. Dominating species as sub-communities are *Quercus acutissima*, *Q. mongolica*, *Q. serrata*, *Robinia pseudo-acacia*, *Pinus densiflora* and *P. rigida*. It seems that the urgent issue in these urban forests is the mean size of the sub-community (approx. 1ha), which has less consecutiveness of functional role as forest ecosystem component.

Email: alp96jk@forest.go.kr

LAARMANN, Diana and KORJUS, Henn (ESTONIA)

Biodiversity assessment through individual tree mortality analysis on permanent sample plot data in Estonia

Assessment of biodiversity and forest naturalness is important for forest management and conservation decisions. This is a complicated matter for forest inventories and therefore usually skipped or extremely simplified methods are used. New methods evaluating ecosystem's structural properties and mortality enable quicker biodiversity assessment for forest inventories. Individual tree death is a process that guarantees vitality and dynamics of a forest ecosystem. Several ecological processes are dependent on this: tree population and structural alterations; biomass shifting to necromass; resources of light, nutrients, moisture released; new resources created for other organisms in ecosystem. Tree death is generally the result of complex interactions among multiple factors. Assessment of individual tree mortality – rate and spectrum of reasons- enables to evaluate naturalness and succession stage of a forest ecosystem.

The study is based on the measurements of forest growth permanent sample plots in Estonia in 2006-2007. The data comprised 294 sample plots with 43848 individual trees. From measured trees 42% were Scots pine (*Pinus sylvestris* L.), 25% Norway spruce [*Picea abies* (L.) Karst.] and other were from hardwood species. 2482 trees became dead on the sample plots during the period 2001 - 2007, counting 28% of pine, 27% of birch and 20% of spruce. Natural value of a stand on permanent sample plots was assessed using quantitative and qualitative scoring method. Preliminary results show that forest naturalness is not connected with amount of dead trees. 40% of forest stand naturalness was described with variation and qualitative properties of dead trees (how and why trees died).

Email: diana.laarmann@emu.ee

LARA ALMUEDO, Pedro, MORENO, R., QUERO FERNANDEZ DE MOLINA, J.M., ARENAS GONZALEZ, R., MARTIN DE ALMAGRO, R., SANTANA, M., and MUÑOZ, A. (SPAIN)

Management of Mediterranean forests for biodiversity conservation: A multifunctional project in Sierra de Cardeña y Montoro Natural Park (Spain)

The Sierra Morena mountain range extends 400 km east-west along the northern shore of Guadalquivir river basin in Andalusia (southern Spain). For millennia, the rich biodiversity and forest resources of this

mountain range have been a source of livelihood for the different civilizations settled within its domain. Sierra de Cardena y Montoro Natural Park, a 38,499 ha protected area embedded in the heart of Sierra Morena, is mainly encompassed by Mediterranean forests where the presence of oaks in combination with extensive rangelands conforms a unique multifunctional human-made ecosystem known as *dehesa*. Together with the dehesas, Mediterranean thick forests, encompassed by a rich variety of tree and shrub species, and reforested pine stands, complete this landscape in which several emblematic endangered species find their preferred habitat.

In this context, an innovative silviculture project launched by the Andalusia Ministry of Environment in 2007 combines several vegetation treatments on pine stands and management of rabbit habitat and populations with a multifunctional purpose:

1. Creation of optimal habitat for rabbits (*Oryctolagus cuniculus*) in order to support the endangered species populations present in the area, highly dependent on this prey species, such as the Iberian lynx (*Lynx pardinus*) and the Iberian imperial eagle (*Aquila adalberti*).
2. Clearing of pine stands (40-50 year old plantations of *Pinus pinaster* and *P. pinea*) to promote natural Mediterranean oak understory regeneration (*Quercus ilex*, *Q. suber* and *Q. faginea*), as well as shrub and pasture recovery in an ecological corridor-based design.
3. Implementation of strategic forest fuel breaks to prevent wildfires in a highly sensitive protected area.

Preliminary results show a stable increment in the established rabbit populations of the area, an increase in its preferred habitat area, a positive response of natural Mediterranean oak, shrub and pasture understory regeneration, and the promising expansion of current Iberian lynx and Iberian imperial eagle territories.

Email: pedro.laraalmuedo@utoronto.ca

LARSSON, Tor-Bjorn, BARBATI, A., BASTRUP-BIRK, A., BOBIEC, A., VAN BRUSSELEN, J., CORONA, P., ESTREGUIL, C., FISCHER, R., MARCHETTI, M., PETRICCIONE, B., & SAN MIGUEL, J. (Denmark)

The long-term biodiversity data collection related to European forests

Demands on forests will become stronger and spatially more diversified. Decision-makers and stakeholders must be provided with the necessary information on forests and forest biological diversity to be able to balance production of wood and other traditional non-wood resources vis-a-vis biodiversity and other kinds of forest ecosystem services.

An important element in support of forest management is forest data provided through monitoring networks. There are currently a number of official monitoring initiatives in Europe such as the Global Monitoring for Environment and Security (GMES) - a joint initiative of the European Union (EU) Commission and the European Space Agency (expected fully operational after 2011), National Forest Inventories that assess forest resources predominantly by field surveys, the EC/ICP Forest monitoring scheme assessing air pollution effects on forests. An important research activity is the global Long Term Ecological Research Network (LTER) and its European counterpart.

Under the EU Forest Focus Regulation 2003-2006 a number of pilot initiatives have been launched, most predominately ForestBIOTA, aimed at monitoring selected key factors of biodiversity over 96 plots followed by the BioSoil demonstration project, a large scale survey of components of forest biodiversity on over 4000 plots. Important collection of direct (i.e. species) information on forest biological diversity is carried out by the IUCN and other NGOs, e.g. Birdlife International, which is behind the Pan-European Common Bird Monitoring which offers a pan-European indicator on common bird populations, and also collects data to identify biologically valuable forests in Europe.

In Europe the Ministerial Conference on the Protection of Forests in Europe provides a framework for forest reporting. Biodiversity policy is guided by the Convention on Biological Diversity, which has established an indicator framework for the 2010 biodiversity target. This is on a pan-European level addressed by the SEBI2010 project, which has identified a number of indicators requesting information on forest biodiversity. Within the EU a forest biodiversity monitoring demonstration project have been proposed to be funded under the EU Life+ Regulation and furthermore reporting requested by the EU Habitats Directive requires a systematic collection of forest biodiversity data.

New and better information, in particular on biological diversity composition (species, communities), is needed. A European-level analysis must be based on a comprehensive forest typology. A European Forest Type scheme has recently been developed to enable more ecologically relevant decision making. Existing knowledge should be made accessible through efficient information systems. The EU Data centres for biological diversity (to be hosted by the European Environment Agency) and for forests (to be hosted by the European Commission's Joint Research Centre) will considerably improve data accessibility and data exchange at both the national and European levels.

Email: tor-bjorn.larsson@eea.europa.eu

LEDO, Alicia (SPAIN)

Response to disturbances in a montane cloud forest: decrease in biodiversity and change in functional characteristics

Tropical montane cloud forests constitute a rare and fragile ecosystem, which is threatened in many of the areas in which it is found due to the pressure of human-originated disturbances. Cloud forests have been identified as a forest type with high levels of species endemism and biodiversity. They also play a basic role in the hydrological cycle and maintain the natural flow patterns of the streams which originate in them. A reduction in the forested area may lead to a loss of biodiversity and changes in the hydrological regime. The aim of this study is to assess the changes in species composition and to identify the factors involved in the loss of diversity.

This study was conducted in a patch of montane cloud forest located in the Piura region of the Peruvian Andes. Random samples were established throughout the forest area in order to study the composition and diversity of species. A second moment measure of the tree diameter was defined to analyse the relationship between the diameter distributions of the highest and the lowest water demanding species in each sample. This function described the dynamics of these species and was able to detect regions where there was a change in the composition of the species. An index consisting of the differences in species richness between young and old tree strata was also calculated in each sample to determine the zones in which species diversity had decreased. Geostatistical analysis was used to relate the rate of diversity loss to environmental factors and to the proximity of the forest limits to defined zones where the forest had suffered detrimental processes. A change towards species adapted to dryer conditions was observed in the major part of the forest as well as a loss of diversity caused by small disturbances, and consequently a change in the functions of the ecosystem. These results point to the existence of a minimum surface area necessary for the maintenance of the ecosystem.

Email: a.ledo@upm.es

LEHTOMÄKI, Joonas, PÄIVINEN, Jussi, TOMPPONEN, Erkki, HANSKI, Ilkka, and MOILANEN, Atte (FINLAND)

Setting conservation priorities for state-owned forest reserves in Finland

Forests cover 76% of Finland's land area and out of more productive forest land 4.5% is currently strictly protected. Several ecological studies have concluded that reserve network is insufficient to prevent further forest biodiversity loss. Here we present a novel way of assessing Finnish state-owned forest reserve network and detecting extension and restoration potential. The Finnish reserve network comprises of national parks, strict nature reserves and wilderness reserves covering approximately 10% of land area. However, the distribution of protected forest land is very unevenly distributed as most of it is situated in Northern Finland. In Southern Finland where forest biodiversity is also greater and land is mostly privately owned, only 1.5% of the productive forest land is protected. Reserves demand active conservation management and restoration actions that ideally should be extended to commercial forest matrix surrounding them in order to increase reserve network connectivity. In this study we used the Zonation conservation planning software to rank the Finnish forest reserves according to their conservation value.

Data used in the study come from high resolution (100m x 100m) nature type inventory database covering all the state-owned forest reserves and include information on for example different nature type characteristics, age of forest stands and the amount of dead wood. An estimate for the quality of forest matrix

between reserves was created using high resolution multisource National Forest Inventory data. The data were used to produce a hierarchical ranking solution for the whole country so that ecologically most important areas in terms of connectivity and local habitat quality were identified both inside the reserve network as well as inside individual reserves. Results can be used to study supplementation of reserve network or to design management or restoration schemes inside reserves and in larger context our aim is to provide a new conservation planning tool for forest conservation on different scales.

Email: joona.lehtomaki@helsinki.fi

LEWIS, Doug, KLENNER, Walt and WALTON, Russ (CANADA)

Mountain Pine Beetle and Salvage Logging: Rapid Landscape Change and Implications to Biodiversity Conservation

The legacy of the Mountain Pine Beetle (MPB) epidemic in British Columbia will be an unprecedented rate of landscape change that presents significant challenges to conserve biodiversity. In the last 10 years, the epidemic has affected over 10 million hectares and is estimated to kill over 80% of mature pine forests in the province by the end of the epidemic in 2015. The subsequent salvage logging of MPB-infested forests may also be one of the largest efforts to recover economic losses following a natural disturbance in recorded history. Individually, the current MPB epidemic likely represents an extreme in historic (natural) range of disturbance severity and magnitude. Salvage logging is an additional perturbation within the normal recovery time following this already extreme natural disturbance event, thus the combined effects of the current MPB epidemic, forest harvesting and various resource impacts (i.e. hunting, trapping, clearing of private land) may represent a particularly significant risk to biodiversity. We present results from three landscapes in Southern Interior British Columbia illustrating the rapid rate of change in landscape composition and structure due to mountain pine beetle and salvage logging. We contend that such rapid change over an extensive area poses a risk to conserving biodiversity on the landscape over time due to: 1) elevated short-term risk due to increased loss of ecological processes and functions in salvaged stands compared to beetle-killed forests, 2) increased long-term risk due to the potential for additional losses through subsequent natural disturbances or logging, and 3) increased vulnerability from human pressures previously managed through forestry activities. Non-salvaged reserves (parks and old growth management areas) and retention of MPB-killed stands in the managed forest matrix and forest structure in harvested openings will be essential to offset the risk.

Email: Doug.W.Lewis@gov.bc.ca

LEWIS, Doug, ST. PIERRE, Christian, and MCCRONE, Alistair (CANADA)

Trends in Salvage Logging Practices in Mountain Pine Beetle Affected Landscapes: Implications to Biodiversity Conservation

The current Mountain Pine Beetle (MPB) outbreak is unprecedented in size affecting over 10 million hectares of mature pine forest in British Columbia. The outbreak has led to accelerated salvage harvesting on the landbase in an attempt to recover timber affected by the MPB epidemic. While British Columbia's Forest and Range Practices Act (FRPA) states clear objectives to maintain biodiversity, during salvage logging of MPB infested stands there are few legal provisions to maintain structural legacies in logged openings or regulate the size of logged areas and adjacency to existing cutover areas. Improper planning of mature forest retention under these circumstances could result in adjacent blocks joining to create large aggregate cutover areas with a paucity of post-disturbance structure. These conditions are inconsistent with structural conditions following natural disturbance alone and could pose a threat to conserve biodiversity on the landscape over time. We monitored trends in the number, size and total area of aggregate openings and internal forest retention associated with recent MPB salvage logging within three landscapes in southern British Columbia. We used forest cover information and satellite ortho-imagery to identify openings and forested retention at discrete time periods prior to and during extensive salvage logging of MPB affected forests.

Trends in landscape logging patterns have shifted from small (< 40 hectares) dispersed logged openings in a mature forest matrix to a greater diversity of opening sizes and a rapid increase in the amount of early seral forest. Most openings under 250 hectares have few internal retention patches (< 5 on average) and they are generally small (< 1 hectare and 1-5 hectares) in size. As opening sizes increase in size (250-100 hectares and > 1000 hectares), the number of internal forest retention patches increases, but the size of retention patches are still generally small with the majority (> 80%) under 5 hectares in size. An increase in the amount and size distribution of early seral forest patches may be consistent with the natural disturbance regime, however, lack of residual forest structure in cutover areas is not. These conditions present an increased risk to conserving forest biodiversity if we rely on these cuts as future habitat as adjacent mature forest are lost to natural disturbance or forest harvesting.

Email: Doug.W.Lewis@gov.bc.ca

MC AFEE, Brenda and MALOUIN, Christian (CANADA)

Implementing ecosystem-based approaches to management in Canada's forests

The Director General's™ Science–Policy (S-P) Dialogues were established in 2004 to foster exchange of information and experiences as a preliminary step to integration of science and policy through shared dialogue. In May 2007, a S-P Dialogue jointly organized by Environment Canada and Natural Resources Canada brought experts, practitioners and policy makers from provinces and territories, federal government departments and non-governmental organizations to share lessons learned from their experiences with ecosystem-based management approaches and identified solutions for common challenges. An analysis of the presentations and discussions at this workshop and from compiled case studies indicate the following:

- Integrated ecosystem-based approaches to sustainable land and resource management have gained broad acceptance at multiple levels of application in Canada;
- The forest sector has been a driving force in the development of ecosystem-based management and a pioneer in its implementation;
- Examples of systems approaches to managing human activities in forests occur in all jurisdictions;
- Provincial forest management plans serve as mechanisms for integrating planning of multiple forest uses;
- Certification standards, model forests and criteria and indicators are tools to facilitate implementation.

Email: bmcafee@nrca.gc.ca

MCLEAN, John and JONES, Diane C. (CANADA)

Beetle diversity in forest and pastoral areas, Whangamata, Coromandel Peninsula, New Zealand

Malaise traps were set out for four weeks in December 1997 to compare the beetle populations in kanuka bush, fern bush, a 25 year old mature radiata pine stand, a 6 year old radiata pine plantation, nearby hayfields, grassed foreshore areas and on coastal sand dune sites. The greatest number of beetle species was collected in the mature radiata pine stand which had a well developed understorey of shade tolerant native shrub species. The beetle faunas at other forested locations had higher degrees of endemism. Habitats maintained by the constant human activity had more adventive species. The most common species in the grassland habitats were the Lucerne weevil *Sitona discoideus* and the predatory click beetle *Conoderus exsul*, both adventive species. The more numerous species in the forested habitats included the bark mould beetle *Salpingus bilunatus*, the elaterid *Panspoeus guttatus* and the fungus weevil *Liromus pardalis*, all native species.

Email: john.mclean@ubc.ca

OATEN, Dustin (CANADA)

Cavity-nesting bird communities within the dry interior forests of British Columbia, Canada: The role of aspen in contributing to biodiversity

The forests of the dry interior of British Columbia, Canada, support a diverse array of cavity-nesting birds. These forests are dominated by conifers, particularly Douglas-fir (*Pseudotsuga mensiezii*), with only a minor component of trembling aspen (*Populus tremuloides*). Because of the rarity of this deciduous component, and with the fact that cavity-nesting birds have been shown to display an affinity towards aspen, we initiated a 2-year study (2005, 2006) on the cavity-nesting bird assemblages within these forest stands. Point-count sampling showed a greater abundance and diversity of cavity-nesting birds within pure aspen stands, as compared to pure stands of Douglas-fir or stands containing a mixture of both tree species. Although only 1 of the 12 cavity-nesting species surveyed (Three-toed Woodpecker, *Picoides tridactylus*) was not detected in all three habitat types, all of the species showed greater abundance within the aspen stands. Further, species richness and several indices of community diversity (Shannon's, Simpson's, and MacArthur's) consistently were higher within the aspen stands. The abundance of five of six species of weak cavity excavating species was correlated with the abundance of primary cavity excavating species. Snag (dead tree) densities were strongly correlated with the abundance of both the primary and weak cavity-nesting species. All told, our results revealed the importance of the relatively scarce aspen stands in maintaining the overall community of cavity-nesting birds within these dry forests.

Email: doaten@forsite.ca

OLSON, Deanna (USA)

The role of riparian buffers and thinning in linkage areas to retain forest biodiversity

Stream riparian protection plus thinning practices in forests provide important ecosystem services including biodiversity conservation. Riparian buffers are the most common mitigation for aquatic species of concern along streams in managed forests, yet there are benefits of retained riparian areas for upland biota as well. Thinning prescriptions also provide benefits for forest-dependent species and their habitats that are adversely affected by regeneration harvests. In combination, thinning with riparian buffers is a recipe for biodiversity protection in managed forest landscapes, and should be considered for key linkage areas during forest planning to reduce the effects of habitat disturbance and fragmentation on forest-dependent species. Placement of linkage areas are particularly needed in headwater drainages, to allow for connectivity across ridgelines adjoining watersheds. Studies of forest management and biodiversity in American northwest forests support the efficacy of this approach. In particular, our large-scale study of the effects of alternative riparian buffer widths, 6 to 145 m on each side of headwater streams, with upslope forest thinning (from ~560 trees per hectare [tph] to 240 tph) in managed stands in western Oregon, USA, is revealing that aquatic vertebrate biodiversity and key habitat attributes with which they are associated are maintained. While some adverse effects on the abundances of species such as terrestrial salamanders have been detected, risk to their persistence at sites appears low. Phase Two of our research is investigating the effects of second-entry thinning harvests, taking stand densities to as low as 74 trees per hectare, with no-entry stream buffers ranging 6 to 70 m wide, and case studies of stream reaches with no buffers within riparian forest stands thinned to 148 tph. Lastly, to illustrate the spatial and functional significance of tying aquatic connectivity measures to over-land linkage areas, we use Geographic Information Systems to design forested landscapes with differing configurations of stream buffers for aquatic habitat conservation, considering both aquatic species distributions and debris-flow disturbances, and managed headwater reserves for terrestrial species habitat and dispersal.

Email: dedeolson@fs.fed.us

TEK (Traditional Ecological Knowledge) and Biodiversity Conservation: Strengthening Community-Based Approaches (CBA) to conservation and building equitable partnerships in practice with indigenous peoples

The use of traditional ecological knowledge (TEK) to preserve and conserve bio-cultural diversity builds-on community-based approaches (CBA) to biodiversity conservation and equitable partnerships in practice with indigenous people. Traditional communities often have diverse rules governing CBA to biodiversity, which serves a dual purpose; meeting the intrinsic desires of indigenous populations to preserve and conserve bio-cultural diversity and the intellectual property, while sustaining ecological public goods and services (Becker, and Ghimire, 2003). Between 2002-2004, the author (as lead-researcher) was funded by IDRC/SSHRC to undertake a detailed ethnographic research project on twenty case-study farms and communities in the Talamanca Indigenous Reserve of south-eastern Costa Rica. Results demonstrated that synergies existed between TEK of the BriBri and Cabecar ethnic groups and CBA to biodiversity conservation. Equitable research partnerships were built by advocating Prior Informed Consent (PIC), common property rights, rights to self-determination, and rights to control TEK and preserve of bio-cultural diversity. Social-ecological resilience was a key evolutionary characteristic of these two indigenous groups, coinciding with linguistic and kinship relations. The BriBri and Cabecar preserve and conserve bio-cultural diversity based on their abilities to maintain traditional roles and responsibilities, and successfully build equitable research relationships with community leaders and decision makers. Loss of TEK however, is due to declining roles and responsibilities of elders, acculturation of valley populations, pressure of external market influences and socio-economic drivers, which reduce their adaptive capacity. Indigenous agroforestry practices have persevered, continuing to shape the biodiversity of their farming systems through decisions affecting biological, social-processes and land-use, by making effective use of all available TEK. Lessons-learned from this research could be applied to extension and research-related scenarios with First Nations groups in Northern B.C. FORREX (Forest Research Extension Partnership) as well, build on equitable partnerships in community-based approaches (CBA) to biodiversity conservation.

Email: dan.orcherton@forrex.org

OXBROUGH, Anne, KELLY, Thomas C., IRWIN, Sandra, and O'HALLORAN, John (IRELAND)

Biodiversity indicators of ground-dwelling spiders in Irish plantation forests and native woodlands

Irish forest cover was reduced to less than one percent by the early 1900s, and since then the amount of forested land has risen steadily, with approximately 10% of the total land area forested today. Just 10% of this forested land is accounted for by native woodlands, while the majority is comprised of plantation forests predominately made up of non-native conifers. The Irish government ultimately aims to achieve a national forest cover of 17% and with such large-scale afforestation planned it is necessary to assess both the impact of such large areas of plantations on the native flora and fauna and also the potential of plantations to provide a refuge for forest-associated biota. Biodiversity research in Ireland's plantation forests is a relatively new field and native woodland research has focused on floristic differences between stands while largely ignoring forest fauna.

This study was undertaken at 25 sites with a wide geographical spread across Ireland in the following forest types: 5 first and 5 second rotation commercially mature Sitka spruce (*Picea sitchensis*) plantations; 5 commercially mature Ash plantations (*Fraxinus excelsior*); 5 Oak (*Quercus petraea* and *Q. robur*) and 5 Ash (*F. excelsior*) dominated native woodlands. Pitfall traps were used to sample the ground-dwelling spider fauna using three plots of 5 traps per site. At each plot plant species diversity, plant structural diversity, canopy cover, soil pH and organic content and litter and deadwood cover were recorded. Spiders were identified to species level and assigned habitat associations as follows: woodland specialists, open-habitat specialists, or generalists. Spider assemblages were assessed among the different forest types and Generalised Linear Modelling was used to identify potential biodiversity indicators and make management recommendations.

Existing sustainable forest management plans frequently overlook smaller, less charismatic organisms such as spiders, which are difficult to capture and identify. Identification of links between their biodiversity and the structural and compositional characteristics of the forest ecosystem, which can be readily identified by non-specialists, will facilitate their incorporation into forest management plans.

Email: a.oxbrough@ucc.ie

PARK, Chan Ryul, SEOL, A Ra, CHUNG, Joo Sang, MI KIM, Eun, KANG, Chang Wan, and LEE, Sung Gie (KOREA)

The Difference of Nest Web of Cavity Nesters between *Cryptomeria japonica* stands and deciduous forests in Jeju Island, Korea

We studied the difference of nest web of cavity nesters at two stands (*Cryptomeria japonica* stands, CJ; Deciduous forests, DF) of the Hannam experimental forest in Jeju islands. We surveyed three plots in size of 50 x 50m at each stand for two years. White-backed woodpeckers (WBW, *Dendrocopos leucotos*) were only primary cavity nesters at two stands. (*Cryptomeria japonica* stands, CJ; Deciduous forests, DF). WBW made high numbers of holes (nests and fake nests) on live trees and snags at CJ stands, and they made nests at sapwood parts of CJ stands. At DF stands, they made nests at heartwood parts of trees such as *Styrax japonica*, *Lindera erythrocarpa* and *Ilex pedunculata*. We found that secondary cavity user such as Great Tits, Varied Tits and tricolor flycatcher at CJ stands, but detected the secondary nests of Varied Tits at DF stands. WBW made high numbers of holes at CJ stands, however the ratio of effective nest was not so different between two stands. Secondary cavity nesters utilized the fake nests as a nest with putting the nesting materials. It seems that it takes no more than one year for WBW to make a nest at CJ stands. The difference of nest use would be related with the difference of rottenness of hardwood between CJ and DF stands. We suggest that different pattern of nest use can be a factor for maintaining the diverse secondary cavity nesters at CJ stands. We discussed the decay process and nest use by White-backed woodpecker at two stands.

Email: chandrap@chol.com

PAWSON, S.M., MCCARTHY, J., LEDGARD, N.J. and DIDHAM, R.K. (NEW ZEALAND)

Invertebrate community response to afforestation of native grassland communities

Significant areas of the New Zealand high country were planted with exotic trees. The motivation for afforestation was either economic (timber production), or to prevent erosion on steep unstable hill slopes. Since that time self-perpetuating populations of several species of wilding pines have established in some areas of the high country, including the Mackenzie basin. Currently very little is known about the ecological effects induced by a change from grassland to forest in New Zealand.

This study evaluates the effect that different densities of *Pinus nigra* have on the structure of invertebrate community assemblages, with a focus on Coleoptera. Invertebrates were sampled from the experimental stands of *P. nigra*, old stands of *P. nigra* at low (local golf course) and high (military camp) densities, and in unimproved native grasslands from the Mackenzie basin, South Island, New Zealand. The replicated stands of *Pinus nigra* were planted at densities of 400, 800, 1600, 2500, and 5000 stems per hectare in 1993. Older stands of *P. nigra* were included as a temporal reference point to determine if there were significant changes in invertebrate community composition with age.

Preliminary results show significant changes in the community structure of several insect orders, Hemiptera, Orthoptera, Hymenoptera, Pseudoscorpionida and Collembola decreased in abundance with increasing density of trees. In contrast Diptera increased in abundance with increasing tree density. The abundance of Coleoptera did not change with tree density; however there were significant changes in species structure at different stand densities that are the focus of continuing analysis.

Email: Steve.Pawson@scionresearch.com

Fragmentation and variable retention: What can carabid beetles tell us about effects on biodiversity?

Carabid beetles appear to be a useful indicator for studies of the effects of fragmentation, patch size, and harvesting method on forest biodiversity. Over the past 7 years, we have conducted a number of large-scale field projects on Vancouver Island and mainland B.C., and we have identified that carabid beetles show significantly different communities in clearcut, immature and mature forests, and show traits that would identify them as disturbance specialists, generalists, forest specialists and old-growth specialists. We have shown that their responses are sensitive at small enough spatial and temporal scales such that they may be used to indicate edge conditions and to assess how quickly sites recover and re-establish typical old-growth communities. Here we present some of the results from our work done in the oldest VR sites in coastal B.C., showing the responses of carabid beetles to fragmentation 4-6 years post harvest, and comparing between dispersed and group level variable retention, two strategies used to retain biodiversity in forest ecosystems. We examine the utility of forest patches to act as refuges, the prevalence of "lifeboating" which enables cut matrices to act as sources for repopulation of adjacent cut matrices, edge effects and the short-term effects of fragmentation of forest populations of beetles.

Email: pearsalli@shaw.ca

PFUND, Jean-Laurent, LAUMONIER, Yves, COLFER, Carol, GERMAN, Laura, BOISSIÈRE, Manuel, and WATTS, John (INDONESIA)

Biodiversity conservation: Making a case for assessments highlighting governance realities in tropical forest landscapes

Forested landscapes are becoming more and more fragmented in the tropics. Mosaics of agricultural lands, forest corridors and patches, especially those in the vicinity of protected areas, are increasingly important for biodiversity conservation. Landscape approaches are now generally promoted as a means to link conservation areas to their surrounding variety of biotic communities, land uses and values. Frontier landscapes are mainly shaped by poor rural communities driven by immediate livelihood needs, and other external pressures resulting from infrastructure development and expansion of private enterprises. In order to elicit the involvement of local communities in conservation, it is necessary to allow them to participate in land use decision-making. But local ideas must be negotiated with different levels of government and their institutions, along with other interested stakeholders, such as private companies and NGOs.

This article reviews landscape assessments carried out in Indonesia, Laos, Cameroon, and Madagascar in the context of action research projects aiming to support biodiversity conservation while enabling communities to effectively negotiate their interests vis-à-vis other interest groups. Different tools have been developed and used to assess the potential of landscape-level biodiversity conservation with local communities. This analysis shows that careful consideration of external trends and relationships, e.g. between the private sector and politicians or decision-makers, remains central to shaping realistic biodiversity conservation models. While tools designed to understand and collaborate with local communities are available, they may fail to consider critical elements of governance which have an overriding influence on landscape management and conservation. This article explores the reasons and effects of using landscape assessment tools that, sometimes for ethics or conservation sake, do not sufficiently consider economic and governance dimensions that are likely to have a profound effect on outcomes. We make recommendations on how conservation and development approaches can be supported by governance assessment tools.

Email: j.pfund@cqjar.org

Impact of fires in 2007 on forest spatial pattern and functional networks in the Peloponnesus peninsula (Greece)

Landscape connectivity, a central issue for the conservation of biodiversity, is affected by local changes, like wildfires, frequent in the Mediterranean region, which can increase the loss and fragmentation (i.e. forest spatial pattern change) of forest patches with effects on interior forest-dwelling species (i.e. change in functional connectivity). Impacts of burned areas at landscape level and inside Natura2000 protected sites were assessed for the Peloponnesus peninsula in Greece, the most heavily damaged region by the 2007 fires in Europe. The methodology combined mathematical morphology based spatial pattern analysis and least-cost modeling for deriving forests functional networks. First, the method based on mathematical morphology (in-house JRC software) was tested to characterize the change in forest spatial pattern before and after fire: loss/gain of core forest (forest area patches minus forest area influenced by forest edge dynamics), and creation/loss of non core forested islets and connectors. Second, change in functional connectivity was derived from least-cost modeling for the generic ecoprofile of a small forest-dwelling mammal and from a resistance map derived from a DEM, land cover types, distances to roads and populated areas. The thresholding of the least-cost models showed the networks or functional dispersal range. For the pre and post-fire situation, the networks were characterized as well as their spatial pattern structure across scales.

Twenty-four Natura2000 sites were affected by fires. The highest forest area loss was in 12 sites among which 4 sites showed a significant loss of core forest (30% loss in number of units and in area) that increased the small forest islets and connectors between the smaller core units.

Before fire, one main large connected network (1.5 M ha for 96% of the total network area) was mapped. After fire, this main network was split into four significantly smaller disconnected networks (covering 44%, 31%, 13% and 9%). The functional territory was reduced by 6.8% and three large disruption areas in the dispersal range were geolocated to guide and prioritize future restoration measures to improve connectivity.

Email: monica.rodriquez@jrc.it

RUBIO, Agustin, LEDO, Alicia, GAVILAN, Rosario, and MONTES, Fernando (SPAIN)

Species dynamics in the *Pinus sylvestris* L. *Quercus pyrenaica* Willd. ecotone in central Spain

Human activities, species population dynamics and climatic variations bring about changes in the limit between plant communities. These changes may lead to the loss of marginal populations and species linked to such ecosystems. This study focuses on the characterisation of changes in the species composition in the Scots pine (*Pinus sylvestris* L.) and Pyrenean oak (*Quercus pyrenaica* Willd.) ecotone in central Spain. This Mediterranean mountain area is at the south-western limit of the distribution area for natural populations of Scots pine and is the habitat of many of taxa of exceptional geobotanical importance. Within this area, three sites were studied, one of which, Hoyocasero Pinewood (an isolated population of Scots pine), is home to several understory species which are normally found in much more northerly locations. Five plots of 25 m radius were established across the ecotone at each site, and within each plot the understory vegetation was sampled in 12 subplots. A second-order moment measure was developed that gives the probability of trees belonging to different species according to the differences in diameter. The mean of this function, weighted by the diameter difference, was defined as an index reflecting the likelihood of change in the species composition. The sum, weighted by the inverse of the diameter difference, illustrates the mixture of the two species. The values of both indices across the ecotone were compared for the different sites. The understory species were related to these indices for the three sites.

The results showed a change from pine forest to broadleaved forest. The proposed method allowed the species substitution process to be characterized for each site. In Hoyocasero, a relationship was found between some understory taxa and the presence of Scots pine, indicating that the conservation of the pinewood may be the only way to maintain the biodiversity of that forest.

Email: agustin.rubio@upm.es

RUNZER, Kyle and HAWKINS, Chris (CANADA)

Stand diversity after MPB attack: The forest is alive

British Columbia's lodgepole pine (*Pinus contorta* Dougl. Ex Loud. Var. *latifolia* Engelm.) forests are experiencing their greatest mountain pine beetle (*Dendroctonus ponderosae* Hopkins) (MPB) epidemic. Some suggest the forest is dead after attack and must be immediately rehabilitated. We sampled 459 age class 1 - 8 stands within nine SBS sub-zones in the Prince George TSA over three years. Our objectives were to quantify MPB attack and document beetle induced changes in stand structure. At the landscape level, attack rates increased with age class and almost all pine was killed in older age classes. Residual basal area after attack was similar for age class 1 to 6. Residual trees in immature age classes were predominantly lodgepole pine; whereas in the mature age classes, there was much greater residual tree species diversity.

Most plots in immature and mature stands have adequate regeneration to be considered stocked even if all tree layer pine were to succumb to the MPB. However, in some instances, regeneration would result in mixed broadleaf-conifer stands or less commercially desirable conifer stand composition. On average, dry and mesic sub-zones were dominated by lodgepole pine and hybrid spruce regeneration. Regeneration in wetter sub-zones was predominantly hybrid spruce, sub-alpine fir, and lodgepole pine. Minor amounts of trembling aspen and black spruce regeneration was found in all sub-zones and age classes.

Landscape level, attack rate, residual tree layer and secondary structure were highly variable. As a result, management decisions need to be made and implemented at the stand level. Clearly across all age classes, many of the attacked stands are not dead and potentially have increased species and structural diversity, and in fact can contribute to short, mid and longer term timber supply. Perhaps rather than stand rehabilitation, allowing stand dynamics to proceed without intervention is a prudent management option.

Email: runzerk@unbc.ca

SCUDDER, Geoffrey G.E. (CANADA)

Taking Nature's Pulse: The Status of Biodiversity in British Columbia

Taking Nature's Pulse: The Status of Biodiversity in British Columbia examines the condition of B.C.'s natural environment. It covers ecosystem, species and genetic diversity, key and special elements of biodiversity, threats, and knowledge and capacity. The report concludes that, compared to the rest of the world, biodiversity in BC is in relatively good shape, but without immediate action is vulnerable to rapid deterioration, especially in light of climate change. The 23 major findings in the report highlight the features of biodiversity that are most vulnerable and/or have experienced the greatest impact from human activity. Scientists—both provincial and international—played an important role in helping to develop the report through the provision of technical information and peer-reviews of the report as it was being drafted. The report has four main sections.

1. *Talking about Biodiversity*: provides background on biodiversity, including its elements, importance and history in B.C.
2. *British Columbia's Natural Legacy*: describes the current status of B.C.'s natural legacy of ecosystem, species and genetic diversity, and key and special elements.
3. *Threats to Biodiversity in British Columbia*: describes the stresses and threats affecting biodiversity in British Columbia.
4. *Major Findings*: provides a synthesis of the status of biodiversity at the ecosystem, species and genetic scales and the major stresses and threats to biodiversity in B.C.. The major findings will be used to inform the development of priorities and actions for conserving biodiversity in B.C.

Email: scudder@zoology.ubc.ca

SCUDDER, Geoffrey G.E. and KLENNER, Walt (CANADA)

Carabid beetles in some forested ecosystems in British Columbia, and response to harvesting

The predaceous carabid beetle fauna of several forested ecosystems in British Columbia have been sampled by pitfall trapping, before and after harvesting. The forested ecosystems sampled included Coastal Western Hemlock, Interior Cedar Hemlock, Engelmann Spruce-Subalpine Fir, and Interior Douglas fir. The dominant species in most of these was *Staphinotus angusticollis*. Harvesting resulted in an increase in species diversity, and at times a change in the most dominant species. Most harvesting treatments resulted in a change in species composition, as well as changes in overall abundance. Old growth specialists, when they could be identified, decreased with disturbance, but rarely totally disappeared, while open habitat species increased. The time frame involved in the development of typical guild structure in forested ecosystems is discussed. The implications for management of the forest lands are also discussed.

Email: scudder@zoology.ubc.ca

SEIDL, Rupert, RAMMER, Werner, and LEXER, Manfred J. (AUSTRIA)

Addressing biodiversity in a stakeholder-driven climate change vulnerability assessment

Besides protected areas managed forests are an important pillar in the effort to maintain biodiversity. In Central Europe, due to intensive historical and current societal demand for forest products and services hardly any virgin forests remain. Thus, the integration of biodiversity under the umbrella of sustainable forest management (SFM) is vital to achieve conservation goals. A major challenge for SFM is climate change. Considering the associated complexities and uncertainties as well as the extended lead times of potential silvicultural adaptation measures a science-based decision support for a SFM under changing environmental conditions is needed.

In our contribution we address issues of biodiversity in the context of a comprehensive climate change vulnerability assessment for 165,000 ha of mountain forests managed by the Austrian Federal Forests. The specific objectives are to (i) review the representation and prioritization of biodiversity within a set of vulnerability indicators covering both ecological and socio-economic aspects of SFM, and (ii) analyze the role of biodiversity indicators with regard to climate change vulnerability and the implications for adaptation measures. Principle tool in studying climate and management effects on forest dynamics is the ecosystem model PICUS v1.4. Besides a de-trended climate baseline (1961-1990) three climate change scenarios are investigated to account for uncertainties in future climate conditions until 2100. Model simulations feed into a framework of vulnerability indicators based on a stakeholder dialogue. Within this framework, the role and limitations of biodiversity indicators are discussed. Furthermore, the contribution of biodiversity indicator performance to overall climate change vulnerability is assessed and a sensitivity analysis with regard to varying indicator preferences is presented. Building on findings of the vulnerability assessment we review the potential for facilitating biodiversity objectives in adaptive management strategies.

Email: rupert.seidl@boku.ac.at

SEOL, A Ra , CHUNG, Joosang, PARK, Chan Ryul, and CHUNG, Jin Heon (SOUTH KOREA)

Regionally-Specialized Habitat Use Patterns of White-backed Woodpecker in Jeju Island, South Korea

Due to the pattern of wildlife habitat varying with its living conditions, a regionally-specialized strategy would be required for the appropriate biodiversity conservation. The white-backed woodpecker (*Dendrocopos leucotos*) at the Hannam experimental forest in Jeju-island is the species needing a regionally-specialized conservation strategy. According to the literatures review, only the bird inhabiting in deciduous forest stands in Europe has been reported. However, it was found that the bird in the study site prefers the *Cryptomeria japonica* plantation forest to the natural deciduous for its nesting area. Lots of holes for its nests are found only in *C. japonica* plantation forest stands surrounded by the natural deciduous. In the natural deciduous forest, the *C.*

japonica plantation forest stands scatters with the range of the long-nearest neighborhood distance of 60m-to-128m and the high edge contrast index of 94%. The deciduous forest seems to provide a foraging habitat to the bird and it is not difficult to find pecking traces on dying and dead woods in it. In addition, it was also found that the bird builds nests on relatively large DBH trees ($45.1 \pm 7.4\text{cm}$) in swampy forest stands; the bird prefers making nest holes at the branch stub on the trunk, of which part is of less strength and might be more vulnerable to fungus-infection compared with that of the sound trunk; most of bird nests were found along stand edges ($25.7 \pm 20.2\text{m}$) or forest roads ($68.8 \pm 51.2\text{m}$), which might be related with microclimate and higher rate of fungal infection of trees. According to the results, the primary conservation strategies for the bird would be longer harvest rotation to protect stand edges in *C. japonica* plantation forest stands, and effective deadwood management in deciduous forest stands.

Email: jschung@snu.ac.kr

SIDDIQUI, Muhammad Tahir, and IJAZ, M. Furqan (PAKISTAN)

Potential of Non-Timber Forest Products in Poverty Alleviation of Mountain Forest Dwellers

Non-Timber Forest Products (NTFPs) play a vital role in creating livelihood for the forest dwellers. Eighty percent of poverty stricken people especially in North West Frontier Province of Pakistan depend on NTFPs. Important NTFPs are; morels, honey, fruits and nuts, vegetable, condiments and spices, mazri palm, silk cocoon etc. Mountain forests of Pakistan constitute the largest and most valuable natural resource of the country. According to a recent study, tangible benefits of these forests yield to; grazing worth Rs. 500 million, medicinal plants worth Rs. 140 million and resin yield worth Rs. 176 million. Although development and conservation circles have been interested in NTFPs from decades, there are a number of reasons for the general spread and upsurge of interest among them since 80s, leading to the belief that the promotion of their sustainable use could lead to a win-win situation for the poverty reduction and biodiversity conservation. This paper attempts to analyze the role and potential of NTFPs to meet the subsistence and income needs of forest inhabitants. Based on literature and field experience, it shows that the NTFP has not received due importance in the country. The paper also studies the economic impact of NTFP value additions such as lack of awareness about collection and processing of various products and knowledge about marketing among collectors, adoption of appropriate technology, distribution and packaging.

Email: drmtsiddiqui@yahoo.com

SIMARD, Suzanne (CANADA)

Mycorrhizal networks and Douglas-fir stand dynamics

Mycorrhizal networks (MNs) occur where mycelia link the roots of multiple plants, possibly facilitating transfer of nutrients or water. My students, colleagues and I have been examining MNs and their influence on seedling establishment across a range of climatic and site conditions in the interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) forests of British Columbia, Canada. Interior Douglas-fir ranges from Mexico to central BC, where establishment at high latitudes and elevations is limited by low summer temperatures. At low latitudes and elevations in BC, where the forests interface with grasslands, seedlings are limited by summer drought. This distribution is expected to expand northward with climate change, but also contract in southern BC where increasing summer drought is predicted. Because the edaphic and climatic amplitudes of Douglas-fir are wide, we have used its natural distribution to examine the role MNs play in establishment limitations across a range of sites and regional climates.

To characterize MNs, we used morphotyping, DNA sequencing, and microsatellite primers to determine linkage potential between mature trees, saplings and establishing seedlings by the same fungal taxa or genets. We have found that multiple Douglas-fir cohorts in a 30-150 year-old stand were linked together in a complex MN comprised of overlapping *Rhizopogon vinicolor/vesiculosus* genets. More specifically, we found that all 65 trees in a 900m² plot were linked together by no more than three degrees of separation. In harvested stands, we used root-excluding mesh bags and isotopic labeling to discover that seedling establishment was significantly

enhanced where linked into a MN with older trees, and this was associated with carbon transfer. Seedlings also received water redistributed through MNs, explaining improved water relations. Although preliminary, our experiments suggest that the degree of MN facilitation increases with climatic and site aridity. These results suggest that MNs may be important to gap-phase regeneration following mixed severity disturbance in IDF forests, linking trees together through space and time, and bolstering their resilience to climatic stress. Retaining legacy trees and conserving MNs during harvesting may be important to Douglas-fir establishment, particularly at the changing margins of its range.

Email: suzanne.simard@ubc.ca

STARLINGER, Franz (AUSTRIA)

Changes in ground vegetation of managed forests in Austria: Diversity indices and species richness

Within the framework of the Pan-European Programme for Intensive and Continuous Monitoring of Forest Ecosystems, 20 Level II Plots were established in Austria in 1995, which are distributed across Austria and include the most common forest types. The plots are managed in a "traditional" way by their owners without any restrictions. On sub-plots within these homogeneous stands, ground vegetation was sampled in 1996, 2001, and 2006. Species cover of vascular plants and of terricolous bryophytes and lichens was recorded.

These data were used to assess temporal changes of Shannon and Simpson diversity indices as well as species numbers against the background of forest management. In the observation period, tree felling occurred on most plots with different manipulation intensities, including thinning and selective cutting. Only one plot was clear-cut.

In largely unmanipulated stands, diversity indices showed only minor temporal changes, whereas wood extraction at higher intensities generally caused stronger changes of indices. In response to management, indices either increased or decreased. Species numbers of vascular plants in largely unmanipulated stands generally showed a slight decrease, whereas selective felling at higher intensity caused an increase of species number. However, in the clear-cut plot the species number was almost unchanged. In this plot the loss of forest species was balanced by gain of successional species.

Email: franz.starlinger@bfw.gv.at

SULLIVAN, Thomas, SULLIVAN, D.S., LINDGREN, P.M.F., and RANSOME, D.B. (CANADA)

Incremental silviculture and biodiversity: Whither the future for managed forests?

A major goal of forest management is to conserve biological diversity by maintaining a variety of tree species, age classes, successional stages, harvesting strategies, and protected areas (reserves) in a 'mosaic' of habitats. Each kind of habitat will have various groups of species and at the large-scale landscape level, there will be many different habitats and species. Inherent with this plan is the need to meet the apparent increased global demand for wood. Integrating conservation and wood production in forested landscapes could help alleviate harvesting pressure on old-growth forests and augment the role of reserves in protecting biodiversity. A major uncertainty is whether wildlife species associated with structural characteristics of late-seral forests will respond positively to their development in intensively managed young even-aged stands. Results are available from two relatively long-term studies that have investigated the role of pre-commercial thinning and fertilization in enhancing tree growth, vegetative succession, and overall stand structure in even-aged stands of lodgepole pine (*Pinus contorta*) in the south-central interior of BC, Canada.

Stand structure and the responses of several mammal groups were used as indicators of sustainability and biodiversity. Examples of these species and groups are the masked shrew (*Sorex cinereus*) and the southern red-backed vole (*Clethrionomys gapperi*) on the forest-floor and the northern flying squirrel (*Glaucomys sabrinus*) and red squirrel (*Tamiasciurus hudsonicus*) in the arboreal mammals, and mule deer (*Odocoileus hemionus*) in the large mammals. Stand structure attributes included productivity and structural features of

young lodgepole pine, as well as diversity of coniferous tree layers, and biomass and structural diversity of understory vascular plants. As expected, there was a variety of responses to the incremental silviculture treatments.

Email: tom.sullivan@ubc.ca

SUTHERLAND Glenn D., WATERHOUSE, F. Louise, SMITH, Jason, HAMMAN, Andreas, HARESTAD, Alton S., O'BRIEN, Daniel. T., and HAFFER, Mark (CANADA)

Potential impacts of climate change on habitat availability and demography of the Northern Spotted Owl

Focusing on the Northern Spotted Owl (*Strix occidentalis caurina*), an endangered species located in southwestern British Columbia, we explore the effectiveness of long-term species conservation strategies in the face of climate change. The Northern Spotted Owl is of high priority for conservation planning and its management affects a large land area in British Columbia (e.g., approx. 362 000 ha of reserves under the 1997 BC Spotted Owl Management Plan). We hypothesize that climate change will affect availability of the owl's habitat by altering vegetation, fire disturbance, temperature and weather. These changes to habitat will affect prey for owls, owl vital rates and thus the density and distribution of Spotted Owls.

To explore these dependencies, we first developed a conceptual model with 18 direct links between measures of vital rates and temperature and snow fall and 4 indirect links measures of vital rates and climate variables and 4 indirect links to prey density. Then, we use a quantitative, spatially explicit model (at 100m resolution for southern BC) that predicts owl habitat and population dynamics as a function of climate and landscape structure. We simulate the effect of climate change by (1) projecting one of the underlying modelled habitat attributes — biogeoclimatic sub-zone / variant through bioclimate envelope modeling, and (2) by manipulating the rate of stand replacing natural disturbance regimes.

Our approach identifies zones of management uncertainty where current Northern Spotted Owl reserves are most vulnerable to change, and highlights how the efficacy of conservation areas may be diminished if we account for climate change over an 80 year period. We further contrast how modelled Spotted Owl population responses may differ when climate change is accounted for under different reserve designs. Our results reveal some of the challenges in understanding species conservation management under climate change and our approach provides a forest management tool that offers potential methods to incorporate climate change assumptions into conservation planning.

Email: gsutherland@cortex.ca

SUZUKI, Nobuya (Nobi) (USA)

Effects of climate change on lentic habitats and associated biota in mountain forest ecosystems of the US Cascade Range

Climate change has increasingly become a concern for conservation of biodiversity across forested landscapes. However, effects of climate change on mountain forest habitats in the US Pacific Northwest are largely unknown and difficult to assess due to complex climate patterns produced by El Nino/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). We assessed changes in snowpack levels in the US Cascade Range between the late 1930s and 2008 and how these changes would potentially affect lentic habitats in forests and associated species, such as Cascade frogs (*Rana cascadae*) and western toads (*Bufo boreas*), which are species of concern in these mountain forest ecosystems. To anticipate potential negative effects of regional climate change, we developed Geographic Information Systems (GIS) models to determine locations across the landscape where low and unstable snow pack levels could potentially be threats to biodiversity and ecological processes of lentic habitats in mountain forest ecosystems in the US Cascade Range. Our snowpack analyses indicated that snowpack levels have significantly decreased in both the Oregon and Washington Cascades since the end of the last warm phase of PDO and has not recovered to the levels seen during the previous cool phase of PDO between 1947 and 1976. Mountain forest habitats in Oregon may be more vulnerable than those in the Washington Cascades due to lower snow pack levels, higher annual

fluctuations in snow pack levels, and higher summer temperatures. Our GIS risk map of snowpack conditions can be used to identify geographic locations vulnerable to climate change and focus our conservation efforts, for example to manage habitats for connectivity among lentic habitats and to minimize additional human-induced threats to species in these areas.

Email: nobi.suzuki@oregonstate.edu

TODD, Melissa, WATERHOUSE, F. Louise, SAUNDERS, Sari, MEGGS, J.M., LINDGREN, B.S. and MARCOT, B.G. (CANADA)

Monitoring ground arthropod functional communities to evaluate the effectiveness of structural retention for forest biodiversity conservation

We are examining the utility of ground arthropod communities as suitable, sensitive response indicators of structural integrity in coastal forests. To monitor and evaluate the effects of stand-level retention practices on biodiversity and the potential interactions of such management with the effects of climate change, we are exploring cost-effective, logistically simple ways of assessing functional biotic responses reflective of ecosystem resilience. The ecosystem approach under investigation examines the responses of ground arthropod functional groups (e.g. based on trophic and/or ecosystem process roles) to changing patterns in ecosystem structure and function resulting from different types and degrees of stand-level disturbance. Functional rather than taxonomic diversity becomes the surrogate for biodiversity, with shifts in functional diversity and richness reflecting shifts in microhabitat and microclimate either in direct response to changing conditions, or through interaction with more dominant functional groups under those changed conditions.

Work began in 2007 in the Roberts Creek Study Forest (RCSF) in the Douglas-fir dominated, dry Coastal Western Hemlock biogeoclimatic sub-zone (CWHdm). The RCSF offers a range of structural types and conditions created through alternative harvest systems applied between 1993 and 1999. Using pitfall traps as the primary sampling tool, our goal is to determine if we can relate the responses (biomass, abundance, diversity) of functional arthropod assemblages to a suite of structural habitat attributes. Arthropod samples are sorted and identified to the level of morphospecies, grouped by functional roles, and response variables analysed relative to key structural variables.

We present preliminary results from 2007 samples on comparative morphospecies assemblages across various structural types. Approaches to functional group identification are discussed, with linkages to morphological and taxonomic characteristics supporting these groupings. Identification of a sub-set of better known taxa (e.g. Carabidae) will support a comparison of morphospecies with fuller taxonomies, to evaluate the reliability of using morphospecies as a basis for functional community analysis. Multivariate analyses will be used to explore relationships between structural conditions and arthropod community responses. Patterns of functional redundancy, richness and diversity will be examined, as these relate to the functional resilience of the community.

Email: Melissa.Todd@gov.bc.ca

VENNETIER, Michel (representing 25 scientists from 10 teams) (FRANCE)

Impact of repeated fires on functional biodiversity

Between 2005 and 2008, a group of 10 research teams studied vegetation, litter, earthworms, microfauna, bacteria, soil physics, nutrients, organic matter (quality and quantity) and toxic compounds in a multidisciplinary research program dealing with the impact of repeated forest fires on biodiversity and the soil in Mediterranean forests. Plots were laid in old growth forests and in sites burned between 1 and 4 times in the last 50 years. For each fire regime, fires dating 1, 3, 5 or 15 years were chosen. The goals were: (1) to look for biodiversity indicators for the assessment of the ecosystem status and functioning, (2) to understand interactions between biotic and abiotic factors in ecosystem resistance and resilience, (3) to look for critical fire frequency thresholds. Taking advantage of the exceptional drought which occurred during the experiment, we studied the interaction between fire and drought.

Two thresholds appeared in fire frequency (1 and 4 fires in 50 years) leading to deep changes in the ecosystem biodiversity and functioning. Few differences were observed 3 and 15 years after fire between plots burned 1, 2 or 3 times, the ecosystem being used for millenniums to such fire frequencies. Earthworms and bacteria diversity and activity appeared critical for ecosystem functioning and recovery after fire. Due to drought, this activity was severely reduced and strong interactions were found between fire and drought, each of these disturbances amplifying the impact of the other. High disturbance frequency by fire or drought reduced biological diversity, increasing the resistance but reducing the resilience of communities. Some obligate seeders tree species disappeared when fire occurred at less than 15 to 20 years interval, changing the ecosystem structure. Trees mortality due to drought was far higher in recently burned areas, degrading vegetation from forest to matorals. Most of the critical biological, physical and chemical processes were concentrated in the topsoil (0-5 cm), deeper horizons being impoverished by a long fire history, except in old growth forests. These ecosystems are fragile and their dynamics may shift to desertification with increasing drought due to climate change.

Email: michel.vennetier@cemagref.fr

VENNETIER, Michel and RIPERT, Christian (FRANCE)

A new bioclimatic model to quantify climate change impact on forest flora diversity

In Mediterranean Europe, one of the richest biodiversity hotspots, GCM models forecast a faster climate change than in most other regions. Water availability is there a key factor driving vegetation distribution and growth. We designed a new bioclimatic model computing a water-availability index for Mediterranean forests. The model was calibrated in France by means of a vegetation index, based on the flora composition of 325 representative old forests. Eighty percent of the variance of the vegetation index was explained by the model. We used this model to quantify the potential impact of climate change scenarios on flora (see table below), and verified that these predictions fitted the flora turnover observed in the last 15 years.

| Climate change (vs 1961-96 mean parameters) | Predicted Flora turnover |
|--|--------------------------|
| +1 / +2°C mean annual t° | 7 / 12 % |
| -10 / -20% in spring or summer rainfall | 3 / 6 % |
| +2°C and -20% spring rain (IPCC B2 for 2050 in the study area) | 18% |
| +1.4°C -15% spring -32% summer rainfall (1998-07 for the study area) | 25% |

A new flora census performed in 2008 on the plots initially surveyed between 1995 and 1997 to calibrate our model confirmed that the flora turnover was ongoing, with a sharp increase of water-stress-resistant species and the reduction in number and cover of water-demanding species.

The maps of our bioclimatic index at local as well as at regional scale showed that the potential distribution area of species is very fragmented in the landscape: drought tolerant species are already scattered in rocky and South-facing sites within the hinterland, ready to spread from these bases. Numerous favorable sites allow mesophilous species to survive in dry or hot areas, although such sites may become rarer and smaller in time.

Our model, including variables describing precisely landscape structure, allows the assessment of climate change impact on flora diversity at a biologically realistic scale, our basic pixel corresponding to the average dispersal distance of a majority of species.

Email: michel.vennetier@cemagref.fr

VILLARD, Marc-André (CANADA)

Tolerance of indicator species to harvesting intensity as a guide to set conservation targets

Biodiversity is particularly challenging to integrate in forest management plans because it comprises a wide range of components, each being associated with specific ecosystem conditions. A promising approach to guide this integration is to measure the tolerance of indicator species to harvesting intensity. Indicator species may require specific stand structures, landscape configurations, or both. My research team has examined the

tolerance of forest birds and epiphytic lichens to various intensities of forestry at stand and landscape scales. Specifically, we have sought thresholds or transition points in the probability of presence or reproduction of individual species along gradients in harvesting intensity. Our results indicate that many species show statistically-significant transitions in their status as harvesting intensity varies, and that when considering both the probability of presence and the probability of reproduction for one species (Brown Creeper, *Certhia americana*), habitat requirements for nesting (density of large-diameter trees) were twice as high as those associated with its mere presence. Several forest bird species also responded significantly to the amount of mature forest at the landscape scale. This response varied among species and it was not always consistent geographically for a given species, but it showed remarkable consistency through time at a given location. Epiphytic lichens (*Lobaria* spp) also showed sensitivity to canopy opening through single-tree selection, indicating that they are sensitive even to moderate alterations of stand structure and, presumably, microclimate. Hence, transition points in the response of indicator species to harvesting intensity generally provide useful guidance when setting conservation targets. The greatest challenge is to make sure that we err on the side of caution when setting such targets because (a) objectives defined according to the mere presence or absence of species may not meet their requirements for reproduction and (b) targets may vary as a function of the indicator species selected. In this presentation, I will review the conceptual and statistical aspects of conservation target setting and I will show specific applications of the approach.

Email: villarm@umoncton.ca