Welcome to Hobart, Tasmania

On behalf of the Conference Committee, I would like to welcome you to Hobart to the *Old Forests, New Management* conference. This conference is supported by the Australian and Tasmanian governments through the Tasmanian Community Forest Agreement, and in addition is the 9th conference in the Sir Mark Oliphant International Frontiers of Science and Technology series. The impressive array of national and international speakers and poster presenters will stimulate us to take a deeper look at the characteristics and values of the range of old forest ecosystems around the world, and the management options for these forests. Enjoy the conference presentations, the dialogue and debate, the social functions, and Tasmania's forests!

Dr Steve Read

Chair, Conference Committee
Chief Scientist, Forestry Tasmania

Conference Committee

Ms Jayne Balmer
Biodiversity Conservation Branch, Department of Primary Industries & Water

Dr Chris Beadle
CSIRO Forest Biosciences

Ms Taylor Bildstein
Cooperative Research Centre for Forestry (Media Coordinator)

Professor Gordon Duff
Cooperative Research Centre for Forestry

Mr Fred Duncan
Forest Practices Authority

Mr Mark Neyland
Forestry Tasmania

Professor Brad Potts
University of Tasmania and Cooperative Research Centre for Forestry

Dr Steve Read
Forestry Tasmania (Chair)

Associate Professor Alastair Richardson
University of Tasmania

Mr Sean Riley
Forests and Forest Industry Council of Tasmania

Conference Secretariat

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Sponsors

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Conference Venue

Hotel Grand Chancellor
1 Davey Street, Hobart

Social Functions

Welcome Drinks

Venue: Bond Store,
Tasmanian Museum and Art Gallery

Time: 1700 - 1800, Sunday 17 February

Dress: Smart casual

Meet the other delegates and enjoy a drink after registering for the Conference.

Government House Reception

Venue: Government House

Time: 1800 - 1900, Monday 18 February

Depart: 1745 Hotel Grand Chancellor

Dress: Jacket & tie/Cocktail dress

The Governor of Tasmania, His Excellency, the Honourable Mr William Cox, AC RFD ED, and Mrs Cox will host a reception for delegates and their partners at Government House to mark the conference. Tasmania's Government House is regarded as one of the best vice-regal residences in the Commonwealth and is one of the largest in Australia.

Conference Dinner

Venue: Meadowbank Vineyard

Time: 1900, Wednesday 20 February

Depart: 1830, Hotel Grand Chancellor

Cost: $100.00
Inclusive for full registrants

Dress: Smart casual

Relax, unwind and join your colleagues at one of Tasmania's premier venues, Meadowbank Vineyard, where you will enjoy some of Tasmania's finest food and wine. The cost includes dinner, entertainment, transport and a glass of wine on arrival.

General Information

AATSE Post-conference Survey

Please note that the names and email addresses of speakers and Conference participants will be provided to the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering to conduct a small post-conference survey.

Delegate List

A delegate list will be supplied to all conference attendees including exhibitors and sponsors. Please email or write to Conference Design if you do not wish to have your details included on the delegate list.

Privacy

Conference Design Pty Ltd will gather and record personal information necessary for your attendance at the Conference. Personal information will be gathered, stored and disseminated in accordance with the National Privacy Principles.

Disclaimer

Whilst we have endeavoured to ensure all information on the Conference website and printed material is accurate, all details are subject to change without notice. Any corrections or amendments will be updated on the Conference website, **www.oldforests.com** as soon as possible.

In the event of industrial disruptions or service provider failures, neither the members of the Organising Committee nor Conference Design Pty Ltd, accept any responsibility for losses incurred.

Dress

Dress throughout the Conference is smart casual. Dress for each function is indicated in the function description.

Photocopying at the Conference

The Conference will not be providing photocopying facilities, so please ensure you bring a sufficient number of any handouts.

Smoking

The Conference and all social functions are non-smoking.

Name Badges

Name badges will be issued when registering at the Conference. For security purposes the Conference name badge must be worn at all times during the Conference and social functions.

Baby Sitting

Please contact your chosen hotel to arrange a baby-sitting service.

Parking

No parking is provided at the Conference venue. A number of commercial car parks are located nearby.

Accommodation Accounts

All accommodation accounts must be settled on check-out. The Conference Committee and Conference Design will not be responsible for accommodation accounts.

Registration Desk

The Registration Desk will be located on the Mezzanine Floor, Hotel Grand Chancellor and will be open at the following times:

Sunday	1530 – 1700
Monday	0800 – 1730
Tuesday	0800 – 1750
Wednesday	0730 – 0830
Thursday	0800 – 1600

Contact Phone Numbers

Venue – Reception Hotel Grand Chancellor	03 6235 4535
Venue – Reception Hotel Grand Chancellor	Fax 03 6223 8175
Police – Emergency	000
Police – General Enquiries	03 6230 2111
Dentist: Dr Gordon Henry 241 Sandy Bay Rd, Sandy Bay	03 6224 0322
Doctor: Cascade Road Medical Centre 30a Cascade Road, South Hobart	03 6223 5533
	After hours 03 6235 4659
Doctor: City Doctors & Travel Clinic 93 Collins Street, Hobart (through Healthsense Pharmacy) www.citydoctors.com.au	03 6231 3003
Royal Hobart Hospital 48 Liverpool St, Hobart	03 6222 8308
Qantas	13 1313
Virgin Blue	13 6789
Jetstar	131 538
Taxi - City Cabs	131 008
Taxi - Taxi Combined	13 2227

Messages

A message board will be located near the Registration Desk.

Citation of Program Book

Abstracts of this conference should be cited according to the following example:

Wilkinson G, Stricht P, Ades P, Potts B (2008) Local adaptive differentiation within *Eucalyptus obliqua*. Poster abstract in Proceedings of 'Old Forest, New Management' Sir Mark Oliphant Conference, 17-21 February 2008, Hobart, Australia. p. 175.

Invited Speakers

Plenary Speaker

Professor Jerry F. Franklin

Professor of Ecosystem Analysis
College of Forest Resources
University of Washington, Seattle, Washington, USA

Dr Jerry Franklin is Professor of Ecosystem Analysis in the College of Forest Resources, University of Washington. He is a senior consultant for Interforest. Previously, he was Chief Plant Ecologist, USDA Forest Service, and Professor of Forest Science and Botany at Oregon State University. He also served as Director of the Ecosystem Studies Program of the National Science Foundation. He is one of the pioneers of forest ecosystem research, with specialisations in structure and function of natural forest ecosystems; successional processes following catastrophic disturbances; effects of changing environmental conditions on forest processes; application of ecological principles to the management of natural resources; and theory and practical applications of landscape ecology. He is a past president of the Ecological Society of America and has served on the Board of Governors of the Nature Conservancy. He has served on the Forest Ecosystem Management Assessment Team, the Sierra Nevada Ecosystem Project, and the American Indian Forestry Management Assessment Team. He is a world leader in forest management research and his research is documented in nearly 300 publications.

Professor Jürgen Bauhus

Director, Institute of Silviculture, University of Freiburg, Freiburg, Germany

Jürgen studied Forestry in Freiburg, Vienna, and Göttingen and worked in Germany and Canada before he worked in the ANU Forestry Program between 1996 and 2003. Since June 2003 he has held a professorship and the Chair of Silviculture in the Faculty of Forest and Environmental Sciences at Freiburg University, Germany. His research focuses on ecology and silviculture of native forests, carbon and nutrient cycling, dynamics of mixed-species stands, structural diversity and coarse woody debris. He is section editor of the *European Journal of Forest Research*, Associate Editor of the *Canadian Journal of Forest Research* and an associate of the Cooperative Research Centre for Greenhouse Accounting. At Freiburg University, he is directing the International PhD Program 'Forestry in Transition', the German-French binational PhD program in 'Risk Management in Forestry', and the new international MSc course 'Forests, Environment and Bioresources'.

Professor Peter Kanowski

Professor of Forestry
Fenner School of Environment and Society
The Australian National University, Canberra, Australia

Peter Kanowski is Professor of Forestry and Deputy Director of the Fenner School of Environment and Society. Peter was appointed Professor of Forestry at ANU in 1995, and was Head of the ANU Department of Forestry from 1996 -2001. He was Co-Convenor of the ANU Institute for Environment in 2004, and has been Deputy Director since 2005. In 2003/4, Peter was a member of the panel conducting the Council of Australian Government's National Inquiry into Bushfires. He was a member of the Steering Committee for the ACT's post-bushfire Non-Urban Land

Use Study in 2003, a member of the ACT International Arboretum Jury and then Interim Board in 2004-6, and was a member of the ACT Water Supply Catchment Management Advisory Committee in 2005.

Peter grew up in country Queensland, with a forester father, schoolteacher mother and six siblings - all helpful background for a forestry academic with administrative responsibilities. He was Schlich Medallist at the ANU Department of Forestry and a Rhodes Scholar at Oxford University; his honours and doctoral work were both in forest genetics. Peter worked as both a forest and a research program manager with the Queensland Department of Forestry, before moving to Oxford University's Forestry Institute in 1988, where he lectured in forest policy and forest genetics. Since returning to Australia in 1995, Peter has chaired or co-facilitated a number of community engagement processes about forest conservation and management, including the Southern Regional Forest Forum and the NSW Western Regional Assessment community fora. He has continued to work internationally, in forestry education and in intergovernmental forest policy processes.

Professor Juan Armesto

Centre of Advanced Studies in Ecology and Biodiversity, Catholic University of Chile, Santiago, Chile.

Professor Armesto is the Head of the Centre of Advanced Studies in Ecology and Biodiversity at the Catholic University of Chile, is president of the "Senda Darwin" Foundation of Chile, and has received numerous professional awards and fellowships. His research has focused on understanding and predicting how humans affect biological diversity in rural landscapes in southern Chile, including the links between soil biodiversity and the processes that sustain productivity in old-growth forests, the effect of habitat fragmentation, and the relevance of the ecosystem engineering properties of trees for maintaining biodiversity and for enhancing forest recovery from anthropogenic disturbance. The purpose of the research is to identify critical species (or functional groups) and biotic processes that sustain the biodiversity and productivity in Chilean temperate rainforests, including functional groups in temperate forest ecosystems that are most sensitive to losses of biodiversity.

Professor Antonio Lara

Institute of Silviculture,
University Austral de Chile, Valdivia, Chile

Professor Lara is from the Institute of Silviculture at the University Austral de Chile where he heads the research group working on forest ecosystem services (FORECOS). His research includes the ecology and conservation of native forest; silvicultural systems; dendrochronology; climate change; and multi-disciplinary studies into landscape-scale management. He is active in many scientific partnerships (national and international) involving government, industry and conservation organisations. He has been a catalyst for many of these partnerships, and is a key figure in driving Chile's approach to management and conservation of temperate forests.

Professor Sally Aitken

Director, Centre for Forest Gene Conservation;
Program Director, Forest Science undergraduate program
Department of Forest Sciences
Faculty of Forestry, University of British Columbia, Canada

Sally Aitken received her Bachelor's degree in the Faculty of Forestry at UBC in 1984, and her M.Sc. (1986) and Ph.D. (1990) at the University of California at Berkeley. She was a Research Assistant Professor and Associate Director of the Pacific Northwest Tree Improvement Cooperative in the Department of Forest Science at Oregon State University from 1991 through 1996. She then joined the Department of Forest Sciences at the University of British Columbia in Vancouver, Canada, to fill the Natural Sciences and Engineering Research Council (NSERC)/Industry Junior Chair in Genetics, where she is currently Professor, Director of the Forest Sciences undergraduate program, and Director of the Centre for Forest Gene Conservation (www.genetics.forestry.ubc.ca/cfgc).

Sally's teaching responsibilities include forest biology and conservation genetics, and she strives to make the role of genetics in forest management and conservation understandable and accessible to all students. Her research seeks to better understand the genetic structure of local adaptation of forest trees at the ecological, phenotypic, genetic and genomic levels; the respective roles and interactions of natural selection and gene flow in generating population structure; and the capacity of populations of forest trees to adapt or migrate in the face of rapid climate change. Current projects of her research team include investigating the evolutionary potential and conservation importance of peripheral, disjunct populations; dissecting the genomic basis of genetically complex traits involved in local adaptation to temperature; and testing bioclimatic envelope models of current and future species distribution using field common garden experiments. She plays an active role in the development of policy recommendations and operational programs for genetic conservation and management at the provincial and national levels in Canada.

Dr Michael Brown

Honorary Research Associate, School of Plant Science,
University of Tasmania, Australia

Michael Brown is an Honorary Research Associate, School of Plant Science, University of Tasmania and part-time consultant for a number of agencies on conservation ecology. He has worked for many years in the Tasmanian National Parks and Wildlife Service and with Forestry Tasmania, where he was Chief Scientist on his retirement in 2003. He has more than 35 years experience in the fields of conservation and ecology, and is author or co-author of more than 140 scientific and technical publications on forest ecology, fire ecology, biological conservation and other aspects of vegetation science. He was the instigator of the Warra Long Term Ecological Research (LTER) Site in Tasmania, promoted establishment of the National LTER network and represented Australia on the Steering Committee for the establishment of the International LTER network.

Professor Fred Swanson

United States Department of Agriculture Forest Service (USDA),
Pacific Northwest Research Station
Forestry Sciences Lab, Corvallis, Oregon, USA

Fred Swanson is a research geologist and ecosystem scientist with the United States Department of Agriculture Forest Service, Pacific Northwest Research Station, and Professor (courtesy) in the Departments of Forest Science and Geosciences, Oregon State University. For many years he has studied the interactions of physical processes, such as fire, flood, landslides, volcanic eruptions, and forestry operations, including roads, with forest and stream ecosystems. He has been involved with the Andrews Forest Long-Term Ecological Research program since its inception in 1980 and works intensively in the research-land management partnership based at Andrews Forest. His interests are reflected in titles of books on which he has worked with many colleagues: "Sediment Budgets and Routing in Forested Catchments" (1982); "Bioregional Assessments: Science at the Crossroads of Management and Policy" (1999); "Road Ecology: Science and Solutions" (2002); and "Ecological Responses to the Eruption of Mount St Helens" (2005).

Professor David Lindenmayer

Professor of Ecology and Conservation Biology
The Australian National University, Canberra, Australia

David Lindenmayer is Professor of Ecology and Conservation Biology at The Australian National University. He manages five large-scale long-term research programs spanning native forests, plantations, woodland restoration and reserve/fire management in south-eastern Australia. He has worked in the wet ash forests of the Central Highlands of Victoria for the past 24 years where he has completed a wide range of research projects.

Professor Lindenmayer has written 18 books and 460 scientific articles on forest ecology and management, wildlife biology, conservation biology, woodland restoration and management and a wide range of other topics related to natural resource conservation and management.

William J. (Bill) Beese

Forest Ecologist, Corporate Forestry, Western Forest Products Inc.
British Columbia, Canada

Bill is Forest Ecologist for Western Forest Products in Campbell River, British Columbia (BC), Canada. He has worked for over 25 years on the BC coast, since completing a Master's degree in Forest Ecology at the University of BC. Bill began his career in forestry studying the oak-hickory forests of Southern Illinois. He then conducted site classification, fuels surveys and stream inventories for the US Forest Service in Montana in support of wilderness fire management plans. He worked as a forester in the Queen Charlotte Islands where he also helped develop the ecological classification system for the QCI. Since 1983, he has done research, environmental consulting and policy development for several successor forest companies.

Bill is responsible for a program that includes research in silvicultural systems, prescribed burning erosion control, forest regeneration and stand tending, biodiversity, and small stream management. He leads the company's monitoring and adaptive management program, oversees ecosystem mapping, and is project co-coordinator for the multi-agency MASS research partnership investigating silvicultural systems for high elevation forests. He was part of a team that developed and implemented the Coast Forest Strategy – the company's forest ecosystem stewardship program – including phase-in of variable retention harvesting. This program received the Ecological Society of America's Corporate Award for 2001. Bill is a Registered Professional Forester, and was chosen as "Coastal Silviculturist of the Year" in 2000.

Graham Wilkinson

Chief Forest Practices Officer
Forest Practices Authority, Tasmania, Australia

Graham Wilkinson is the head of Tasmania's Forest Practices Authority with responsibilities for the day to day administration of the State's forest practices system. His career spans 30 years of experience in forest management, silvicultural research, forest policy and regulation.

Graham also works extensively within the Asia-Pacific region as a consultant to the United Nations and the World Bank on projects related to the implementation of codes of forest practice and sustainable forest management.

Professor Benjamin Cashore

Professor, Environmental Policy and Governance and Political Science;
Director, Program on Forest Policy and Governance
Yale School of Forestry & Environmental Studies

Benjamin Cashore specialises in Sustainable Forest Policy, at Yale University's School of Forestry and Environmental Studies. He is Director of the Yale Program on Forest Certification and is courtesy joint-appointed (Associate Professor) in Yale's Department of Political Science. He holds a PhD in political science from the University of Toronto, BA and MA degrees in political science from Carleton University, and a certificate from Université d'Aix-Marseille III in French Studies. He was a Fulbright Scholar at Harvard University during the 1996-1997 academic year.

He has held positions as Assistant Professor, School of Forestry and Wildlife Sciences, Auburn University (1998-2001); postdoctoral fellow, Forest Economics and Policy Analysis Research Unit, University of British Columbia (1997-1998), and as a policy advisor to the leader of the Canadian New Democratic Party (1990-1993).

Cashore's new book, *Governing Through Markets: Forest Certification and the Emergence of Non-state Authority* (with Graeme Auld and Deanna Newsom), was awarded the International Studies Association's 2005 Sprout prize for the best book on international environmental policy and politics. Published by Yale University Press in 2004, the book identifies the emergence of non-state market-driven global environmental governance, and compares its support within European and North American forest sectors.

In addition to the 2005 Sprout prize, Cashore was awarded (with Steven Bernstein) the 2001 John McMenemy prize for the best article to appear in the *Canadian Journal of Political Science* in the year 2000 for their article, "Globalization, Four Paths of Internationalization and Domestic Policy Change: The Case of Eco-forestry in British Columbia, Canada."

Professor Thomas G Whitham

Regents' Professor of Biology, Northern Arizona University; Executive Director, Merriam-Powell Center for Environmental Research

Professor Whitham is a leader in the emerging field of community and ecosystem genetics, a research field that links ecology and genetics. He currently heads a large multi-disciplinary research group funded under the US National Science Foundation (NSF) Frontiers in Integrative Biological Research (FIBR) Program, and which is taking a "genes-to-ecosystems" approach to studies of forest systems in both the USA and Australia. For example, Professor Whitham's group has found that genetic diversity in *Populus*, a foundation species of threatened riparian habitat throughout the western USA, is directly associated with increased biodiversity, and that there are strong genetic components to community structure, stability and ecosystem processes. As *Populus* is a model system, their findings are likely to have broad applications to old-growth species that provide habitat and define a much larger community of organisms. Professor Whitham has published over 150 journal articles in prestigious journals such as *Nature*, *Science and Ecology*, and was recently invited to review the field of community and ecosystem genetics for *Nature Reviews Genetics*.

Professor David Bowman

Professor of Forest Ecology, School of Plant Science,
University of Tasmania, Hobart

David Bowman has been recently appointed Professor of Forest Ecology in the School for Plant Science, University of Tasmania in Hobart. He is also an Adjunct Professor at the School of Forest and Ecosystem Science, The University of Melbourne and at the School of Environmental Research, Charles Darwin University in Darwin, and Visiting Fellow at the Fenner School of Environment and Society at Australian National University. In collaboration with colleagues in Australia and abroad, he uses a range of tools, including remote sensing and geographic information analysis, stable isotopes, ecophysiological analysis, mathematical modelling, biological survey and molecular analysis, to understand how Australian landscapes have evolved in response to climatic change, varying fire regimes, the introduction of large vertebrate herbivores and the impacts of contemporary and prehistoric management. His PhD thesis was on the ecology and silviculture of *Eucalyptus delegatensis* in Tasmania. He is the author of numerous papers and the book *Australian Rainforests: Islands of green in a land of fire,* which he wrote when he was a Bullard Fellow in Forest Research at Harvard University.

Professor Thomas Spies

United States Department of Agriculture Forestry Sciences Laboratory,
Corvallis, Oregon, US

Thomas A. Spies is a Research Ecologist in the Pacific North West Research Station. His expertise is in forest stand structure and dynamics, old-growth ecology and conservation, landscape ecology and wildlife habitat. He has studied the ecological basis of forest management in the Lake States, Germany, New England, Australia, and the Pacific Northwest. He has published over 120 papers on subjects including ecological land classification, old-growth ecology and conservation, structure and dynamics of coniferous forests, remote sensing applications, landscape ecology, riparian forest ecology, gap dynamics and integrated regional assessments. He was a member of the Forest Ecosystem Management Assessment Team that helped develop the Northwest Forest Plan for Federal Lands. He is currently team leader of the Landscape and Ecosystem team of the Pacific North West Station. For the last 12 years he has been co-leader of the Coastal Landscape Analysis and Modeling Study, a long-term, large, interdisciplinary project to model and evaluate forest policy effects at multiple scales.

Professor Bob Hill

Executive Dean, Faculty of Sciences, University of Adelaide, and Head of Science, South Australian Museum

Professor Bob Hill is a graduate of the University of Adelaide. He completed his PhD on tertiary plant macrofossils in 1981, and his DSc on the interaction between climate change and the evolution of the living Australian vegetation in 1997. His first academic position was as Tutor in Botany at James Cook University in 1979. In 1980 he accepted a lecturing position in the Department of Botany at the University of Tasmania. He remained at the University of Tasmania until 1999, after being promoted to Professor in 1993. He was Head of the School of Plant Science for 6 years prior to his departure, and was awarded Professor Emeritus status by the University of Tasmania Council in 2000. In 1999 he returned to the University of

Adelaide as an Australian Research Council (ARC) Senior Research Fellow. In 2001 he was appointed Head of Science at the South Australian Museum, a position he still holds, and in 2003 became Head of the School of Earth and Environmental Sciences. He was appointed to his current position of Executive Dean of the Faculty of Sciences, University of Adelaide in September 2006. In this position he is responsible for about 330 staff, over 2000 undergraduate students, and a research budget in excess of $40 million annually.

During his career Bob has won many awards including the Clarke and Burbidge Medals for his research into the impact of long-term climate change on the evolution of Australian vegetation. In particular, he is interested in the impact of temperature change, declining water availability, low nutrients and increasing fire on the vegetation of southern Australia over the last 50 million years.

Dr Ivan Tomaselli

Professor of Wood Science and Technology
Federal University of Paraná, Brazil

Dr Ivan Tomaselli is Professor of Wood Science and Technology at Federal University of Paraná, Brazil. He completed his MSc in wood technology at Federal University of Paraná, Brazil in 1974 and his PhD in wood science from University of Melbourne in 1977.

Ivan's research activities include wood properties, wood drying, biomass energy, and wood utilisation.

Ivan is currently also Director of STCP Engenharia de Projetos Ltda, Curitiba, Brazil. He has a strong international consulting experience in South America, the Asia Pacific and Africa with organisations such as the United Nations Forum on Forests (UNFF), Centre for International Forestry Research (CIFOR, Indonesia), United Nations Development Program, International Tropical Timber Organisation, World Bank, and Food and Agriculture Organisation of the United Nations. His consulting experience includes assessment of sustainable management in tropical forests.

Dr Pablo L Peri

National University of Southern Patagonia (UNPA)
National Institute of Agricultural Technology (INTA)
CONICET

Dr Pablo Peri is Professor of Ecology and Management of Native Forests in the National University of Southern Patagonia. He is also a Head Researcher at the National Institute of Agricultural Technology and CONICET in South Patagonia. He holds a PhD in Plant Science from Lincoln University (New Zealand). Since 1993, his research involves the ecology, management and conservation of native *Nothofagus* forest in Southern Patagonia: silvicultural systems; ecophysiology; silvopastoral systems with *N. antarctica*; carbon storage and windbreak design. He leads national and international scientific partnerships on several research programmes and permanent plots in Southern Patagonia.

Publications from Conference Papers

Forest Ecology and Management Special Issue

Forest Ecology and Management (FORECO) have agreed to proceed with a 'Special Issue' of the journal that publishes selected papers from the conference.

The Guest Editors for this issue will be Drs Chris Beadle (Managing Editor), Steve Read, Alastair Richardson and Professor Gordon Duff, all from the Conference Organising Committee, and they will manage this process on behalf of FORECO. Submissions will be made through the FORECO online submission system, and a special site is being set up by the journal to handle the Special Issue. Access arrangements for this site are advised on the conference website.

The closing date for submissions will be Monday 31st March 2008. If you are interested in submitting your conference paper to FORECO, please discuss this with one of the Guest Editors at or after the conference. Contact chris.beadle@csiro.au

The journal has advised that the maximum number of articles published will be 10-20, and we anticipate that more papers will be submitted for consideration than can be published. The journal has pointed out that a primary requirement for selection for the Special Issue must be scientific quality, and that the papers recommended for publication by the Guest Editors will represent a coherent set of original papers which are clearly linked by an overall theme.

To help ensure these outcomes, the journal requires that the papers are subjected to the same peer-reviewing process as normally practised by the journal, i.e. review of each paper by at least two international specialists in the field covered. After refereeing, the Guest Editors then recommend to the Editors-in-Chief of FORECO the 10-20 papers to be published, and FORECO will make the final decision regarding acceptance for publication.

Please note that, if your submitted paper is accepted for the review process, the intention is to complete this procedure no later than 30th November 2008. The Guest Editors will work with authors and external reviewers to ensure that this date is met.

Tasforests

Authors who are presenting papers of regional interest are advised that the peer-reviewed journal *Tasforests* is publishing an issue based on Conference presentations and will accept submissions of manuscripts based on Conference contributions. The closing date for submissions to this journal is also 31st March 2008. Please note that if, your submitted paper is accepted for the review process, the intention is to complete this procedure no later than 30th November 2008. The *Tasforests* editorial board will work with authors and external reviewers to ensure that this date is met.

If you are interested in submitting your conference paper to *Tasforests*, please discuss this with Dr Steve Read, from the *Tasforests* editorial board, at or after the Conference or contact the*Tasforests* editors by email after the Conference. Contact steve.read@forestrytas.com.au or paul.adams@forestrytas.com.au

Authors should send their manuscripts to:

Dr Paul Adams
Editor, *Tasforests*
Division of Forest Research and Development
Forestry Tasmania
GPO Box 207
Hobart TAS 7001

Notes for contributors to *Tasforests* can be found at:

http://www.forestrytas.com.au/assets/0000/0132/instructions_to_authors.pdf

ABC Radio National – The National Interest

1800 - 1930, Sunday 17 February 2008

Bond Store, Tasmanian Museum and Art Gallery

The ABC Radio National program *The National Interest* will host a forum on old forests on Sunday 17 February, in association with the Old Forests New Management conference. The forum will be recorded on Sunday 17 February then broadcast on Sunday 24 February. Please visit The National Interest website to learn more about the program: http://www.abc.net.au/rn/nationalinterest.

Four panellists - with scientific backgrounds but differing perspectives - will respond to questions from the moderator, veteran Australian journalist Peter Mares. After each has shared their opinions and experience, the panellists will have the opportunity to discuss the issues raised. Finally, there will be an opportunity for members of the audience to ask questions of the panellists.

The event will be held at The Bond Store at the Tasmanian Museum and Art Gallery, an historic building constructed in 1824 that is located across the road from the conference venue. See http://www.tmag.tas.gov.au/

All Conference delegates are invited to attend the forum. The Conference Organising Committee is also inviting representatives from a variety of interest groups.

Old Forests, New Management,
In-conference tour notes

Wednesday 20 February 2008

The in-conference tour will visit the Warra Long Term Ecological Research site, in the southern forests of Tasmania (www.warra.com), approximately 90 minutes drive from Hobart.

There will be five buses travelling to Warra. Each of the buses has a different schedule and some buses visit different sites. All the buses will visit the Airwalk, the Warra Silvicultural Systems Trial and the Big Tree Reserve. Buses one and two (forest management) will go to the Warra 11 lookout to discuss forest management at the landscape scale. Buses 3 and 4 (biology/coarse woody debris) will go to a long-term log decay study site to discuss coarse woody debris and the wildfire chronosequence studies, and bus 5 (forest utilisation) will go to the Huon Wood Centre. Delegates are invited to read through these notes and then look at the schedule for each bus to work out which tour is of most appeal and delegates are requested to indicate in advance the tour on which they would prefer to go. A booking sheet for tours will be held at the conference registration desk.

The buses all leave from the Hotel Grand Chancellor (HGC). They will be ready for loading at 7.45 a.m. and they will leave at 8 a.m prompt. Delegates who are late will find some excellent cafes at Salamanca for a leisurely morning tea (head south along the waterfront from the HGC).

There will be an official Conference host on each bus. They will identify themselves early in the day. They can assist with information, first aid if required, and will carry a two-way radio. Mobile phone coverage is poor, and for most of the day we will be out of range.

It is important that all delegates wear closed shoes. Sneakers are acceptable, sandals are not. We are visiting working forests that contain bitey things, sticks, and rocks. Hats are advised as it could be hot and the sun here also bites. Drinks and snacks will be provided on each bus, but it would be smart to bring your own water bottle and suncream.

Lunch will be provided at the Tahune Airwalk (http://www.forestrytas.com.au/visiting/visitor-sites/south/tahune-airwalk). Delegates who require vegetarian or gluten-free meals should advise us when they are booking their tour.

At some sites hard hats and/or safety glasses will be provided. Visitors to Southwood who tour the regrowth sawmill will also be provided with ear protection.

Bathroom facilities are available at the Tahune site only.

Conference Tour - 20 February 2008					
	Bus 1.	**Bus 2.**	**Bus 3.**	**Bus 4.**	**Bus 5.**
	Forest Management	**Forest Management**	**Biology/CWD**	**Biology/CWD**	**Forest utilisation**
8:00	Depart Hobart	Depart Hobart	Depart Hobart	Depart Hobart	Depart Hobart
	Yellow	Blue	Green	Black	Red
	Bus host:	Bus host:	Bus host:	Bus host:	Bus host:
	Sean Riley	Fred Duncan	Neil Davidson	Marie Yee	Peter Pepper
9.00					
9.15				Log decay	Huon Wood Centre
9.30	Warra LTER	Big Tree Reserve	Big Tree Reserve		
9.45					
10.00	Huon pine walk	Warra LTER			
10.15		Huon pine walk	Warra SST		
10.30					
10.45		Airwalk	Warra LTER		
11.00	Warra SST		Huon pine walk	Warra SST	Warra LTER
11.15					Huon pine walk
11.30		Warra 11 lookout			
11.45			Lunch		Airwalk
12.00				Lunch	
12.15					Lunch
12.30	Lunch				
12.45		Lunch	Airwalk	Warra LTER	
13.00				Huon pine walk	Warra SST
13.15	Warra 11 lookout				
13.30			Log decay	Airwalk	
13.45		Warra SST			
14.00					
14.15				Big Tree Reserve	Big Tree Reserve
14.30					
14.45	Big Tree Reserve				
15.00	(time permitting)				

Location: Big Tree Reserve

All buses

The Arve Big Tree (a *Eucalyptus regnans*) is one of the largest trees in the Southern forests.

Topics: Wet eucalypt forest ecology, stand management and biodiversity conservation

Hosts: Steve Read, Amy Robertson and Tim Leaman.

Steve will outline wet eucalypt forest ecology.

Amy will outline the different types of forest stands (in terms of structure, time since last disturbance, floristics) and their spatial distribution in the southern forests, and the implications for the design and conduct of forest harvesting operations in these areas.

Tim will discuss management of natural and cultural values (or special values) at the coupe level. He will cover threatened species research and how it influences the identification and management of species and their habitats during coupe planning. Case studies to be discussed on the day include Giant Trees, the Wedge-tailed Eagle, the Mt Mangana Stag Beetle and the Swift Parrot.

Steve Read is Chief Scientist with the Division of Forest Research and Development at Forestry Tasmania and Chairman of the Conference Committee. Amy Robertson is the planning coordinator with the Huon District, Forestry Tasmania. Tim Leaman is a conservation planner with Forestry Tasmania.

Location: Warra Long Term Ecological Research (LTER) Site

All buses

At the western end of Huon river bridge at Tahune. Whilst at this site delegates will be able to view the world-famous Huon pine in its natural setting, and walk the Airwalk, which takes you through the eucalypt canopy and above the rainforest understorey, and to a lookout above the junction of the Huon and Picton rivers.

Topic: Long-term multi-disciplinary experiments

Hosts: Michael (Mick) Brown and Fred Swanson

Mick will discuss the rationale behind the establishment of LTER sites generally and the history of the Warra LTER site. Fred will talk about the history of, and recent developments, at the H.J. Andrews LTER site in Oregon, USA, and will compare the Australian and American use of LTER sites.

Michael Brown is a consultant conservation ecologist and Honorary Research Associate at the University of Tasmania and was previously Senior Botanist with Tasmanian National Parks and Wildlife Service and Chief Scientist, Forestry Tasmania.

Fred Swanson is the co-principal investigator at the H.J. Andrews LTER site. His current interests include geomorphology, physical disturbances, research-management-policy links, ecological effects of Mount St Helens eruptions, and collaboration of ecologists and nature writers.

Topic: Towards ecological silviculture

Host: Mark Neyland.

Location: Warra Silvicultural Systems Trial (SST) Stop 1

All buses

Mark will introduce delegates to the Silvicultural Systems Trial (SST), when and why the SST was established, safety and productivity of the trial, issues that arose during the establishment and key results. Delegates will get an opportunity to view most of the coupes in the trial, and to discuss the relative merits of each of the silvicultural systems applied in the trial.

Mark Neyland is the principal research scientist in Native Forests branch with Forestry Tasmania. He has been studying Tasmania's ecology for 27 years.

Topic: Variable retention silviculture

Host: Robyn Scott

Location: Warra Silvicultural Systems Trial (SST) Stop 2

All buses

Robyn will discuss the development of variable retention harvesting in the Pacific Northwest and its subsequent development for use in Tasmania. Variable retention was first used in Tasmania at the Warra SST, but in the last few years its use has been extended across Tasmania.

Robyn Scott completed her MSc on windthrow following variable retention harvesting at the University of British Columbia with Dr Steve Mitchell, and is continuing that collaboration as she works towards a PhD with the CRC for Forestry on the silviculture of variable retention harvesting here in Tasmania, whilst also employed by Forestry Tasmania as the variable retention silviculture research officer.

Topic: The biodiversity implications of variable retention

Host: Sue Baker

Warra SST research has found that birds, bryophytes, and beetles all respond positively to retaining elements of the old-growth forest after harvesting. Although edge-affected, the retained aggregates provide habitat for many species of vascular plant, bryophyte, bird and beetle. Biodiversity monitoring in recently harvested and burnt aggregated retention coupes statewide is comparing biodiversity metrics in aggregates to unlogged control forest.

Sue Baker is a research scientist with Forestry Tasmania. She is currently investigating how old-growth biodiversity responds to variable retention silviculture, with focus on beetles, vascular plants, habitat tree availability and rainforest health.

Topic: Biology of old-growth forests

Hosts: Simon Grove and Pep Turner

Location: Log decay site

Buses 3 and 4

Simon's presentation will cover some of the research undertaken at Warra aimed at understanding the biodiversity and dynamics of dead wood in a forest management context.

Pep will discuss fire and forest relationships. The southern forests are fire-derived and dynamic, and to understand them wildfire chronosequence plots, embedded in an experimental forest landscape, are being established to conduct landscape-level ecological research focusing on forest structure and biodiversity.

Simon Grove is FT's conservation biologist and contributes to the CRC for Forestry Biodiversity Project. While his professional remit is broad, he has a particular interest in researching and promoting what he calls 'deadwoodology'. Perpetua (Pep) Turner is a Bushfire CRC-funded Postdoctoral Research Fellow (School of Plant Science, UTas) based at Forestry Tasmania.

Location: Warra 11 lookout, Warra Road

Buses 1 and 2

From this site delegates can see the Tasmanian Wilderness World Heritage Area (WHA), extensive and intensive forest management, the Southwood integrated processing facility, agricultural districts and distant views of the summit of Mt Wellington.

Topic: Old-growth forest management regimes

Hosts: John Hickey and Jayne Balmer

John will discuss the history of the lower Weld Valley, Forestry Tasmania's 'forestry in the landscape' approach (showing a decrease in forest intensity from east to west), the effects of clearfell, burn and sow treatments on vascular plants, and the motivation to explore alternative silvicultural systems for use in tall wet forests.

Jayne will discuss the history of the reserve system in Tasmania, the comprehensiveness, adequacy and representativeness of the reserve network for the protection of Tasmania's forests, the international and national significance of the WHA with particular reference to the forests, and the management of the WHA with a particular focus on forest and fire management.

John Hickey has worked in Tasmanian forestry for three decades and now manages the Planning Branch of Forestry Tasmania. He has previously been a principal research scientist with Forestry Tasmania and has studied the ecology and silviculture of wet forests. Jayne Balmer is a Senior Ecologist with the Vegetation Conservation Section of Tasmania's Department of Primary Industries and Water, and has worked for more than 20 years as the WHA botanist.

Location: Huon Wood Centre

Bus 5 only

Topic: Intensive management

Host: Murray Kirkwood

The Huon Wood Centre takes timber predominantly from the forests that surround older forest elements (that is, it uses regrowth timber). Management of the whole forest landscape or estate is therefore necessary, not just the older forest elements in that landscape.

The facility comprises a state-of-the-art regrowth sawmill, a merchandising yard and a peeling plant that prepares sheets for later assembly into plywood and flooring materials. Delegates will have the opportunity to view each of these operations in action.

Murray Kirkwood has worked for Forestry Tasmania in a variety of roles for nearly 10 years. He is presently the Manager of the Huon merchandising yard.

Conference Themes

- Old-growth and other natural forests in the 21st century

Opening Plenary Speaker: Jerry Franklin

- Importance of forests to current societies
- Evolution of wet sclerophyll forests and other forest types
- Recent history of temperate old-growth forests – utilisation by aboriginal peoples and utilisation following subsequent settlement
- Social pressures on forests

Theme 1: Social and historical importance of old-growth forests

Keynote Speaker: Peter Kanowski

- Global range of temperate forests
- Forest types and succession
- Ecological dynamics and natural disturbance regimes
- Biodiversity values
- Management of coarse woody debris
- Genetic processes
- Fragmentation and landscape ecology

Theme 2: Biology of old-growth forests: structure, biodiversity and ecological dynamics

Keynote Speakers: David Lindenmayer, Juan Armesto, Sally Aitken

- LTERs and other long-term sites
- Silvicultural systems trials
- Warra, MASS, Demo, EMEND &c.

Theme 3: Long-term, multi-disciplinary experiments

Keynote Speakers: Fred Swanson, Michael Brown

- Forest conservation goals
- Defining and managing reserves
- Maintaining viable populations
- Responses to climate change

Theme 4: Conservation and reserve management

Keynote Speakers: Antonio Lara

- Retention of old-forest elements
- Alternative harvesting methods and biodiversity implications
- Whatever happened to clearfelling?
- Restoration of old-forest elements

Theme 5: Towards ecological silviculture in old-growth forests

Keynote Speaker: Bill Beese

- Regulatory systems/approaches and codes of practice
- Conservation outcomes
- Social perceptions
- Policy outcomes
- Model forests
- Regional challenges to old-growth forest management: Pacific Northwest, Australia, South America, Scandinavia, Central Europe

Theme 6: Shaping old-growth forest management regimes

Keynote Speakers: Graham Wilkinson, Ben Cashore

- Silviculture for old-growthness

Closing Plenary Speaker: Juergen Bauhus

Program

Sunday 17 February 2008

1530 - 1700	Registration, Hotel Grand Chancellor
1700 - 1800	Welcome Drinks, Bond Store, Tasmanian Museum and Art Gallery
1800 - 1930	Hosting of *The National Interest* radio program on management of old forests to be recorded by Radio National, Bond Store, Tasmanian Museum and Art Gallery

Monday 18 February 2008

0800	Registration
0830	Welcome to Country
	Official Opening by The Governor of Tasmania, His Excellency, the Honourable William Cox, AC RFD ED
	Conference Introduction – Representative of the Australian Commonwealth Government, Tony Bartlett, General Manager, Forest Industries Branch, Department of Agriculture, Fisheries and Forestry
	Conference Introduction – Representative of the Tasmanian State Government, Hon. Steven Kons, Minister for Resources
	Conference Introduction – Representative of the Australian Academies, Professor James Reid, University of Tasmania
0915	Conference Overview **Prof. Gordon Duff**, Co-operative Research Centre for Forestry, Tasmania
0920	**Opening Plenary Address** Chair: Dr Steve Read *What about old-growth and other natural forests in the 21st century?* **Prof. Jerry F Franklin**
1000	Morning Tea
	Theme 1: Social and historical importance of old-growth forests Chair: John Spence Ballroom 2/3
1030	**Keynote Address** *The social and historical importance of old-growth forests* **Peter Kanowski**
1100	Mysterium tremendum: *The psychology of reverence for old-growth forests* **Kathryn Williams**
1120	*Is beech native to Northern Europe? Evidence for close anthropogenic control of beech establishment in old-growth Scandinavian forests* **Matts Lindbladh**
1140	*Rotation of silver fir and European beech in Carpathians – developmental cycle or linear trend?* **Tomas Vrska *, Libor Hort, Dusan Adam, Tomas Kolar**
1200	*Old-growth forests – ancient pieces in a modern jigsaw* **Bob Hill**
1220	Lunch

	Theme 2: Biology of old-growth forests	
	Chair: John Hickey	Ballroom 2/3
1320	**Keynote Address** *Perspectives on old-growth – insights from mainland eastern Australia* David Lindenmayer	
1350	**Keynote Address** *Old-growth forests – function and dynamics in southern South America* Juan Armesto*, A Gutierrez, C Smith-Ramirez, C Perez, I Diaz, C Cornelius, M Carmona, F Diaz, D Christie, M Willson	
1420	**Keynote Address** *Can native populations of long-lived forest trees adapt to rapidly changing climates?* Sally Aitken	
1450	Afternoon Tea	
	Theme 2: Biology of old-growth forests	
	Chair: Brad Potts	Ballroom 2/3
1520	*Genetics of a foundation tree species drives community structure, biodiversity, stability and ecosystem processes: The importance of a community genetics perspective in the dynamics of old-growth forests* Thomas Whitham	
1540	*Coarse woody debris, old trees and biodiversity conservation in production forests* Simon Grove *, Anna Hopkins, Katherine Harrison, Marie Yee, Lee Stamm, Tim Wardlaw, Caroline Mohammed	
1600	*Old trees, flammable forests and global climate change* David Bowman	
1620	Close of Session	
1745	Coaches depart Hotel Grand Chancellor	
1800	Government House Reception	
1900	Coaches return to Hotel Grand Chancellor	

Tuesday 19 February 2008

0800	Registration	
	Theme 3: Long-term, multidisciplinary experiments	
	Chair: Tim Clancy	Ballroom 2/3
0830	**Keynote Address** *Perspectives on old forests from the Pacific Northwest (USA) and Andrews Forest* Fred Swanson	
0900	**Keynote Address** *Long-term ecological research at Warra, Tasmania: The first fifteen years, and what next?* Michael Brown*, Simon Grove	
0930	*Ecological and aesthetic effects of variable-retention harvests in the northwestern United States: Initial results from the DEMO study* Keith Aubry *, Charles Peterson	
0950	*EMEND: A comparison of natural and anthropogenic disturbance on a forested boreal landscape* John Spence *, Jan Volney , David Langor, Ellen Macdonald	
1010	*Developing variable retention silviculture in Tasmania* Robyn Scott	

1030	Morning Tea		
	Theme 4: Conservation and reserve management Chair: David Bowman		Ballroom 2/3
1100	**Keynote Address** *Conservation and management of rainforests in Southern Chile* Antonio Lara*, P. Donoso, L. Nahuelhual		
1130	*A comparison of old-growth ecology and conservation in the Pacific Northwest USA and south-eastern Australia* Thomas Spies		
1150	*Maintaining forest structure in reserves: A case study of three Western Australian eucalypt forests* Jack Bradshaw		
1210	*Old-growth forest areas and their reservation status across Australia* Adam Gerrand, Stuart Davey, Tim Clancy *, Geoff Dunn		
1230	Lunch & Poster Session		
1330	**Concurrent Sessions**		
	Biology Ballroom 1 Chair: Alastair Richardson	**Genetics** Ballroom 2 Chair: Sally Aitken	**Ecology** Ballroom 3 Chair: Jayne Balmer
1330	*Lichens and bryophytes: Little plants, big message* Gintaras Kantvilas*, Jean Jarman, Peter Minchin	*Seed dispersal of the bird-dispersed tree* Aextoxicon punctatum *in old-growth forest fragments: A modelling approach* Mariela Cecilia Nuñez Avila *, Maria Uriarte, Pablo Angel Marquet, Juan Jose Armesto	*Long-term ecological experiments in New South Wales forests* Rod Kavanagh *, Trent Penman, Bradley S Law
1345		*Phylogeography and refugia of disjunct populations of* Eucalyptus regnans *of south-eastern Australia* Paul Nevill *, Gerd Bossinger, Peter Ades	*Alternatives to clearcutting in the old-growth temperate rainforests of south-east Alaska* Michael McClellan *
1400	*Tree age as a key factor for the distribution of epiphytes in beech forest* Örjan Fritz*, Mats Niklasson, Marcin Churski	*The breeding system of the forest giant,* Eucalyptus regnans Rod Griffin *, Craig Hardner, Peter Buxton, Brad Potts	*Rethinking the paradigm of stand -replacing wildfire in Tasmania's southern forests* Perpetua Turner *, Simon Grove, Chris Barry, Craig Airey
1415	*How well does aggregated retention cater for early and late successional macrofungi?* Genevieve Gates*, David Ratkowsky, Simon Grove	*Managing complex forest tree gene pools: The case of* Eucalyptus globulus *in southeastern Australia* Rebecca Jones *, Dorothy Steane, Brad Potts, Rene Vaillancourt	*Temperate overstorey eucalypt decline is related to altered vegetation dynamics and nutrient cycling in the long absence of fire* Dugald Close *, Neil Davidson
1430	*A coarse filter approach to conserving arthropod biodiversity in Canadian forests* David Langor*, James Hammond, Greg Pohl	*A species exposed: The hidden diversity in* Eucalyptus globulus Dorothy Steane *, Rebecca Jones, Tim Jones, Susan Foster, Greg Dutkowski, Gay McKinnon, René Vaillancourt, Brad Potts	*The impact of timber harvesting on the size, amount, and decay status of large coarse woody debris in the jarrah (*Eucalyptus marginata*) forest* Kim Whitford

1445	*Factors influencing saproxylic beetle diversity in south Swedish beech forests* Jörg Brunet*, Gunnar Isacsson	*Genetic diversity in* Eucalyptus globulus *is affected by hybridisation with the rare species* Eucalyptus cordata Gay McKinnon *, Brad Potts	*Quantifying the canopy nectar resource and the impact of logging and climate in eucalypt forests* Bradley Law *, Mark Chidel
1500	*The distribution of red-listed saproxylic beetles in old-growth reserves and managed forests: Implications for conservation* Joakim Hjältén	*Chloroplast DNA reveals genetic legacy of ice ages in the rainforest species* Nothofagus cunninghamii James Worth *, René Vaillancourt, Greg Jordan, Gay McKinnon	*An analysis of mixed forests under low stand density control and long-rotation silviculture: A case study in Jingu Shrine forest, Mie Prefecture, Japan* Tohru Nakajima *, Satoshi Tatsuhara, Norihiko Shiraishi
1515	*Living* Eucalyptus obliqua *trees and logs as habitat for wood-inhabiting fungi in southern Australia* Anna Hopkins, Simon Grove, Tim Wardlaw, Caroline Mohammed	*Genetic variation in* Eucalyptus globulus *drives forest community structure and ecosystem processes* Robert Barbour *, Julianne O'Reilly-Wapstra, Lynne Forster, Sue Baker, Michelle Storer, Jennifer Schweitzer, Joe Bailey, Jonathan Humphreys, Jules Freeman, René Vaillancourt, Thomas Whitham, Brad Potts	*The effects of silvicultural thinning on bird populations in Boola Boola State Forest, Victoria* Wendy Wright*, Rachel Barr
1530	Afternoon Tea		
1600	**Concurrent Sessions**		
	Process & Structure Ballroom 1 Chair: Chris Beadle		**Conservation & Landscape Management** Ballroom 3 Chair: Andrew Blakesley
1600	*The role of old-growth forest in the global C-cycle* Ernst-Detlef Schulze *, Sebastiaan Luyssaert, John Grace		*Landscape and social perceptions of Tasmania's old forest: Then and now* Gwenda Sheridan
1615	*Assessing the vulnerability of Victoria's Central Highland forests to climatic change* Craig Nitschke *, Gordon Hickey, Rodney Keenan, Stefan Arndt		*Management of old forests by the Tasmanian Parks and Wildlife Service* Peter Mooney*, Anni McCuaig, Adrian Pyrke, Jayne Balmer, Tim Rudman
1630	*Does the increasing concentration of atmospheric CO_2 mean more productive forests?* Mark Hovenden		*The importance of large-scale interdisciplinary forestry experiments in providing information for emerging management issues in the western United States* Charles Peterson, Paul Anderson
1645	*Hydraulic architecture and transpiration of old-growth* Eucalyptus marginata *Donn. Ex. trees in south-western Australia* Craig Macfarlane *, Donald White, Richard Silberstein		*Conservation of threatened invertebrates in Tasmania's production forests* Sarah Munks, Phil Bell*, Karen Richards

1700	*Water and stand management in the world's most productive temperate hardwood forests* Sebastian Pfautsch *, Tim Bleby, Heinz Rennenberg, Mark Adams		*Research informs the improvement of hollow tree retention measures in Tasmania's production forests* Amelia Koch *, Sarah Munks
1715	*Drought and topographic effects on ecosystem d2H, d13C and d18O and growth and hydrology of eucalypt-*Nothofagus *ecosystems at Mt Donna Buang, Victoria* Mark Adams *, Sebastian Pfautsch, Heinz Rennenberg, Chris Weston, Arthur Gessler		*When nature takes over from man: How fast are old-growth characteristics re-appearing in strict forest reserves in Flanders and north-west Europe ?* Kris Vandekerkhove *, Luc De Keersmaeker, Ruben Walleyn
1730	*Effects of natural small-scale disturbances on light conditions, regeneration patterns and understorey plant species diversity in an old-growth evergreen* Nothofagus betuloides *forest in Tierra del Fuego, Chile* Alvaro Promis *, Albert Reif, Stefanie Gärtner, Gustavo Cruz		*Measuring forest maturity within an experimental forest landscape to inform conservation planning in Tasmania* Marie Yee *, Ruiping Gao, Simon Grove, John Hickey
1745	*A methodology for modelling canopy structure: An exploratory analysis in the tall wet eucalypt forests of southern Tasmania* Ian Scanlan, Chris McElhinny Presented by: Perpetua Turner		*Restoration of a degraded coast redwood forest in north-west California* Kevin O'Hara, Daniel Porter *, William Libby
1800 - 1900	Poster Session and Wine and Cheese Evening		

Wednesday 20 February 2008

0730 - 0830	Registration
0730 - 1630	Conference Field Trips, includes transport and lunch (Boarding at 0745)
1830	Coaches from the Hotel Grand Chancellor depart for the Conference Dinner
1900 - 2330	Conference Dinner, Meadowbank Vineyard

Thursday 21 February 2008

0800	Registration	
	Theme 5: Toward ecological silviculture Chair: Tim Wardlaw	Ballroom 2/3
0830	**Keynote Address** *Implementation and monitoring of variable retention harvesting in old-growth forests of coastal British Columbia, Canada* William J (Bill) Beese	
0900	*The potential for uneven-aged silviculture in restoration and management of old forests* Kevin O'Hara, David Porter, William Libby	
0920	*Forest management and conservation of* Nothofagus *forests in south Patagonia, Argentina* Pablo Luis Peri *, Guillermo Martinez Pastur, Maria Vanessa Lencinas	

0940	*Process domains: A useful concept for characterising disturbance and successional trajectories in temperate rain forests* Stephen Mitchell		
1000	*Is single tree selection suitable for Tasmania's wet eucalypt forests? Lessons from the European experience* Andreas Rothe *, Mark Neyland, John Hickey		
1020	Morning Tea		
1050	**Concurrent Sessions**		
	Ecological Silviculture Ballroom 1 Chair: Kevin O'Hara	**Forestry Management** Ballroom 2 Chair: Sean Riley	**Management Regimes** Ballroom 3 Chair: Loren Kellogg
1050	*Feasibility of burning debris from forest harvested with the aggregated form of variable retention* Richard Chuter	*Modelling of timber yield implications of variable retention* Michael McLarin	*Designing old forest for the future: Informing policy and practice* Richard Loyn *, Edward McNabb, Phoebe Macak
1105	*Stocking and early growth of the regeneration in the Warra silvicultural systems trial, Tasmania, Australia* Mark Neyland *, John Hickey, Prof Juergen Bauhus, Chris Beadle, Neil Davidson, Leigh Edwards	*Researching high-value markets for eucalypt timber from old-growth forests* Mark Leech	*Learning from the past, surviving the present and managing for the future: Logging, restoration and conservation on the Tongass National Forest* Lisa Crone
1120	*Using variable retention harvesting to manipulate canopy species dominance and regeneration in* Nothofagus ceratopetalum *cool temperate rainforest* Ross Peacock	*Timber from mature eucalypts: We like it and will miss it when it's gone* Gregory Nolan	*Design of variable retention harvesting and monitoring programs in old-growth* Nothofagus pumilio *forests of South Patagonia, Argentina* G. Martínez Pastur, P.L. Peri, M.V. Lencinas, A.S. Moretto, J.M. Cellini, R. Soler Esteban
1135	*Variable retention and old-growth biodiversity: Forestry Tasmania's goals and monitoring program* Sue Baker, Simon Grove, Steve Read, Tim Wardlaw*	*The safety implications of aggregated retention harvesting in tall wet eucalypt forests in Tasmania, Australia* Greg Howard	*Managing the tree hollow resource in the matrix: From guiding principles to on-ground practices* Sarah Munks *, Mark Wapstra, Amelia Koch
1150	*Early responses of bird assemblages to clearfelling and its alternatives at Warra, Tasmania* Paul Lefort *, Simon Grove	*Integrated farm forestry: Stand structure and diversity in five silvicultural regimes including old-growth* E.obliqua *forest, northern Tasmania* Greg Unwin, John Lord*, Arthur Lyons	*Aligning social values and management of old forests* Rebecca Ford *, Kathryn Williams, Ian Bishop
1205	*Early responses of ground-active beetle assemblages to clearfelling and its alternatives at Warra, Tasmania* Simon Grove, Sue Baker*, Dick Bashford, Lynette Forster, Kevin Bonham, Russel Lewis-Jones, Georgina Brown	*Effect of agricultural land management on the health of old-growth eucalypts in the Midlands of Tasmania* Neil Davidson *, Dugald Close, Michael Battaglia, Keith Churchill, Maria Ottenschlaeger, Tim Watson, Jody Bruce	*A Western Australian solution? A plan for a sustainable estate of old-growth forests* John Meachem, Phil Shedley *
1220	*Creating dead wood in commercial forests to mimic features in natural forest* Markus Abrahamsson *, Matts Lindbladh	*Forestry and agriculture are coexistent issues in most countries in developing regions* Raquel Lopez, Paul L.G. Vlek, Eric Craswell*	*Forest management and regulation in Gondwana's southern outposts: Tasmania and Tierra del Fuego* Fred Duncan*, Leonardo Collado, Gustavo Cruz (20 minutes)

1235	*Victorian Salvage Harvesting Prescriptions – juggling timber and environmental recovery after megafire* Tuesday Phelan	*Forest management based on traditional community in Papua, Indonesia* Paulus Mandibondibo	
1250	Lunch		
	Theme 6: Shaping old-growth forest management regimes Chair: Peter Kanowski		
1350	*Ecosystem-based management in British Columbia, Canada's coastal temperate rainforests* Andy MacKinnon		
1410	*Evolving management of Tasmania's tall old-growth forests* John Hickey		
1430	*Combining old-growth, regrowth and plantation timber for sustainable trade* Ivan Tomaselli		
1450	**Keynote Address** *Age discrimination – a regulatory dilemma for the management of old-growth* Graham Wilkinson		
1520	**Keynote Address** *New solutions for old-growth?* Benjamin Cashore		
1550	Afternoon Tea		
1620	**Synthesis** Chair: Steve Read *Old forest conservation and restoration* David Bowman *New management paradigms for sustainable timber harvesting* Bill Beese *The future of old forests* Pablo Peri		
1650	**Closing Plenary Address** Chair: Steve Read *Silviculture for old-growthness* Prof. Juergen Bauhus*, Prof. Klaus Puettmann, Prof. Christian Messier		
1730	Closing remarks		
1740	Close		

Poster List

1. *Assessment of forest naturalness in the Czech Republic and its use in policy and management*
   Dušan Adam, Tomáš Vrška, Libor Hort, Pavel Unar
2. *Recreating the eucalypt regeneration niche in degraded remnants in production landscapes*
   Tanya Bailey, Neil Davidson, Dugald Close
3. *Habitat tree retention in alternatives to clearfelling*
   Sue Baker, Chris Spencer, Anne Chuter, Leigh Edwards, Amy Koch, Sarah Munks
4. *Beetle assemblages in streamside reserves are edge-affected compared to unlogged forest*
   Sue Baker, Russel Lewis-Jones, Tegan Kelly, Stewart Alexander, Alastair Richardson
5. *Management of Tasmania's giant trees*
   Jayne Balmer, John Hickey, Timothy Leaman
6. *Will pollen-mediated gene flow from industrial* Eucalyptus *plantations impact on the genetic integrity of native eucalypt forests in Australia?*
   Robert Barbour, René Vaillancourt, Brad Potts
7. *The usefulness (and otherwise) of measuring ecosystem processes in small headwater streams*
   Leon A. Barmuta, Joanne Clapcott
8. *Cryptogamic diversity on coarse woody debris*
   Belinda J Browning, Patrick Dalton, Perpetua Turner, Gregory Jordan
9. *Den use by the common brushtail possum* Trichosurus vulpecula fuliginosus *in logged and unlogged dry forest in SE Tasmania*
   Lisa Cawthen, Sarah Munks
10. *Silviculture treatments for old-growth forests dominated by* Nothofagus betuloides *in southern Patagonia, Chile*
    Gustavo Cruz, Alvaro Promis, Harald Schmidt
11. *Effectiveness of wildlife habitat strips in maintaining vegetation structure and composition in Tasmanian wet eucalypt forest*
    Fred Duncan, Anne Chuter, Michael Brown, Simon Grove
12. *Where's Wally's wattle? Management of old-growth stands of* Acacia pataczekii *in north-east Tasmania*
    Fred Duncan, Nina Roberts, Anne Chuter, Tim Leaman, Simon Davies, Adrian Walls
13. *Native earthworm species diversity, abundance and biomass in a wet eucalypt forest ecosystem (Warra LTER Site)*
    Susan Emmett
14. *Assessing the effect of habitat type and disturbance on population size and structure, and physiological parameters, in the common brushtail possum* (Trichosurus vulpecula)
    Erin Flynn, Sue Jones, Sarah Munks
15. *Macrofungal diversity as a tool in the sustainable management of coarse woody debris*
    Genevieve Gates, Caroline Mohammed, Neil Davidson, Tim Wardlaw, David Ratkowsky
16. *The effectiveness of wildlife habitat strips in maintaining mature forest carabid beetle assemblages*
    Simon Grove, Belinda Yaxley, Robert Taylor
17. *Long-term responses of mollusc assemblages to partial harvesting, wildlife habitat strip retention and wildfire*
    Simon Grove, Robert Taylor, Kevin Bonham, Robert Mesibov
18. *A long-term experimental study of saproxylic beetle succession in Tasmanian* Eucalyptus obliqua *logs*
    Simon Grove, Dick Bashford, Marie Yee
19. *Engendering ecological research at broad spatial and temporal scales through establishing an Experimental Forest Landscape*
    Simon Grove, Marie Yee, Ruiping Gao
20. *Saproxylic beetles and industrial fuelwood harvesting: retrospective studies in Tasmania's Southern Forests*
    Simon Grove, Marie Yee, Sarah Nash
21. *Projections for coarse woody debris in Tasmanian wet eucalypt forest under a range of disturbance regimes*
    Simon Grove, Lee Stamm
22. *Estimating decay rates for* Eucalyptus obliqua *coarse woody debris in Tasmania using a chronosequence approach*
    Simon Grove, Chris Barry, Lee Stamm
23. *Successional pathways in the development of wood decay in Tasmanian* Eucalyptus obliqua*: from living tree to rotten log*
    Anna Hopkins, Simon Grove, Kate Harrison, Marie Yee, Tim Wardlaw, Caroline Mohammed
24. *Succession-based management of blackwood swamp forests in north-west Tasmania*
    Sue Jennings, Fred Duncan, John Pannell
25. *The effect of climate change and atmospheric CO_2 elevation on carbon dynamics of mountain ash forests*
    Kenichi Kurioka, Jason Beringer, Lindsay Hutley, A. David McGuire, Eugenie S. Euskirchen
26. *Implications of new management of old-growth forests for the leatherwood nectar resource*
    Tim Leaman, Ruiping Gao, John Hickey

27. *Changes in structure and composition in an old-growth temperate rainforest stand in British Columbia, Canada*
Andy MacKinnon, Sari Saunders

28. *FORESTCHECK – monitoring biodiversity in jarrah* (Eucalyptus marginata) *forest managed for timber harvesting*
Lachlan McCaw, Richard Robinson
Presented by Kim Whitford

29. *The legal requirements of sustainable forest management*
Rowena Maguire

30. *Genome sharing patterns in south-east Australian eucalypts*
Paul Nevill, Gerd Bossinger, Peter Ades

31. *The impact of harvesting disturbance on the floristics of the Warra silvicultural systems trial*
Mark Neyland, David Ziegeler

32. *Forest carbon use efficiency: Is net primary production a constant fraction of gross primary production?*
Kazuharu Ogawa

33. *Protected forest areas in Europe: Different backgrounds and different approaches for similar goals.*
Jari Parviainen, Kris Vandekerkhove, Georg Frank, Declan Little

34. *Variation in coarse woody debris attributes in Tasmanian tall wet* Eucalyptus obliqua *forest*
Julia Sohn, Chris M. McElhinny, Simon Grove, Perpetua Turner, Juergen Bauhus

35. *Woodland caribou and mountain pine beetle – A challenge for Alberta forest managers*
Eiry Spence, Ben Poltorak

36. *A five-point decay-class system for coarse woody debris in Tasmanian wet eucalypt forests*
Lee Stamm, Simon Grove

37. *A framework for modelling downed woody debris dynamics, and a case study from Tasmania*
Lee Stamm, Simon Grove

38. *Sensitivity of saproxylic Coleopterans to modern forestry: Implications for conservation strategies*
Fredrik Stenbacka, Joakim Hjältén, Jacek Hilszczanski

39. *Effect of taking in the atmosphere of the old forest*
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40. *Just scratching the surface? The impact of the superb lyrebird* (Menura novaehollandiae) *in Tasmanian forest ecosystems*
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41. *Epiphytic soil characterisation in emergent trees* Eucryphia cordifolia *(Eucryphyaceae), in a coastal temperate forest of Chiloé, Chile*
Camila Tejo, Iván Díaz, Martín Carmona, Maurice Peña, Cecilia Pérez, Juan Armesto

42. *Ecology and habitat use of the Tasmanian masked owl* Tyto novaehollandiae castanops
Michael K. Todd, Sarah Munks, Alastair Richardson, Phil Bell, David Bowman, Rod Kavanagh

43. *Establishment of a set of wildfire chronosequence benchmark plots in southern Tasmania*
Perpetua Turner, Simon Grove,Craig Airey, Chris McElhinny, Ian Scanlan, Julian Power, Oliver Strutt, Julia Sohn

44. *Managing threatened flora in wood production forests in Tasmania: A pragmatic approach*
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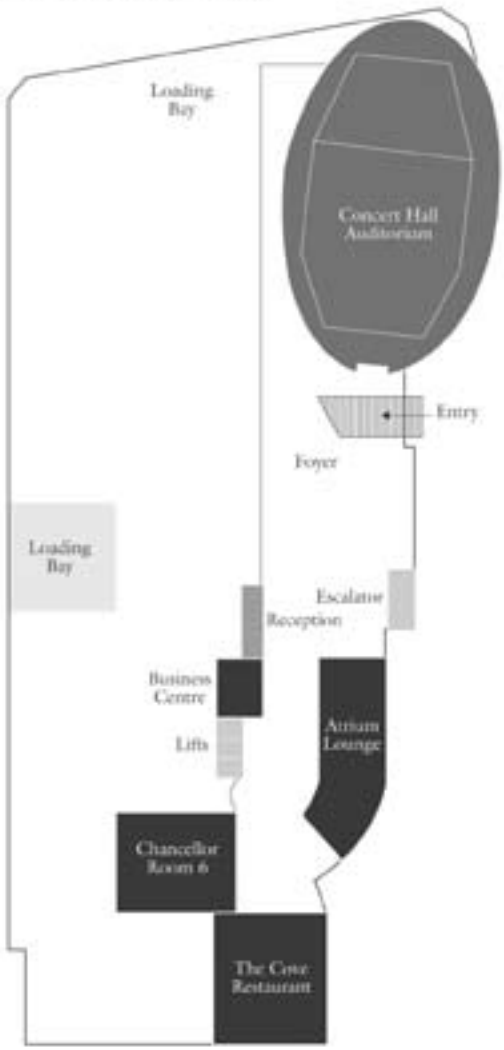
45. *Local adaptive differentiation within* Eucalyptus obliqua
Graham Wilkinson, Petra Strich, Peter Ades, Brad Potts

46. *How old are old-growth forests? Using dendrochronology to investigate the age and fire history of* Eucalyptus regnans *forests in Tasmania*
Sam Wood, David Bowman, Kathy Allen

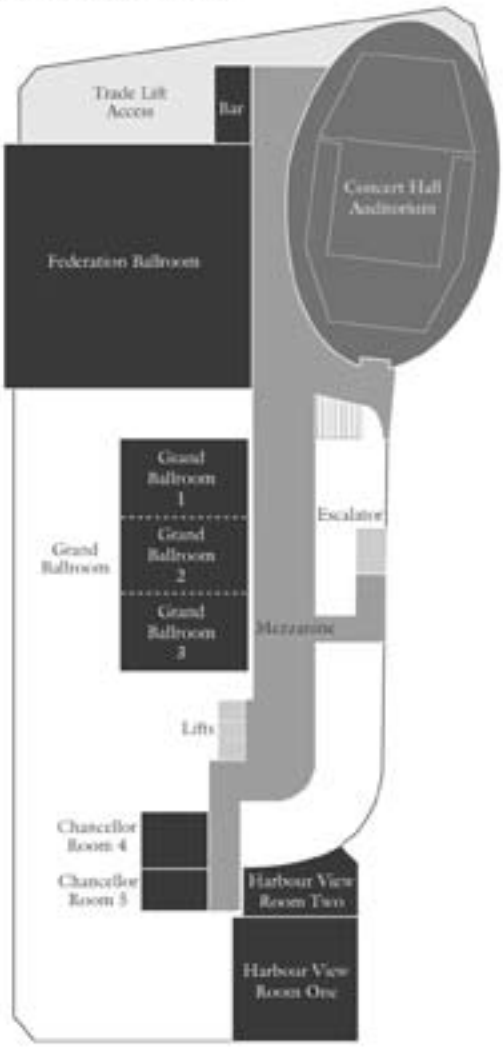
47. *Biology and conservation ecology of selected saproxylic beetle species in Tasmania's southern forests*
Belinda Yaxley

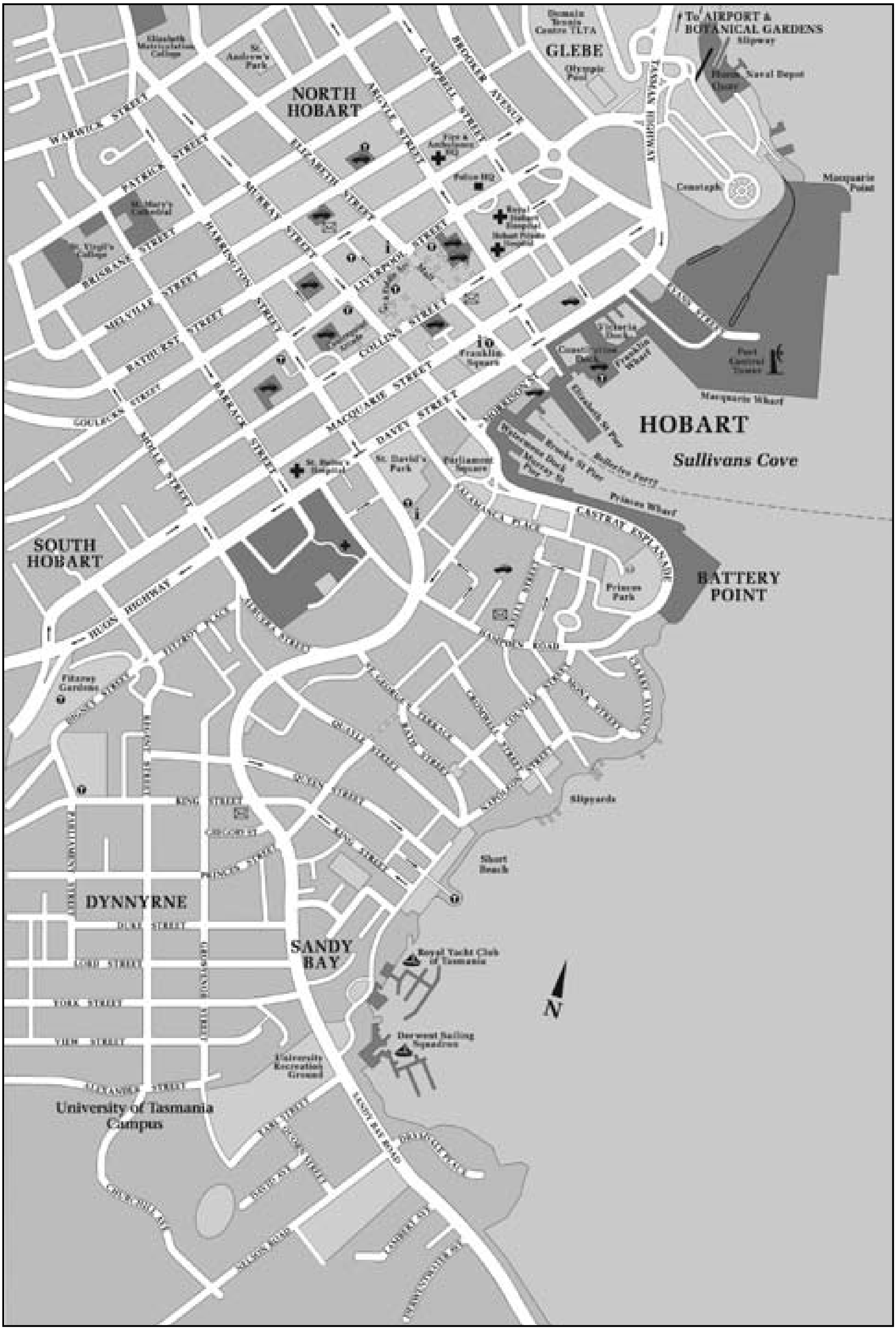
Hotel Grand Chanellor Floor Plan

GROUND FLOOR PLAN



FIRST FLOOR PLAN





To AIRPORT & BOTANICAL GARDENS
Slipway
Naval Depot
Domain Tennis Centre TLTA
GLEBE
Olympic Pool
NORTH HOBART
TASMAN HIGHWAY
BROOKER AVENUE
CAMPBELL STREET
ARGYLE STREET
ELIZABETH STREET
MURRAY STREET
HARRINGTON STREET
BARRACK STREET
WARWICK STREET
PATRICK STREET
BRISBANE STREET
MELVILLE STREET
BATHURST STREET
LIVERPOOL STREET
COLLINS STREET
MACQUARIE STREET
DAVEY STREET
GOULBURN STREET
MOLLE STREET
St. Andrew's Park
St. Mary's Cathedral
St. Virgil's College
Elizabeth Matriculation College
Police HQ
Royal Hobart Hospital
Cenotaph
Macquarie Point
Victoria Dock
Franklin Wharf
Franklin Square
Port Control Tower
Macquarie Wharf
HOBART
Sullivans Cove
Elizabeth St Pier
Brooke St Pier
Murray St Pier
Princes Wharf
St. David's Park
Parliament Square
St. Helen's Hospital
SALAMANCA PLACE
CASTRAY ESPLANADE
BATTERY POINT
Princes Park
SOUTH HOBART
HUON HIGHWAY
HAMPDEN ROAD
Fitzroy Gardens
KING STREET
QUEEN STREET
Slipyards
Short Beach
DYNNYRNE
DUKE STREET
LORD STREET
YORK STREET
VIEW STREET
ALEXANDER STREET
SANDY BAY
Royal Yacht Club of Tasmania
Derwent Sailing Squadron
University Recreation Ground
University of Tasmania Campus
SANDY BAY ROAD
NELSON ROAD
CHURCHILL AVE
N

Abstracts

Monday 18th February

Opening Plenary Address

What about old-growth and other natural forests in the 21st century?

Jerry F. Franklin

College of Forest Resources, University of Washington, Seattle, USA

The 21st century is unfolding as a time of unprecedented environmental and social change, with significant consequences for forests and societal views of their multiple values. Climate change is the most pervasive of the environmental changes and is becoming most obvious in altered disturbance regimes (wildfire, outbreaks of forest pests and pathogens, and intense storms), which are accelerating loss of existing natural forests and the habitat that they provide. Globalization of the wood products industry has focused production forestry on intensively managed plantations of eucalyptus and pines located primarily in the southern hemisphere; consequences include a global surplus of wood fiber and dramatically reduced markets for wood produced by long-term management (as opposed to simple exploitation) of natural forests. Hence, *uncertainty and highly disruptive change* are key contextual elements for forest management and challenge societies to develop policies and practices reflecting this reality. For example, it would seem appropriate to put greater emphasis on managing forests to reduce risks of catastrophic events with consequent loss of critical forest services and increasing – rather than reducing – options for future generations. Old-growth and other structurally-complex natural forests provide irreplaceable habitat for forest biodiversity, including many specialized biota, and perform diverse and important ecological services, such as by protecting watersheds and sequestering carbon. The extent of these forests likely will continue to decline locally and globally, despite the critical roles that they play; we can expect climatically-generated disruptions to greatly accelerate their loss. Such prospects argue for an emphasis on conserving such forests where they currently exist. Utilizing such forests as raw materials for production of common fiber-based products seems inappropriate. If such forests are harvested they should be utilized as sources of specialized and value-added products. Furthermore, the silvicultural practices used should conserve the structural, compositional, and functional diversity of these forests. A large and expanding body of scientific knowledge about old-growth and other natural forests provides a sounder basis for ecologically-based management.

Keynote Address

The social and historical importance of old-growth forests

Peter Kanowski

The Fenner School of Environment and Society, The Australian National University, Canberra;
CRC for Forestry, Hobart, Tasmania

Old-growth forests have been, and remain, important to people for reasons that are both compelling and diverse – ranging from the sacred to the profane, from the spiritual to the utilitarian, and from the realised to the imagined. Old forests appear to have been important to most societies throughout history, for each of these reasons. Over the past 500 years, since the Age of Exploration, old-growth forests have become important globally, as trade has expanded and the forest frontier receded. Their importance was initially a consequence of both the economic resources and the opportunity costs they represented; more recently, it has been a consequence more of their increasing scarcity and of postmodernity, in which they have assumed iconic status. The particular environmental, economic and social values of old-growth forests mean that they will continue to be important, to individuals and to societies, for a variety of reasons, and that - as a result - their management will continue to challenge us.

Mysterium tremendum: The psychology of reverence for old-growth forests

Kathryn Williams

University of Melbourne, Burnley Campus, Richmond, Victoria

This paper explores the psychological basis for the spiritual significance of old trees and old-growth forest, and the challenges and opportunities this poses for forest management. Based on Jungian psychology, the deep emotional resonance of old forests might be understood as arising from unconscious association of old trees with culturally shared archetypes of continuity, connectedness and the mystery of life. Based on evolutionary psychology, this significance might be attributed to biophilia, or a genetically driven appreciation of all life. Both theory and empirical research suggests that moments of awe and wonder in the presence of old trees and forest are experienced by people from all perspectives on forest management. Popular media provides many examples of how these experiences are valued and reinforced. While the significance of spiritual connection to forest is recognised in forest policy, including criteria for sustainable forest management, it is not easily translated into management practice. In part this reflects the difficulty of measuring and mapping the 'ineffable'. It may also relate to the challenge that strong emotion presents for rational paradigms of forest management, or to a concern that attempting to measure or explain spiritual connections to forest detracts from the significance of this relationship.
The paper will consider opportunities for better integration of the spiritual dimensions of human-forest relationships in management of old-growth forests.

Is beech native to northern Europe? Evidence for close anthropogenic control of beech establishment in old-growth Scandinavian forests

Matts Lindbladh

Southern Swedish Forests Research Centre, Alnarp, Sweden

Beech (*Fagus sylvatica*) and spruce (*Picea abies*) started to spread into southern Scandinavia during the Bronze Age (ca 1000 BC), but in some places they established as recently as during Modern Times (AD 1500-). Pollen and charcoal data from a large number of small forest hollows show that spruce spread from the north as a migrating front, probably closely tracking the changing regional climate, while the spread of beech from the south seems to be linked to anthropogenic activities and disturbance by fire.

A case-study from southern Sweden shows that the local establishment of beech from AD 900-1200 in a forest reserve was heavily influenced by selective cutting, human-induced fires, and agriculture. Beech spread into the reserve more than 1000 years after it was common regionally, making climate less probable as the dominant force behind the species' stand-scale establishment. With the long-term perspective provided by our study we identify the last 200–300 years as an unrepresentative period with respect to tree species composition and forest dynamics. The increase of spruce locally and regionally the last 50-100 years has altered the tree composition and forest dynamics to such an extent that active management is necessary in order to maintain biodiversity in the reserve. The study demonstrates a paradox that many biodiversity hotspot stands not only have been under strong human impact during the last several hundred years, but also to a large degree are created through human activities.

Rotation of silver fir and European beech in Carpathians – developmental cycle or linear trend?

Tomáš Vrška[1], Libor Hort[1], Dušan Adam[1], Tomáš Kolář[2]

[1] Silva Tarouca Research Institute for Landscape and Ornamental Gardening – Department of Forest Ecology, Lidicka, Czech Republic

[2] Mendels` Agriculture and Forestry University in Brno, Faculty of Forestry and Wood Technology, Zemedelska, Czech Republic

The Carpathians are a part of the East-European region of mixed deciduous-coniferous forests (Otto 1994), amongst which beech and fir (*Abies alba)*-beech *(Fagus sylvatica*) stands predominate (Korpel 1995). The largest areas of old-growth temperate forests across Europe are located in the Ukraine, Romania, Slovakia and the Czech Republic (Korpel 1995).

The main hypothesis about the developmental cycle of natural fir-beech forests describes the regular rotation of one fir generation during two beech generations (Leibundgut 1993, Korpel 1995). The aim of this presentation is to introduce different hypothesis based on the large data sets from old-growth Carpathian forests in the context of research on the historical influence of man.

We used the data sets from our repeated measurements in fir-beech old-growth forests i) in the Czech Republic (3 fully measured old-growth forests 1972-2004; 13.000 trees) and ii) in the Ukraine (fully measured plot 1932-2005!). The results were compared to published data from Slovakia (Korpel 1995). The historical influence of man since the colonization of the mountains to the present was studied from archive documents across the Carpathian.

Old-growth fir-beech forests in the Carpathians have long been affected by human activities, particularly browsing and grazing by livestock and wild herbivores (whose density has been greatly affected by people), occasional tree cutting and litter gathering. This has had a major impact on the representation of the two main stand-forming tree species. Beech was generally replaced by silver fir in the 15-19th centuries (connected with litter gathering, livestock grazing and a substantial decline in large herbivores). Since the 19th century, however, large herbivores have increased dramatically, livestock grazing and litter gathering have stopped and this has allowed beech to increasingly replace silver fir as the main tree. It is not possible to interpret this developmental trajectory as the regular developmental cycle – it is a linear trend caused by man. The rotation of fir and beech is more irregular.

Old-growth forests – ancient pieces in a modern jigsaw

Robert Hill

University of Adelaide, South Australia

Old-growth forests disarm you with their name – 'old' has special connotations, suggesting a timelessness stretching back into the distant past. But how real is this? There is ongoing debate on the origins of these forests, and particularly the role played by humans in their stability and extent. Many of the taxa that together constitute old-growth forests have a long pedigree – their origins are Gondwanan to the extent that we can any longer trust that term as meaningful. Tasmanian rainforests are spectacularly old, even though they have been shaped and simplified over millions of years by climate change, declining soil nutrients, changes in photoperiod and an increasing threat from fire. Eucalypts, however, have a much less certain history. The fossil pollen record has been overinterpreted and hence our confidence in the data produced from molecular clocks must remain low. The oldest macrofossil record is most convincing from South America, and some of the best eucalypt fossils have been found in New Zealand. The main question this past wide distribution poses is what caused the major extinction events of a group that is ecologically robust and resilient today? In Australia eucalypts first appear in large numbers on the east coast around the late Oligocene-early Miocene. These fossils appear as concentrations of leaves and sometimes fruits interspersed amongst rainforest remains in a way that suggests interdigitating vegetation dominated on the one hand by eucalypts and on the other by rainforest – a scenario reproduced today in areas where complex fire history coincides with landscapes that allow rainforests to survive in wet refuges. However, at this early stage we see little evidence of eucalypts occurring in vegetation with rainforest. In contrast, the massive increase in Australian eucalypts in terms of biomass and perhaps diversity is undeniably recent and its cause is still unclear. It is remarkably coincident with, although not identical to, the well known but not yet properly understood extinction of the Australian megafauna. Present day old-growth forests may hold the key to this recent upsurge in eucalypts – we just need someone with imagination to find it.

Theme 2: Biology of old-growth forests

Keynote Address

Perspectives on old-growth – insights from mainland eastern Australia

David Lindenmayer

Fenner School for the Environment and Society, The Australian National University, Canberra, Australian Capital Territory

Old-growth forests are perceived by the human population to be a valuable structural vegetation type; therefore there is a need to fully understand what is meant by the term. There are considerable differences among the definitions of old-growth forest in Australia suggested by different organisations, reflecting differing ethical, social and ecological perspectives.

Most definitions of old-growth include some measure of time since disturbance. However, most organisms that are most abundant in, or restricted to, old-growth do not respond to time itself, but rather to the attributes of a forest that develop or accumulate over time. Although ecological processes and some structural attributes may be shared by some old-growth forests, no single definition is applicable to all forest types. For example, structural features such as dead and dying trees accumulate at different rates in different vegetation types. Similarly, tree hollow development depends on tree species and the environment. Thus, the concept and definition of old-growth only has ecological meaning when it is attached to a particular vegetation type. Each forest type (and other type of vegetation) will probably have a set of characteristics that uniquely defines old-growth within it, and that may serve to distinguish old-growth from other successional stages. Moreover, the concept of old-growth relates most easily to vegetation types where major disturbances (principally wildfires) are stand-replacing (or predominantly stand-replacing). It is difficult to examine the characteristics of old-growth stands when many individual trees survive disturbances such as fire (e.g. by resprouting from epicormic buds, as occurs in most eucalypts) and clear patterns of stand succession among dominant overstorey trees are not always readily apparent.

In summary, old-growth forest is not necessarily defined by the presence or absence of old trees, trees with hollows or logs. Not all old-growth forests have cathedral-like qualities that depend on great size and superficially pristine appearance. They do not necessarily harbour species that depend on them exclusively. They are not necessarily rich or diverse in species, although some species may be most abundant in them.

Old-growth forests – function and dynamics in southern South America

J.J. Armesto, A.G. Gutiérrez, C. Smith-Ramírez, C. Pérez, I.A. Díaz, C. Cornelius, M.O. Carmona, M.F. Díaz, D. Christie, M.F. Willson

Center for Advanced Studies in Ecology & Biodiversity, P. Universidad Católica de Chile; Instituto de Ecología & Biodiversidad, Universidad de Chile, Santiago, Chile; and Fundación Senda Darwin, Chiloé, Chile.

The definition of old-growth (OG) forests is not exempt from difficulties. Theoretical steady-state conditions or ecological equilibrium states are seldom applicable to real situations and are inconsistent with a patch dynamics view of forests. The contrast between Andean forests, subjected to frequent stand-scale, catastrophic disturbances, and coastal forests, subjected to small-scale disturbance regime, with rare episodes of large-scale opening of the canopy, allowed us to characterize the function and dynamics of continuously regenerating, old-growth forests in southern South America. Based on this natural experiment, we offer a definition of OG forest independent of age, applicable to ecosystems in temperate South America, and possibly to other southern hemisphere temperate forests. Southern OG forests, containing 300-400 yr-old trees, are characterized by small-scale, gap-phase dynamics with continuous regeneration of predominantly shade-tolerant tree species (sapling banks), under an evergreen canopy of emergents, which may include occasional fast-growing, long-lived pioneer species. Functionally, OG forests store large amounts of carbon as coarse woody debris, logs provide the primary recruitment substrate for a diversity of tree species, including gap colonizers, and large trees are the habitat of cavity-nesting birds, arboreal mammals and epiphytes. Soils of OG forests are rich in organic matter and microbial systems hold nutrients tight in the soil, with limited hydrologic losses. We predict that accelerated loss OG forest cover will not only lead to local extinctions at the landscape scale, but also to impaired productivity and altered hydrologic cycles in lowland soils. In addition, at the landscape scale, OG forests are reservoirs of key species that maintain mutualistic plant-animal interactions which influence the rate of succession. OG forest cover must be included in future regional ecosystem assessments and deliberately sustained in management plans.

Keynote Address

Can native populations of long-lived forest trees adapt to rapidly changing climates?

Sally N. Aitken,[1] Makiko Mimura,[2] Jason Holliday,[1] Tongli Wang,[1] Sierra Curtis-McLane,[1]

[1] Department of Forest Sciences and Centre for Forest Conservation Genetics, University of British Columbia, Vancouver, BC, Canada

[2] Gene Research Center and Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Species distribution models predict wholesale relocation of tree species ranges in the next century, yet migratory responses necessary to track predicted rates of climatic change exceed current post-glacial migration rate estimates. The extent to which populations will adapt to new climates will depend upon amounts of phenotypic variation, strength of selection, fecundity, interspecific competition, and biotic interactions. Populations of temperate and boreal trees show moderate to strong clines in phenology and growth along temperature gradients, indicating substantial local adaptation to climate, yet exhibit little differentiation for genetic markers, indicating high levels of gene flow. Peripheral populations have lower levels of genetic diversity and higher levels of inbreeding than populations from central populations, and may adapt at different rates. Gene flow carrying preadapted alleles from warmer to cooler climates may promote adaptation and migration at the leading edge of migration; however, populations at the rear may be extirpated. Genomic research indicates traits involved in local adaptation such as phenology and resistance to abiotic stresses appear to be the product of small effects of many genes. The resulting genotypic redundancy of many potential genetic combinations resulting in the same phenotype, combined with high fecundity, may ensure that at least some progeny are adapted to current conditions in each generation and facilitate rapid local adaptation despite high gene flow. Widespread species with large populations and high fecundity are likely to persist and adapt, but will likely suffer adaptational lag for a few generations. Interspecific competition may weaken as all tree species experience some degree of adaptational lag, facilitating persistence under suboptimal conditions. Species with small populations, fragmented ranges, low fecundity, or suffering declines due to introduced insects or diseases may be candidates for facilitated migration in a conservation context, although there will be debate around such interventions. Facilitated migration of populations for reforestation will be necessary to sustain productivity in future environments.

Genetics of a foundation tree species drives community structure, biodiversity, stability and ecosystem processes: The importance of a community genetics perspective in the dynamics of old-growth forests

Thomas G. Whitham

Department of Biological Sciences & the Merriam-Powell Center for Environmental Research, Northern Arizona University, Flagstaff, USA

Because different genotypes of cottonwoods support different communities of arthropods and microbes, and affect ecosystem processes such as decomposition and nutrient cycling, these predictable effects are termed 'community and ecosystem phenotypes'. These phenotypes are especially important to evaluate when they are expressed in foundation tree species that are recognized as drivers of community structure and ecosystem processes. Studies in the wild and in common gardens demonstrate several major points of basic and applied value. First, these phenotypes exhibit broad-sense community heritability in which related individuals tend to support the same community members and ecosystem processes. Second, there is a strong genetic component to biodiversity and community stability, in which community richness and stability (i.e., year-to-year change in arthropod species composition) is a heritable tree trait. Third, the genetic diversity in stands of cottonwoods explains about 60% of the variation in the diversity of a community composed of 207 arthropod species. Thus, the loss of genetic diversity in a common tree species could result in the extinction of species dependent upon those genotypes for their survival. Fourth, there are genetic components to ecosystem services that explain about 50% of the variation in carbon storage, water cycles, and nutrient fluxes. Because the field of ecosystem science is largely genetics free, it is important to understand how tree genetics affects carbon storage and other ecosystem services. Fifth, the effects of climate change on the genetic structure of foundation species are likely to alter their community and ecosystem phenotypes to affect a much larger community of organisms. Our studies suggest that ~1000 species from microbes to vertebrates have been affected by the impacts of drought on the genetic structure of a foundation tree species. Sixth, because the phenotypes of genetically modified trees are likely to have community and ecosystem phenotypes, it is important to evaluate these higher order phenotypes before their release is approved. These findings have emerged from a large collaborative effort supported by an NSF FIBR grant.

Coarse woody debris, old trees and biodiversity conservation in production forests

Simon Grove,[1] Anna Hopkins,[2] Kate Harrison,[3] Marie Yee,[4] Lee Stamm,[4] Tim Wardlaw,[5] Caroline Mohammed[6]

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[2] Ensis Forest Biosecurity and Protection, Rotorua, New Zealand

[3] School of Agriculture, University of Tasmania, Hobart, Tasmania

[4] Forestry Tasmania, Hobart, Tasmania

[5] Forestry Tasmania, Hobart, Tasmania; Cooperative Research Centre for Forestry, Hobart, Tasmania

[6] Ensis, Hobart, Tasmania; School of Agricultural Science, University of Tasmania, Hobart, Tasmania; Cooperative Research Centre for Forestry, Hobart, Tasmania; Tasmanian Institute of Agricultural Research, Hobart, Tasmania

Coarse woody debris (CWD), and the old trees from which CWD is derived, together comprise key structural features of wet eucalypt forests and support a wide range of dependent species. In other regions with a longer history of intensive forest management, many dependent species are threatened with extinction. In Tasmania, the harvesting of mature forests is a more recent phenomenon. This shorter history may allow us to avert some of the risks to dependent species in these forests through the adoption of appropriate management. However, we are starting from a low level of understanding concerning these habitats, their biodiversity, and their relationships with natural disturbance and forest management. Thus we first needed to identify key knowledge gaps and to develop and implement a research plan to address them. Over the past decade, a 'CWD research package' has been instigated, involving researchers and students from a range of institutions and disciplines. Most research has had a biological focus – particularly on invertebrates and fungi; but it has also addressed the distribution and dynamics of CWD and its relationships with disturbance. This paper summarises the research process from its inception to today's situation, in which we feel our research findings are robust enough to be able to inform forest management. Remaining knowledge gaps representing future research priorities are also outlined.

Old trees, flammable forests and global climate change

David Bowman

School of Plant Science, University of Tasmania, Hobart, Tasmania

Global environmental change is a ubiquitous 'threatening' process to biological diversity that profoundly challenges conventional conservation practice. The case of fire-disturbance dependent forests, such as tall eucalypt forests, is particularly problematical given the likelihood of increased fire risk associated with a drier and hotter world. I argue that our current knowledge base and research foci poorly equip us to address many pressing questions that arise when designing management programs for long-lived trees in a hotter and more fire-prone climate. Central questions include: how long is carbon stored in 'old-growth'? Are regrowth forests more fire-prone than old-growth forests? Will a management emphasis on carbon sequestration necessarily be optimal for biodiversity or for forest production? Is there an optimal solution to the trade-offs between ecosystem services, wood production and biodiversity? I propose some potential avenues to jump over the formidable logistical and practical difficulties in answering these questions about long-lived trees in a rapidly changing world.

Tuesday 19th February

Theme 3: Long-term, multidisciplinary experiments

Keynote Address

Perspectives on old forests from the Pacific Northwest (USA) and Andrews Forest

Fred Swanson

USDA Forest Service, Pacific Northwest Research Station, Corvallis, USA

Human perspectives on the significance of old forests have changed greatly over history and especially in recent decades. Human perceptions of and interactions with old-growth have shifted from avoidance to land use conversion to unregulated exploitation to sustained yield to conservation and recreation to seeing them as providers of ecosystem services. Our language for identifying and describing old forests has changed as well. Early in the 20th century in the Pacific Northwest it was "decadent, over-mature large saw timber." In the second half of the 20th century "old-growth" became the widely used term in the US in both science and public circles; "ancient forests" is the term of choice in the fight for its preservation. In the past few decades old-growth has been used as a weapon in the battle over the fate of federal forest lands; that battle may be largely over, but a new one looms. What will be the role of old-growth in the coming decades which may be marked by public debate the future of our forests in the face of changing climate and social forces?

Set in this context, the H.J. Andrews Experimental Forest in the Oregon Cascade Range has been a focal point for old-growth science, policy, and management in the Pacific Northwest (USA) over the past 60 years. Studies of these old-growth, Douglas-fir forests are addressing structural, compositional, and dynamic aspects of forests and associated streams; implications for management of plantations originally created in the 1950s-1980s for now-outdated (on federal land) objectives of maximum wood production; and implications for forest management in a changing climate. A landscape management plan using historic disturbance regimes to set cutting prescriptions provides an example of a management approach quite different from the species-conservation focus of the existing regional management plan. Since about 1990 on Pacific Northwest federal lands we have seen a nearly complete shift away from cutting of old-growth forest (>200 yrs old) and pressure remains to cease cutting any native forests greater than about 100 yrs old. On federal lands this has diverted timber production emphasis to thinning in plantations.

Keynote Address

Long-term ecological research at Warra, Tasmania: The first fifteen years, and what next?

Michael Brown[1], Simon Grove[2]

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[2] Forestry Tasmania, Hobart, Tasmania; Bushfire CRC; Cooperative Research Centre for Forestry, Hobart, Tasmania

Research at the Warra Long Term Ecological Research (LTER) site in the Southern Forests of Tasmania began in 1993, with the site becoming fully functional in 1995. Like other LTER sites in the global network, the objectives of Warra are built on the premise that multi-disciplinary long-term ecological research can yield system insights that may not emerge from disparate short-term projects. At Warra, we are researching the fundamental ecological processes in *Eucalyptus obliqua* wet forests and the means of assessing and monitoring their biodiversity. These forests have high conservation values and are also commercially important. We want to understand how different management regimes both for conservation and for wood production compare with regard to their ecological, social and economic sustainability. We also want to learn from, and contribute towards, national and international programmes with a long-term ecological focus. Although a decade or so of research is not long in the life of a wet eucalypt forest, much has been achieved at Warra over this period. The five 'icon' long-term research projects running at Warra (on the themes of alternatives to clearfelling, hydrology, log decay, climate change and wildfire ecology) have jointly spawned an average of ten new ancillary studies per year. They have involved researchers and 'trainee researchers' (students) from Australia and beyond, across a range of disciplines and institutions. Findings have already begun to feed into forest policy and management, but the real value of Warra is yet to be realised and will depend on the commitment of future generations of researchers and their host institutions.

Ecological and aesthetic effects of variable-retention harvests in the northwestern United States: Initial results from the DEMO study

Keith B. Aubry, Charles E. Peterson

U.S. Forest Service, Pacific Northwest Research Station, Olympia, USA

In Douglas-fir forests of the northwestern United States, effective silvicultural strategies are needed to meet increasing demands for wood, other forest products, and a broad array of competing societal values in a sustainable manner. To generate reliable and broadly applicable information that will be required to develop such forest management strategies, the Pacific Northwest Research Station initiated the Demonstration of Ecosystem Management Options (DEMO) study in 1993. DEMO is an interdisciplinary study that includes six harvest treatments implemented at six locations in western Washington and Oregon at an operational scale (13 ha). The experimental design enables researchers to contrast the effects of retention level (15-100% of original basal area) with spatial pattern (dispersed vs. aggregated) for a variety of response variables, including microclimatic conditions, vascular plants, bryophytes, ectomycorrhizal fungi, arthropods, wildlife, and public perceptions of aesthetic quality. Pre-treatment sampling was completed in all blocks by 1997, experimental harvests were implemented by 1998, and the initial phase of post-treatment sampling was completed by 2001. Initial results indicate that the level of retention has a greater influence than its pattern on many types of forest-dependent species, and that the lowest level of retention may be inadequate to retain many sensitive plants and animals or ameliorate harsh microclimatic conditions. However, the pattern of retention strongly influenced public perceptions; aggregated treatments containing clearcut areas produced negative responses at all levels of retention. Additionally, aggregating retained trees in unharvested patches of at least 1 ha in size provides refuges that contain ecological and microclimatic conditions that may enable many sensitive species to persist, at least in the short-term. Consequently, a combination of dispersed and aggregated retention will likely provide the greatest societal, microclimatic, and ecological benefits.

EMEND: A comparison of natural and anthropogenic disturbance on a forested boreal landscape

John Spence[1], Jan Volney[2], David Langor[2], Ellen Macdonald[1]

[1] University of Alberta, Canada

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The EMEND (Ecosystem Management Emulating Natural Disturbance) Experiment is a large-scale, replicated comparison of variable retention forest harvesting and fire-dominated natural disturbance in the western Canadian boreal forest. Outcomes of 5 levels of strip retention harvesting (75%, 50%, 20%, 10% and 2% residual structure) in 4 mixedwood canopy cover types (deciduous dominated, deciduous dominated with coniferous understorey, mixedwood and coniferous dominated) are being compared with data collected after whole compartment burns and slash burns in 10-ha compartments. Residuals have been left evenly distributed in strips throughout compartments and as aggregated elliptical patches of two sizes (0.20 and 0.45 ha). The set of response variables is wide-ranging, including biodiversity, productivity, dynamics of coarse woody material, soil nutrient dynamics, hydrology, fire effects, harvesting costs and regeneration. This presentation will provide an overview of the entire experiment and focus on what has been learned about the responses of various biodiversity elements to the disturbances that have been applied. Implications for improving the sustainability of forest management practices through emulation of natural disturbances will be discussed.

Developing variable retention silviculture in Tasmania

Robyn Scott

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Forestry Tasmania is developing variable retention harvesting as an alternative to clearfelling in most of Tasmania's publicly-owned oldgrowth wet eucalypt forests. Forestry Tasmania's goals and guidelines for variable retention have evolved as harvesting has moved from an experimental to an operational context. The first operational aggregated retention (ARN) coupes in Tasmania were harvested in 2004, with ten coupes harvested and burnt as of March 2007. Initial ARN prescriptions called for retention of 20% of the coupe area in island aggregates of at least 0.5 ha. Challenges with obtaining good regeneration and concerns regarding safety and productivity have led to changes in coupe design. Current coupes have no minimum retention requirement, but are designed to maintain forest influence over the majority of the felled area and to retain biological legacies at the coupe level. ARN coupes now contain fewer, larger aggregates (of at least one hectare) and more edge aggregates that are contiguous with standing forest outside of the coupe. These larger aggregates are separated by felled 'fairways' generally no greater than four tree lengths across. A monitoring program has been established to assess windthrow, harvesting damage, amount and distribution of natural seed, seedbed, burn damage and regeneration in these ARN coupes.

Keynote Address

Conservation and management of rainforests in southern Chile

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Native rainforests in the Valdivian ecoregion of Chile and adjacent areas of Argentina (35°S - 48°S) have high conservation priority worldwide due to their high degree of endemism, large long-lived trees (including *Fitzroya cupressoides* that may live over 3,620 years), and significant threats mainly due to human-set fires, conversion to other land uses and unsustainable logging. Public policy has had important limitations in the promotion of forest conservation and management. Therefore, the participation of the private sector and NGOs in the creation of protected areas and in the conservation of *F. cupressoides* and other threatened species has played been important in the last decade. These private efforts have provided protection to over 1.2 million ha since 2007. Other initiatives oriented towards sustainable forest management for timber production, and mainly focused on second-growth forests, have been developed by the Chilean Forest Service (CONAF), NGOs, small land-owners and indigenous groups. On-going research on ecosystem services from native forests are providing new insights into the value of native forests. These services include water supply, tourism opportunities, and biodiversity conservation. Studies on the effects of forest management on streamflow indicate that thinning increased the total monthly streamflow in a watershed covered by deciduous *Nothofagus* second-growth forests by 37% compared to unthinned stands. The annual economic value of drinking water supply as a forest ecosystem service has been estimated as US$162.4/ha for the summer period and US$61.2/ha for the rest of the year. The annual value of nature-based recreation opportunities in two National Parks has been estimated as US$6.3/ha and US$1.6/ha, respectively. As a conclusion we propose some key elements for a policy towards the conservation and management of native forests in Chile.

A comparison of old-growth ecology and conservation in the Pacific Northwest USA and south-eastern Australia

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Old-growth has become an icon for protecting forest biodiversity and wildness in many parts of the world including the Pacific Northwest (PNW), USA and southeastern Australia (SEA). Forest managers and policy makers have struggled in both regions to incorporate old-growth into the mix of forest management objectives on public lands. This process has used a variety of approaches to retaining old forest values including the establishment of reserves, restoration, and new silvicultural practices that attempt to integrate commodity production with biodiversity protection at the stand level. A comparison of old-growth conservation in these regions can provide insights into developing more effective conservation. Although generic definitions exist in both regions and are useful to convey a general idea of the phenomenon, a one-size fits all approach does not work because of ecological diversity. Old-growth definitions in the PNW region have been based on structure, while definitions in SEA have tended to emphasize lack of disturbance. Old-growth conservation in the PNW has been based on a mix of reserve establishment, restoration, and retention silviculture. In SEA, the emphasis has been on establishing reserves and transferring these to park agencies. Attempts to mix commodity production and old-growth values at the stand level, through alternative silvicultural practices, have had mixed success in the PNW region largely because of the continued social resistance to logging larger trees despite the presence of scientifically-based conservation plans. In SEA these new silvicultural approaches are just now being tested in parts of Tasmania and Victoria. Given the complexity of the old-growth issue it is important that policies and management use a multi-scale approach and develop appropriate ecological metrics. In addition, monitoring and adaptive management programs are needed to insure that policies and management practices are leading us toward desirable outcomes.

Maintaining forest structure in reserves: A case study of three Western Australian eucalypt forests

Jack Bradshaw

Manjimup, Western Australia

Since 2004 all remaining old-growth forest in the south west of Western Australia forest has been reserved and is no longer subject to harvesting.

This presentation examines the structure of the virgin forest and the characteristics of the old-growth forests for three forest types: the wet sclerophyll karri forest (*Eucalyptus diversicolor*); the dry sclerophyll jarrah forest (*E. marginata*) and the tall tuart (*E. gomphocephala*) savannah forest, and discusses how the structure of reserved forests might change over time. The critical role of fire in the regeneration process, the maintenance of forest and stand structure and in understorey diversity is considered in relation to each of these forest types.

The review suggests that the structure of the karri and jarrah forests is relatively robust and is likely to remain reasonably stable over time. However without ongoing silvicultural intervention, the tall tuart forest is unsustainable and will continue to decline.

An argument is presented for more explicit management objectives for reserved forests, and for the monitoring of the effectiveness of management practices

Old-growth forest areas and their reservation status across Australia

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Old-growth forests are the subject of significant scientific and public interest. The 1992 National Forest Policy Statement (NFPS) definition of old-growth forest is forest that is *"ecologically mature and has been subjected to negligible unnatural disturbance such as logging, roading and clearing".* Old-growth forests are of particular interest to many in the community for their habitat, conservation and aesthetic values that are not found in other forest areas.

There has been no comprehensive survey of old-growth forests across Australia. Only relatively small areas have been assessed for growth stage and these have focused on the taller wetter forests within Regional Forest Agreement areas.

There is also additional old-growth forest outside RFA regions but it is not well known or documented. Applying the concept of old-growth is more difficult in drier regions where forest structure and age of the trees is more diverse and fire is frequent. The classification of forests as old-growth is also hard to determine in areas where the disturbance history is not known, which is especially common in more remote forests.

Within the RFA areas there were significant efforts to define and map the extent of old-growth forests during the 1990s and these have been reported in the national State of the Forests report in 2003 indicating high levels of protection in most regions. The paper will present new national information on the area of old-growth forests collected for the 2008 State of the Forests report which is currently being collated.

Lichens and bryophytes: Little plants, big message

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The impact of alternative silvicultural treatments on the lichens and bryophytes in wet eucalypt forest at Warra is examined by comparing the pre-treatment floras with those at about one, three and five years after harvesting. The most dramatic effects are apparent with the clearfell, burn and sow treatment, which provides a benchmark against which the other treatments can be measured. Successional trends are described briefly in the lichens and bryophytes, and compared to those in vascular plants. The relatively high species numbers found by year five are made up of a high proportion of species not recorded in the unharvested forest. These are species generally well-adapted to brightly lit, drier and/or disturbed environments. Most of the recolonising taxa characteristic of the pre-harvest vegetation are highly localised and uncommon in the post-harvest vegetation at year five.

Recolonisation in the logged plots is discussed with respect to the major lichen and bryophyte habitats present. The floristic differences found between the treatments can be interpreted in terms of the nature of the substrates produced or retained, and this is affected, in particular, by the effects of fire, the post-fire vascular vegetation, and the original floristic composition of any unburnt remnants left by chance or design. An understanding of how the lichen and bryophyte floras respond locally to these habitat conditions provides a means of predicting the likely effects of any particular silvicultural operation in this forest community.

The flora in the Warra SST is briefly compared with that of other commercial wet forests. Preliminary observations suggest the findings at Warra cannot necessarily be extrapolated to other forest types and locations.

Tree age as a key factor for the distribution of epiphytes in beech forest

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Multiple uses of broadleaved deciduous forests are currently studied in a research programme in southern Sweden. The programme includes a project on factors that limit the occurrence of epiphytic lichens and bryophytes in beech (*Fagus sylvatica*) forests, with focus on species of conservation concern. For this study 571 age-determined beeches distributed in 29 stands were studied in a 550 ha forest landscape.

Tree age was identified as the most important factor structuring epiphyte species richness and species composition. Whereas the number of common epiphytic species was positively correlated to diameter at breast height (DBH), the frequency of red-listed lichens did not increase significantly until beeches were 180 years or older. This pattern is probably due to absence of suitable microhabitats on younger trees and a low establishment probability. Significantly more epiphyte species of conservation concern grew on damaged (late-grown and/or fungi-infected) trees than on healthy trees of the same ages. Thinning had a negative influence on the occurrence of rare epiphytes. The common practise to cut damaged beeches in managed stands in order to favour economically profitable trunks may explain this pattern.

Being a primary target in the national forest conservation strategy the most valuable beech forests are currently set aside as nature reserves. However, most beech stands will remain managed in the forest landscape. Our results show that conventional shelter-wood systems in beech forest result in an impoverished epiphytic flora. Tree ages of ca 120 years at final cutting prevent establishment of late successional species (maximum age of beech is 300-400 yrs in southern Sweden). We conclude that management systems with continuous presence of old-growth forest patches are urgently needed to enhance epiphyte diversity in Swedish beech forests.

How well does aggregated retention cater for early and late successional macrofungi? A case study from the Warra silvicultural systems trial, Tasmania

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Aggregated retention is a silvicultural method that retains patches of mature forest in an otherwise harvested coupe, primarily to help maintain mature forest biodiversity at small spatial scales. Under this system, harvesting of the forest surrounding the 'aggregates' is followed by a low-intensity regeneration burn. This is the first Australian study of fungi in an aggregated retention coupe, complementing studies following other silvicultural treatments. The macrofungi of an aggregated retention coupe at the Warra Long-Term Ecological Research site were documented at approximately fortnightly intervals over a period of 16 months (Feb. 2005 - June 2006). Separate fungal species lists were made in each of the three aggregates chosen, as well as in the harvested part of the coupe. A nearby unharvested mature forest coupe of the same forest type was used for comparison, and was sampled at the same intensity as the aggregates. In total, the study found 387 species of macrofungi. Most of the mycorrhizal species were confined to mature forest areas (of the unharvested coupe and/or within aggregates), while most early successional, non-mycorrhizal fungi were confined to recently harvested, regenerating areas. 288 species were recorded in the unharvested mature forest coupe, compared to 167 in the aggregates; of these, 117 species were common to both. Far fewer species (13) were common to both the unharvested mature forest coupe and the harvested area; likewise, only 11 species were shared between the aggregates and the harvested area. While aggregates of the size used in this study have great value in retaining macrofungi typical of mature forest, larger aggregates would be better buffered from the effects of edge desiccation and of encroachment by regeneration burns.

A coarse filter approach to conserving arthropod biodiversity in Canadian forests

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Terrestrial arthropods are hyper-diverse and sensitive to environmental disturbances. However, utilization of arthropods as ecological indicators in forests and their incorporation in biomonitoring is hampered by limited ecological knowledge for interpretation of human-caused changes in abundance and distribution of taxa in space and time against a background of natural variation. This poses a challenge for a 'fine-filter' approach to arthropod conservation in managed forests. Can arthropod conservation objectives be better incorporated into operational forest planning using a 'coarse-filter' approach? This question was addressed by investigation of the utility of the Canadian Forest Ecosystem Classification (FEC) system as an ecological surrogate for arthropod assemblage structure. The FEC integrates knowledge of vegetation communities in relation to environmental gradients, such as regional climate and site-specific moisture and nutrient regimes. We hypothesized that epigaeic arthropods inhabiting soil and litter would respond to some of the same environmental factors incorporated into the FEC, and that the FEC would be a reasonable surrogate for arthropod assemblage structure. Epigaeic assemblages (carabid beetles and spiders) were characterized in 15 ecosites in Upper Cordilleran forests. Partial congruence of ecosite classification with arthropod assemblage structure, especially at the extremes of soil nutrient and moisture gradients, suggests that the FEC may be used as a biodiversity conservation tool.

Factors influencing saproxylic beetle diversity in south Swedish beech forests

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Since the 1990s increased concern for saproxylic species has led to modified beech forest management in Europe including retention trees after regeneration cutting and leaving naturally blown down trees. The aim of this study was to analyse the importance of snag characteristics and snag density to distribution patterns of saproxylic beetles in south Swedish beech forests. Complete snag surveys were combined with beetle inventories using small window traps attached to beech snags in two study areas.

Within the contiguous beech forest of the first study area, occurrence of saproxylic beetles was strongly correlated with age of snags. Total species richness and number of fungi associated species was lowest around very old snags, but number of species living in cavities was higher than around younger snags. Most freshwood species were found around the youngest snags. No consistent differences in beetle composition were found between snags in small set-aside stands and snags in the surrounding managed stands.

Within the more fragmented beech forests of the second study area, the number of redlisted and regionally rare species was highest around snags in old-growth stands, intermediate in managed stands contiguous with old-growth and lowest in managed stands isolated from old-growth by a two km-wide zone of planted spruce stands. The number of non-redlisted species was not correlated with isolation from old-growth forest. The number of redlisted species was also depending on snag density within 200-300 m around traps.

We conclude that low dispersal capacity is one of the factors behind rarity and redlisting of saproxylic beetles in south Swedish forests. High diversity of saproxylic beetles can be developed in managed beech forests given a continuous supply of coarse dead wood and absence of severe dispersal barriers. Large snags (>1m dbh) are especially valuable as they eventually provide cavities for rare species otherwise found in living hollow trees.

The distribution of red-listed saproxylic beetles in old-growth reserves and managed forests: Implications for conservation.

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Forest management in Fennoscandia has become a serious threat to flora and fauna. The most threatened group of species are those that depend on coarse woody debris, i.e. saproxylic species. This has lead to suggestions from governmental organisations that all remaining forest areas with high conservation values should be protected. At the same time there is an intense debate on the relative importance of protected old-growth forest areas for conservation. We conducted a large scale field experiment at 10 localities, each consisting of three forest types, i.e. an old-growth forest reserve, a mature managed forest and a clear-cut, in northern Sweden. Saproxylic beetles were trapped with eclector and window traps on 1350 standardised experimental substrates of spruce and birch. During 2001-2004 we collected and identified about 340 000 beetle-individuals belonging to more than 900 species, of which 834 individuals and 44 species were red-listed saproxylics. Clear-cuts supported a lower abundance and species richness of red-listed species than the other forest types, while somewhat surprisingly, the differences were small between reserves and managed forests. The assemblages differed between the forest types, also slightly between old-growth forests and mature managed forests. The lack of clear distinction between the mature managed and reserves could partly be due to the fact that the mature managed stands in this study never has been subjected to modern forestry, e.g. clear-felling, that became widely used in the 1950s. Instead they have been selectively logged, thus resembling continuity forests, and therefore may still support a large fraction of the original beetle fauna. These forests constitute a large part of the forest area in Sweden today. Therefore a considerable part of the beetle fauna will be at even greater risk of extinction when these mature managed stands are harvested. The implication of this for conservation strategies is discussed.

Living *Eucalyptus obliqua* trees and logs as habitat for wood-inhabiting fungi in southern Tasmania

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We describe two studies examining fungal species richness and fungal community composition in living trees and downed logs (coarse woody debris –CWD) in the wet eucalypt forests of Tasmania. In the first study, six living *E. obliqua* trees in each of three age-classes (69, 105 and >150 years old) were felled, dissected and sampled for fungi associated with any internal wood decay. Ninety-one species of wood-inhabiting fungi were isolated from these trees. The community composition of wood-inhabiting fungi in trees greater than 150 years old (mature trees) was very different compared with those found in the younger two age-classes; more than half of all species were only found in these older trees.

In the second study, large (>85 cm) and small (30-60 cm) diameter *E. obliqua* logs from mature, unlogged forests and 20-30 year-old logged forests that were regenerating after clearfelling were dissected and sampled for fungi associated with decay. A total of 60 species of wood-inhabiting fungi were commonly isolated from the 36 logs examined. Significant differences in fungal community structure were found between mature forests and regenerating forests. Some differences in fungal species richness and community composition were also found between logs of different sizes.

These studies have demonstrated a rich and distinctive community of wood-decay fungi developing in mature *E. obliqua* trees and in logs derived from such trees in Tasmania. The results indicate a need for management to allow for sufficient trees in the production forest landscape to live long enough to develop mature tree characteristics. This will provide important fungal habitat in the form of both trees and large diameter logs, sustaining an important component of forest biodiversity.

Seed dispersal of the bird-dispersed tree *Aextoxicon punctatum* in old-growth forest fragments: A modelling approach

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The processes determining where seeds fall relative to their parent plant influence the spatial structure and dynamics of plant populations and communities. Models are frequently used to estimate the seed shadow, due to the difficulty of quantifying it directly. Here, we illustrate a mechanistic, spatially explicit model that predicts the seed shadow and recruitment pattern of the rainforest tree *Aextoxicon punctatum* with a resolution of 1-m^2 in a mosaic of fog-dependent rain forest fragments on coastal mountaintops of semiarid Chile (30° S). The model was parameterized from field data on seed fall, seedling and adult distributions of *Aextoxicon* in remnant forest patches and on literature-based information about avian frugivore life histories. We used maximum likelihood statistical methods to estimate parameters for functions that provide the best fit to empirical data.

For a 24 ha old-growth patch, the simulated seed shadow was heterogeneous, with high spatial variance in seed density. Only 4% of 1-m^2 quadrats (N=3500) received <1 recruit within our study plot, suggesting that recruitment of *Aextoxicon* within a patch is not limited by seed dispersal. However, some model assumptions can lead to an overestimation of seed densities at the stand level. Challenges for development of a more realistic, spatially explicit model for the seed shadow of *Aextoxicon* in this fragmented landscape lie in improving the knowledge of behavioral and physiological traits of local seed dispersers. Low seed fall and seedling densities in small rainforest patches (1-2 ha) suggest that dispersal limitation may affect seed movement between patches and the regeneration of small patches. Thus, this model contributes to understanding the constraints on biotic seed dispersal under different scenarios in fragmented landscapes.

Phylogeography and refugia of disjunct populations of *Eualyptus regnans* of south-eastern Australia

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Cyclical climate oscillations during the quaternary have had a strong influence on species distributions and evolution. During the Last Glacial Maximum (LGM), south-eastern Australia was colder and more arid than present day and tree species are thought to have contracted to coastal refugia. Chloroplast DNA has been used to examine the broad scale phylogeography of selected members of the *Eucalyptus* genus with studies focusing on the predominately lowland *Eucalyptus globulus*. Less is known about the effect of past climate changes on widespread montane species. This study examines the phylogeography of the south-east Australian montane tree species *E. regnans* and infers the location of refugia during past climate oscillations. *E. regnans* is discontinuously distributed on the Australian mainland and on the large island of Tasmania. We determined the chloroplast DNA (cpDNA) haplotypes of 400 *E. regnans* individuals (40 locations) based on five chloroplast microsatellites. Among the 400 *E. regnans* individuals analysed 35 haplotypes were identified. Phylogenetic relationships were determined by maximum parsimony. Genetic structure was examined using an analysis of molecular variance (AMOVA) and a statistical parsimony network constructed showing the number of nucleotide differences between haplotypes. The statistical parsimony network and cladistic analysis show haplotypes divided into two distinct groups corresponding to continental Australia and Tasmania. The distribution of haplotypes across the range of *E. regnans* shows strong geographic patterns with many populations and even certain regions in which a particular haplotype is fixed. All samples from the central highlands of Victoria were fixed for one haplotype while all samples from the northern and central Tasmanian regions were fixed for other haplotypes. These regions are thought to have been treeless during the LGM. Many locations had unique haplotypes, particularly those in East Gippsland in Victoria, north-east Tasmania and south-east Tasmania. Higher haplotype diversity was found in putative refugia and lower haplotype diversity in areas likely to have been re-colonized since the LGM. The data are consistent with the long term persistence of *E. regnans* in certain regions such as East Gippsland and the recent recolonisation of other regions, such as the central highlands of Victoria.

The breeding system of the forest giant, *Eucalyptus regnans*

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Eucalyptus regnans is the tallest angiosperm species on earth. It predominates in the fertile, wet forests of south-eastern Australia and is an important component of the production forests of Victoria and the island of Tasmania. It frequently forms pure stands that can revert to climax temperate rainforest unless fire creates a suitable regeneration niche. The species is mass flowering, animal pollinated and has a mixed mating system. While there are post-zygotic barriers to selfing, these are incomplete and 18 to 77% of the mature seeds produced under natural pollination are the result of self-pollination. We here report the results of a selection experiment run over a 27-year period aimed at understanding the fate of these inbred products in a regenerating forest.

Managing complex forest tree gene pools: The case of *Eucalyptus globulus* in southeastern Australia

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Many forest tree species are recently evolved, poorly differentiated at the molecular level, and form geographic and morphological continua, which can make identification of management units difficult. This is seen clearly in *Eucalyptus globulus*, a species complex consisting of four taxa variously described as species or subspecies (*bicostata, globulus, maidenii and pseudoglobulus*). These taxa are morphologically and geographically distinct, but are linked by intergrade populations that are intermediate in morphology. The origins of the intergrade populations are unknown; some could be the result of primary differentiation (divergence within a continuous series of populations resulting from varying selection pressures) while others may result from secondary intergradation (hybridization and introgression between previously isolated taxa). The intergrade populations represent a significant proportion of the distribution of the *E. globulus* species complex, however their diverse and intermediate morphology confounds taxonomic classification. Correct classification is important for conservation planning, as well as for seed collections for native forest regeneration, reforestation and breeding programs. To assess the molecular affinities within the complex, we used nine microsatellite DNA markers to genotype 1239 trees representing 33 morphological core and intergrade populations from across the natural range of the species complex in southeastern Australia. This analysis provided insights into the evolutionary processes that have shaped the patterns of genetic variation in the *E. globulus* species complex, and a framework for identifying the potential impact of gene flow from *E. globulus* planted within the natural range of the complex.

A species exposed: The hidden diversity in *Eucalyptus globulus*

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Sustainable management of native forest gene pools requires an understanding of the levels and spatial patterns of genetic diversity in tree species. This diversity impacts on numerous management issues including seed transfer guidelines and *in situ* genetic resource conservation. Our long-term studies of *Eucalyptus globulus* (Tasmanian Blue Gum) have provided unprecedented insights into the complexity of the genetic variation that can exist in natural populations. We demonstrate that *E. globulus* comprises a fine-scale mosaic of family groups superimposed on a complex spatial pattern of local and broad-scale adaptive and non-adaptive genetic variation. The high level of genetic diversity observed within forest tree species such as *E. globulus*, coupled with their flexible breeding systems, provides the fundamental elements for adaptation to future environmental challenges.

Genetic diversity in *Eucalyptus globulus* is affected by hybridisation with the rare species, *Eucalyptus cordata*

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The Tasmanian blue gum, *Eucalyptus globulus*, is planted globally for pulpwood and timber but is native to south-eastern Australia. To support the management and deployment of this important forest species, numerous studies have examined the structure and diversity of its native gene pool, either as a discrete unit or in the context of closely related taxa of the *E. globulus* complex (*E. pseudoglobulus, E. bicostata* and *E. maidenii*). Field observations show that in addition to intergrading with the above taxa, *E. globulus* hybridises naturally with many other co-occurring eucalypt species. The full significance of this hybridisation to genetic diversity and adaptation in *E. globulus* remains unknown.

Our research examines the interaction between *E. globulus* and the rare Tasmanian endemic, *Eucalyptus cordata*. In a broad-scale study of mixed populations of the two species, we found evidence that *E. globulus* and *E. cordata* shared chloroplast DNA sequences at numerous sites, consistent with frequent hybridisation. We are now using AFLP markers to determine whether these species are exchanging nuclear genes at the same sites. A fine-scale study of *E. globulus* surrounding a small *E. cordata* population in the Meehan Ranges has found highly structured genetic variation in *E. globulus* surrounding *E. cordata* within the study area of 3 km^2. The preliminary findings suggest that the genetic composition of *E. globulus* is affected by its proximity to *E. cordata* in mixed forest. Together with similar studies on forest trees in Europe, this work indicates that species may be far more interdependent genetically than we recognise, and that a rare species may influence the gene pool of a commercially important species.

Chloroplast DNA reveals genetic legacy of ice ages in the rainforest species *Nothofagus cunninghamii*

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Cool temperate rainforest species would have been particularly sensitive to the dry climates believed to have occurred during the Quaternary glacial cycles. *Nothofagus cunninghamii* (myrtle beech) is the dominant tree in most of the rainforests of Tasmania and Victoria. Understanding the history of *N. cunninghamii* is a key to determining how plants survived the ice ages in south-eastern Australia.

By examining the distribution and phylogenetic relationships of *N. cunninghamii* chloroplast DNA variants (haplotypes) among 208 trees sampled across the species entire range, this study aimed to elucidate the history of migration and glacial survival in response to the Quaternary climatic oscillations. Most haplotypes (16 out of 20) were confined to western Tasmania, a finding consistent with the probable long history of *N. cunninghamii* in this region and glacial survival in multiple refugia. Thus western Tasmania is a "centre of diversity" for the species. The disjunct *N. cunninghamii* rainforests in north-eastern Tasmania and in Victoria were comparatively depauperate in haplotype diversity, indicating either recent immigration or severe past range contractions in response to Quaternary climatic changes. However, endemic haplotypes were found in both these regions providing evidence for the continued existence of these populations *in situ* throughout at least the last glacial maximum (LGM). In north-eastern Tasmania, an intensive survey of the distribution of the two haplotypes present showed strong spatial structuring of current populations, consistent with a 'genetic footprint' of post glacial expansion which is best explained by multiple refugia. This genetic evidence for glacial survival of *N. cunninghamii* in the northeast of Tasmania is enigmatic in the face of seemingly contradictory geo-morphological and paleo-climatic evidence indicating an extremely stressful arid and cold climate for the species there during the LGM.

Both Victoria and northeast Tasmania harbour important endemic genetic variation of *N. cunninghamii* that warrants recognition if a whole species gene pool approach to conservation planning is taken in the future. Finally, results from range-wide chloroplast variation studies of other cool temperate rainforest trees and shrubs, including *Tasmannia lanceolata* (mountain pepper), *Atherosperma moschatum* (sassafras), *Telopea truncata* (waratah) and *Phyllocladus aspleniifolius* (celery-top pine) will be presented to corroborate patterns seen in *N. cunninghamii* and expand our knowledge of historical processes in the flora of south-eastern Australia.

Genetics of dominant trees can drive forest community structure and ecosystem processes: The case of *Eucalyptus globulus*

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Trees dominate many of the earth's ecosystems and understanding how genetic variation within tree species affects dependent communities and ecosystem processes is a major frontier in ecology and forest management. Over two decades of research has established the highly diverse nature of the Eucalyptus globulus gene pool and significant genetic control of phenotypic variation in virtually all traits examined. The species exhibits genetic variation in susceptibility to disease, associated insect communities and marsupial browers, which in specific cases has been shown to be correlated with genetic variation in morphological or phytochemical traits. The variation in foliar chemistry in particular is highly heritable and genomic regions which affect key defensive chemicals have been identified. We are now using this well-studied eucalypt system to examine how the effects of genetic variation in a foundation tree species extend beyond the individual and population to impact dependent biodiversity and even ecosystem processes. We used a common garden field trial to show that genetic variation between geographical races of *E. globulus* not only acts to drive divergence in foliar and bark communities of the tree itself, but also affects associated detritivore communities, rates of wood/litter decay and soil nutrient availability. Such extended consequences of tree traits demonstrate the importance of considering tree genetic diversity in understanding and managing forest biodiversity and the services these forests provide.

Long-term ecological experiments in New South Wales forests

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The NSW Department of Primary Industries has several ecologically-focussed forest management experiments that have been running for 20-35 years. These long-term experiments have delivered three main benefits that could not have been obtained using short-term studies. First, species and community responses to disturbance, including rates of recovery following logging and fire, provide the capacity to put management impacts into perspective. Second, long-term studies provide a better indication of the levels of natural variation (species richness and abundance) occurring in ecological systems. Third, they also enable identification of unknown or unexpected directional processes (e.g. climate change, landscape effects) that may be operating in ecological systems. We use selected results from a number of studies to illustrate these points. Long-term ecological studies require strong institutional and funding support for their maintenance and continuing existence. Long-term ecological studies and species monitoring programmes have similar design requirements in that sampling points should not be overly constrained by specific management questions because these issues evolve and are periodically addressed by management during the life of the experiment.

Alternatives to clearcutting in the old-growth forests of southeast Alaska

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Even-age management and clearcutting have dominated the management of old-growth temperate rainforests used for wood production in southeast Alaska. Although well suited for wood production, this system is criticized for its effects on other forest values. Important features of the native western hemlock-Sitka spruce (*Tsuga heterophyla-Picea sitchensis*) forests are lost or greatly reduced because of clearcut harvesting and, as a result, concerns for habitat, biological diversity, threatened or endangered species, and the value of wild and remote places have focused national attention on this issue. In 1994, the USDA Forest Service began a long-term, multidisciplinary study of silvicultural alternatives to clearcutting in southeast Alaska. This operational-scale experimental study has nine treatments replicated in three blocks. The treatments include both even-age and uneven-age silvicultural systems and vary in three factors: cutting intensity, spatial arrangement of retained trees and snags (dispersed vs. aggregated), and patch size. The variable-retention treatments were designed to create conditions similar to those produced by the small-scale, high frequency natural disturbances common in coastal southeast Alaska, maintaining key old-growth features of ecological importance. There were significant concerns, however, that these treatments would greatly increase logging costs and risks to the residual stands from damaging agents such as logging injuries, wind, wood decay, and dwarf mistletoe. The first experimental block was harvested in 1997, the second in 1999, and the third in 2005. This presentation will include findings on logging operations, overstory and understory plant responses, deer forage availability, and tree damage agent dynamics. I will also discuss application of these results in current forest planning efforts.

Rethinking the paradigm of stand-replacing wildfire in Tasmania's southern forests

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Stand-replacing fire is a phenomenon known all over the world, particularly in boreal forests. The concept of stand-replacing fire leading to single-aged stands is well known to Australian forest scientists, particularly in regard to Mountain Ash (*Eucalyptus regnans*) forest. It is a principle upon which much of current fire and silvicultural management in wet eucalypt forest is based. Although it is recognised that multi-aged stands also occur, the 'stand-replacing wildfire' paradigm dominates. However, in forests of southern Tasmania, this paradigm appears to be misleading. Here *E. regnans* and *E. obliqua* co-occur and stands are frequently dominated by the latter species. Research conducted during the selection of permanent plots for the Wildfire Chronosequence Project included ground-truthing and/or research investigating over 150 sites across ~ 50 km^2 of forested landscape. Preliminary analyses of these sites suggests, for 75% of these sites, stands were found to comprise several cohorts, and therefore can be considered to have arisen from separate wildfire events of which at least the most recent was non-stand-replacing. The few areas where stand-replacing fire was evident were small patches (~ 0.25 - 1 ha). The present paper discusses how these sites were selected and some preliminary findings from the project, and discusses some of the consequences of the apparent misrepresentation of stand-replacing fire in the southern Tasmanian forest landscape.

Temperate overstorey eucalypt decline is related to altered vegetation dynamics and nutrient cycling in the long absence of fire

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Overstorey eucalypt decline is significant in some temperate woodlands and forests. The decline may be linked to the long absence of fire. The objectives of this project were to survey overstorey tree decline, vegetation understorey, soil and tree nutrition, and tree foliar carbon isotope ratios (an indicator of water stress) in paired sites that have either a history of a long absence of fire or a history of relatively frequent fire. Plant nutrient-availability following prescribed fire was also studied using seedlings as a bioassay and ion exchange resins buried in the soil. It is hypothesised that altered eucalypt nutrient uptake may underpin the decline. Experiments were replicated at the site level in *Eucalyptus gomphocephala* woodland (WA) and *E. delegatensis* forest (Tas). Tree decline was elevated on long unburnt sites (Tas and WA). The understorey differed in composition and there was greater % cover of shrubs in long unburnt sites (WA). In WA there was higher soil nitrogen (N) but tree foliar N was lower and foliar copper (Cu) was deficient in long unburnt sites. In Tas there was higher soil N but similar tree foliar N and foliar phosphorus (P) was deficient in long unburnt sites. In WA seedlings had higher foliar P and Cu on the burnt than the unburnt site and ion exchange resins captured significantly elevated levels of N, P, K and most micronutrients. In WA trees had higher water use efficiency in long unburnt sites and were more water stressed. We conclude that the long absence of fire leads to the development of understorey and overstorey tree decline possibly via Cu deficiency and/or water stress in WA and via P deficiency (altered mycorrhizal relations?) in Tas. Prescribed fire may address nutrient deficiency through increased plant nutrient availability in ash.

The impact of timber harvesting on the size, amount, and decay status of large coarse woody debris in the jarrah (*Eucalyptus marginata*) forest

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The common observation of large logs and limbs left on the forest floor after harvesting of native jarrah forests has lead to a perception that much of the existing forest, which has a history of harvesting, contains substantially more coarse woody debris (CWD) than forest that has never been harvested. With current harvesting of the jarrah forest, some large diameter standing and downed dead wood is removed for firewood and charcoal production, and there is increased emphasis on utilisation of low grade logs, including the possible use of harvesting residues for bioenergy production. These practices could reduce the volume of large CWD on the forest floor, alter the size distribution of this material, and alter the distribution of decay classes. On harvested sites these changes could impact vertebrates that use ground hollows, invertebrates and fungi involved in soil nutrition, and crytogamic flora that grow on decaying wood.

The assumption that historical timber harvesting has greatly increased the amount of dead wood on the forest floor was investigated by comparing large (>20 cm diameter) CWD on seven harvested sites in the jarrah forest and five sites that have never been harvested. The distributions of log sizes, the decay stage, and the distribution of hollow sizes found in these logs were compared, and the suitability of these hollows for use by native fauna was determined from the size of the hollows. From these attributes, differences between the large CWD found on harvested and never harvested sites were identified. The implications of these differences for jarrah forest management are discussed. The adequacy of the current strategies for managing dead wood in these forests and the possible impacts of CWD harvesting are considered in light of the existing stocking and the current intensity of CWD harvesting about the study sites.

Quantifying the canopy nectar resource and the impact of logging and climate in eucalypt forests

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Nectar is a significant resource for fauna in Australia, but it has not been quantified in tall forest canopies over multiple sites. We investigated the impact of logging on nectar production in the canopy of spotted gum *Corymbia maculata* and grey ironbark *Eucalyptus paniculata* in southern New South Wales. In addition we quantified the magnitude of canopy nectar production and how this varied between years in relation to prevailing and preceding climate. This presentation focuses on spotted gum. In 2005 flowers were bagged on large and small trees in replicate recently logged, regrowth and mature forest. Neither logging history nor tree size significantly affected over-night nectar production per flower, although there was a significant interaction. When nectar production was scaled up to the forest stand (incorporating flower and tree density), mature forest produced almost 10 times as much sugar per ha as recently logged forest, with regrowth being intermediate. At the compartment scale, the difference between mature forest and recently logged forest was reduced to a factor of two times when the extent of areas left unlogged under current NSW forest practices was considered. One distinctive characteristic of *C. maculata* nectar in 2005 was its high sugar content (40-60 %) compared to the concentrations measured in 2003 (mean = 18 %). Nectar was only slightly depleted in unbagged flowers in 2005 as flowering was extensive. We estimated that, on average, mature spotted gum forest produced a vast resource over-night: 35,000 kJ ha^{-1}. Flowers measured in 2003 provided a strong contrast with only occasional stands of trees flowering, much less sugar per flower early in the morning and unmeasurable quantities by mid-morning, indicating that nectar was limiting. Models of nectar production collated over both years, using climate and site variables, indicated nectar volumes and sugar concentration respond differently to environmental conditions. Predicting the nectar resource, which is made up of both components, was most consistently related to recent conditions that were unfavourable to foliage production.

An analysis of mixed forests under low stand density control and long-rotation silviculture: A case study in Jingu Shrine forest, Mie Prefecture, Japan

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Ise Jingu is a grand shrine in Mie Prefecture, Japan. The"Shikinen Sengu Ceremony,"the periodic rebuilding of the shrine, has been carried out every 20 years since the 7th century. The Shikinen Sengu Ceremony requires old-growth in a quantity more than about 10,000 m^3. These timbers have been supplied from some prefectures since ancient days. However, Ise Jingu decided to supply its own timbers for the next ceremony that is to be held in 2013. Controlling plantation forests at low stand densities and in long-rotation silvicultural systems, Jingu Shrine forest aims to produce old forests with a component of broad-leaved species. We analyzed the stand structure of mixed forests with coniferous and broad-leaved species in Jingu Shrine forest. We established sample plots in *Chamaecyparis obtusa* stands with various ages and divided them into 16 subplots. In these subplots, we took hemispherical photographs and recorded tree height, DBH, and species of all standing trees ≥1.5 m in height. The diameter distributions of *Chamaecyparis obtusa* and understory vegetation resembled bell-shaped and J-shaped curves, respectively. The number of tree species and the density of broad-leaved species increased with stand age: the older the stand age, the larger the variance of canopy openness. Our findings suggest that the photoenvironment, tree species, and stand structure diversified with stand age in mixed forests controlled at low stand densities in long-rotation silvicultural systems.

The effects of silvicultural thinning on bird populations in Boola Boola State Forest, Victoria

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Thinning is a silvicultural technique used extensively throughout Australia's production forests. The longer term impacts of thinning on forest biota are not well understood. This study provides an insight into the effects of thinning on avifauna, five to ten years after a thinning operation. A paired site design was chosen to compare bird abundances and species richnesses at thinned and unthinned sites in a mixed eucalypt production forest in Gippsland, Victoria. Guild compositions at thinned and unthinned sites were also explored. The 2006/07 fires across Gippsland directly affected eight out of twelve sites in this study, providing an opportunity to investigate the immediate effects of wildfire on birds.

Significantly greater number of birds and species were found at thinned sites, compared to unthinned sites. Guild composition was similar between site types, however more guilds were represented at thinned sites. A reduction in both bird abundance and species richness was found immediately after the wildfire.

The role of old-growth forest in the global C-cycle

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We will summarize global information about unmanaged forests as carbon sinks. In addition we will present data based on a global data set, on net primary production and net ecosystem productivity in relation to forest age. We will show that, based on a global data set, undisturbed natural forests (forests without wood extraction) remain a significant carbon sink for centuries. An equilibrium of production and decomposition has not been observed.

Assessing the vulnerability of Victoria's Central Highland forests to climatic change

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Sustainable forest management requires managing for varying environmental conditions including potential impacts associated with human-induced climate change. Projected changes in climate as a result of human activities include increased temperatures, changes in precipitation and increased frequency and intensity of extreme events such as storms and bushfire. These changes will influence forest ecosystem resilience directly and indirectly via changes in the frequency and intensity of natural disturbances and changes in regeneration potential of different species. Despite the growing public awareness and profile of climate change in political debate there has been little scientific analysis of the impacts of climate change on Australian native forests and little evidence that forest managers are considering the potential impacts of climate change in management planning.

Maintaining ecosystem resilience requires an understanding of ecosystem vulnerabilities. This study aimed to improve understanding of how climate change could affect the regeneration phase in forest ecosystems in Victoria's Central Highlands. These forests provide important biodiversity habitat, water, recreation and timber values. Regeneration capacity is an important component of ecosystem resilience and assessing changes in this capacity can provide a guide to the potential impact of future climate change on forest composition and structure from the stand to the landscape-level.

We conducted a regeneration vulnerability assessment for 22 canopy and understorey tree species in this region. Using a mechanistic model of forest regeneration (TACA,Nitschke and Innes 2007) calibrated with information from the literature and local databases on species distributions, we assessed the regeneration vulnerability for each species for multiple future climate scenarios (derived from CSIRO and other sources) for the next 90 years. Results indicate that species are resilient, in terms of regeneration capacity, to predicted changes in climate over the short term (2010-2039) but that vulnerability increases significantly for climate projections from 2040 onwards. Model output suggested that a trigger point may be reached in the 2055 (2040-2069) period that will result in a loss of ecological resilience as species-specific thresholds are exceeded. By the 2070-2100 period, 18 of 22 species were classified as extremely vulnerable. By this time, all species had the ability to regenerate above 1500 m in elevation but none could regenerate naturally following disturbance or harvesting below 400 m. Lack of area at higher elevations was found to be a constraining factor as species contracted from lower elevations in response to increasing temperatures and drought conditions. Species vulnerability was lower under a stand modifying treatment scenario (which had a moderating impact on temperature) with only 10 of 22 species being rated as extremely vulnerable by 2085. Thus, stand modifying treatments such as shelterwood and selection harvesting rather than clearfall regeneration mechanisms may improve future species resilience. A shift from seed-based regeneration to seedling-based regeneration (planting) could also increase the probability of successful regeneration across the Central Highlands under predicted climate change. We conclude that many forest tree species that currently dominate Victoria's Central Highland are vulnerable in their regeneration niche to future climate change due to their specific regeneration requirements, relatively narrow environmental distribution and the topographic characteristics of this region. Further research is required into the impacts of climate change on growth, competition, disturbance and mortality to ensure that we can manage these forests sustainably for future generations.

Does the increasing concentration of atmospheric CO_2 mean more productive forests?

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While the increasing concentration of carbon dioxide in the atmosphere should lead to an increase in leaf-level photosynthesis, improve water use and thus increase tree growth and forest productivity, it appears as if this might not always be the case. This talk will present the current state of understanding with regard to the effects of global climate change on tree growth, nutrient cycling and forest productivity. The talk will demonstrate why short-term measurements are basically useless for making long-term projections and will emphasise the work that needs to be done before we can begin to make predictions of how forests will behave in the future.

Hydraulic architecture and transpiration of old and young *Eucalyptus marginata* Donn. Ex. trees in south-western Australia

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We compared the hydraulic architecture and water use of stands of very old jarrah (*Eucalyptus marginata*) with that of younger jarrah forest in the high rainfall (1200 mm year^{1}) Mediterranean climate region of south-western Australia. Stands of large, old trees had 20% less foliage cover, 40% less leaf area and half the sapwood area of younger jarrah stands on similar sites. The ratio of leaf area to sapwood area was 0.45 m^2 cm^{-2} in stands of older trees compared to 0.32 in the younger stands. There were no great differences between the younger and older trees in sapwood density – an indicator of the permeability of sapwood to sap flow. We measured sapflow velocities in younger and older trees at one site near Dwellingup using heat ratio method heat-pulse sapflow sensors (ICT International). The range of sapflow velocity in the younger trees was larger than in the older trees. Combined with larger sapwood area this resulted in transpiration of approximately 80% of potential evaporation in the stand of younger trees during winter, compared to only 30% of potential evaporation in the stand of older trees. Overall, our results support the popular theory of hydraulic limitations to tree height growth but suggest that tall trees have not evolved to maintain a large stomatal conductance, rather our results support a growing consensus that large trees have evolved to optimize carbon gain.

Water and stand management in the world's most productive temperate hardwood forests

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Water is a limited source, and changing climates emphasise that sustainable management of available water sources is crucial. The State of Victoria has experienced below-average rainfall for the last decade. Water restrictions have been in place for many years. There is a growing interest in techniques and models to describe the water balance of forested landscapes. Melbourne's water catchments host extremely productive eucalypt forests and these are the subject of intense political and scientific attention.

We examined the water use of 68 year-old *Eucalyptus regnans* stands located in the Upper Yarra catchment area. Our measurements included two understorey species (*Acacia dealbata* and *A. melanoxylon*) that are common elements of these forests and play an important role in maintaining nitrogen availability – and thus the productivity - of these stands. Depending on their contribution to total stand basal area, the *Acacia* spp. used up to 30% of the total water use by the studied *E. regnans* stands. Monthly total water use in such stands reached more than 640 x 10^3 L ha^{-1} in early spring and was directly related to daily maximum temperatures. Water use was curvi-linearly related to sapwood area of *Acacia* spp. and logistically related to sapwood area of *E. regnans*. Such clear and simple relationships provide clear guides to the likely impacts of climate change and management on water yield. If thinning (of overstorey and/or understorey) is possible (given other values) at an appropriate age, water yield could be readily increased.

Drought and topographic effects on ecosystem δ2H, δ13C and δ18O and growth and hydrology of eucalypt-*Nothofagus* ecosystems at Mt Donna Buang, Victoria

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Within eucalypt-dominated landscapes east of Melbourne, *Nothofagus cunninghamii* grow at higher elevations as understorey to eucalypts or as co-dominants with other rainforest species restricted to deeply incised valleys. These ecosystems produce a high proportion of catchment water yield. Analysis of stable isotopes of O and H in water samples (rainwater, stream-water, soil-water, twig-water) from the Cement Creek Catchment, revealed a strong influence of drought in 2001/2, at the end of a decade-long period of below-average rainfall. A major shift in both δ2H and δ18O signatures of both rain- and stream-water between 2001/2 and 2003 was supported by analysis of data from long-term monitoring stations. The shift seems likely due to changes in atmospheric conditions, and especially relative contributions to rain-water from oceanic and continental sources. Progressive evaporative enrichment among rain-, soil- and twig-water accounted for observed δ2H and δ18O signatures. Analysis of tree rings (growth and δ13C) of *N. cunninghamii* laid down between 1979 and 2000 showed that growth did not vary significantly between the deeply incised valley and the more exposed and higher elevation, plateaux sites. Patterns of abundance of stable isotopes in these south-facing sub-catchments, strongly suggest that water is not limiting, can be divided into a freely draining portion and another portion that is retained by soil peds, and does not limit growth or distribution of *N. cunninghamii*. Future management of eucalypt-dominated catchments for water as well as for conservation, and including likely different climatic regimes, needs to recognize the large hydrological differences between different sub-catchments that vary in topography and aspect. Similarly, future distributions of species such as *N. cunninghamii* may depend less on climatic influences in some parts of these landscapes (e.g. deep valleys), and more in others (e.g. plateaux).

Effects of natural small-scale disturbances on light conditions, regeneration patterns and understorey plant species diversity in an old-growth evergreen *Nothofagus betuloides* forest in Tierra del Fuego, Chile

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Over the last decade a shelterwood system utilising natural regeneration has been applied in Chilean old-growth forests in southern Patagonia and Tierra del Fuego. Most of these forests are naturally uneven-aged, but with applications of this silvicultural system, homogenisation and simplification of the stand structure have been sought. An ecological understanding of natural disturbance processes should be a basis for the promotion of new silvicultural practices in the region to ensure the maintenance of high diversity, such as gap approaches. The research objective, therefore, was to analyse the effects of natural gap disturbances on light conditions, regeneration and understorey plant species diversity in an old-growth evergreen *Nothofagus betuloides* forest on the south-western side of Tierra del Fuego.

The vegetation was sampled in 65 quadrants (2x2 m) in and around 13 canopy gaps, along a light gradient. Changes in the regeneration density were studied and all *N. betuloides* seedlings and saplings were counted. The height and radial growth was measured for the tallest plant in each plot. Additionally, the coverage of all plant species was recorded. The species numbers and coverages were determined for the following taxonomic groups: Spermatophyta (Monocotyledons, Dicotyledons), Pteridophyta, Bryobiophyta, Marchantiophyta, Anthocerotophyta, Lichens.

The results revealed that the the availability of global solar radiation in the forest understorey ranges from 3.1 to 16.6 % compared to the open-land. *N. betuloides* is able to regenerate also under very shady conditions, resulting in a more continuous forest regeneration, and apparently did not require large gaps to establish. Differences in light explained <9% of the variation in regeneration density, <13% in height growth rates, and <31% in radial growth rates. Furthermore, there was a low and not statistically significant variability of forest floor vegetation in response to light and also to the sampled canopy gaps.

A methodology for modelling canopy structure: An exploratory analysis in the tall wet eucalypt forests of southern Tasmania

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Canopy structure is the spatial arrangement of the leaves, twigs and branches of the crowns of all trees in a forest stand. It is a complex and dynamic entity that can be difficult to quantify. This is especially the case in tall closed forests where the vertical arrangement of the canopy can be highly variable, and in which it may be difficult to recognise strata and/or identify the crowns at a particular level in the canopy. A number of studies have developed specialised equipment for measuring canopy structure, but these methods are often expensive and difficult to apply to tall closed forests with multiple strata.

A methodology for creating a spatial model of forest canopy structure is presented using simple field measurements in conjunction with AutoCAD™ technical drawing software. This methodology utilises allometric relationships to predict the geometry of a free-growing tree crown on the basis of stem diameter at breast height. A spatial model of the canopy structure is then created in AutoCAD™ using field data describing the genus, dbh and relative positions of all trees greater than 10 cm dbh and observations of the typical crown shape for each genus. This spatial model also accounts for the effects of competition for light between neighbouring crowns. By horizontally partitioning the completed canopy models, the presence of distinct strata and the dominant genera associated with each stratum can be identified. This methodology was applied at four permanent plots in the tall wet eucalypt forests of southern Tasmania. These plots were established as 'benchmark' sites representing stands regenerated following wildfire in 1966, 1934, 1898, and an old-growth stand regenerated prior to 1895. The results demonstrate that canopy stratification is present and quantifiable within this forest type. The power of the proposed methodology lies in the use of easily measured variables to predict the location and volume of crowns in the canopy, and the ability to identify the genus to which these crowns belong. This methodology could be used to better understand changes in vertical structure over time (due to natural or human disturbance), and as a means of 'ground truthing' remotely sensed data in order to map and monitor canopy structural variation across forested landscapes.

Landscape and social perceptions of Tasmania's old forests: Then and now

Gwenda Sheridan

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When Tasmania's old forests were seen by explorers and scientists from the other side of the world, heroic descriptors like mighty, primeval, 'as ancient as the world' were used. A German scientist Von Hügel climbing Mt. Wellington in 1834, distinguished three strata of the forest; noting very tall trees ('to such a height I do not care to record for my estimate would smack of exaggeration') understorey trees, and 'majestic' tree-ferns. Later in the century the 'tall trees' vied with the *Sequoiadendron giganteum* from the U.S as the tallest trees on the planet. The different layers are critical to how the forest of the nineteenth century was perceived. Tall timbers were for sawn hardwood, while the beautiful and unique timbers of the understorey trees were used for decorative and specialist work. They won prizes at the 1851 Crystal Palace Exhibition, and were in the 1862 London Exhibition where Tasmanian timber occupied 'the most conspicuous position.' Meanwhile at ground level, the beauty and softness of the giant tree-ferns with their 12' fronds were illustrated from the 1830s by artists such as Glover, well before a similar interest occurred elsewhere in Australia. Later in the century tree ferns became an exchange plant from the Royal Society's Garden, (now R.T.B.G.) to the northern hemisphere then importing plants from Europe and England.

A fundamental change has occurred in Tasmanian forest perception since the 1970s, this from earlier primarily sawn wood production use to woodchip export production, occurring on Crown and private forested land. The changed forestry perception and dramatic switch in the use of the old forest has seen decades of controversy between protagonists as ancient diverse forests have been fought over. In 2007, this reached yet another crescendo point with the Longreach pulp mill.

Management of old forests by the Tasmanian Parks and Wildlife Service

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Australia's island state, Tasmania, has one of the best protected area systems in the world. Nearly 44% (3 million ha) of the state's land area is reserved on public and freehold land. Although our first national parks, proclaimed in 1916, included old forests, it was not until the 1980s and 90s that comprehensive state-wide surveys of forest communities were undertaken and a systematic approach to forest reservation undertaken. Identification and management of old forests as part of the protected area system is therefore a relatively new science here.

Nearly 1 million ha (79%) of remaining old-growth forest is reserved. Just over 0.7 million ha is managed by the Tasmanian Government Agency, the Parks and Wildlife Service, in formal public reserves declared under the *Nature Conservation Act 2002*.

These forests occur in many different forms: short to very tall; dry, wet and in between; coastal to sub-alpine; from wind-pruned to sheltered; dominated by primitive species and species more recently evolved, living in poor to rich soil; some are fire-adapted and others fire-sensitive; and they range in age from old to very old – over 1,500 years in the case of ancient Huon pines on the West Coast Range.

Old-growth forests have a diverse range of conservation values. The fire-sensitive rainforests and mixed forests are important for the conservation of a rich endemic and primitive vascular flora. These and other old-growth communities are important for a number of threatened as well as endemic forest-dependent biota (eg. wedge-tailed eagle, grey goshawk, masked owl, swift parrot, tree blanket leaf, king's holly, fairy lanterns, and myrtle elbow orchid). In general, old-growth forests have a greater abundance of arboreal and hollow- dependent fauna species and a greater richness of non-vascular plant species than equivalent regrowth forest communities. Roosting sites for bats are more numerous in old-growth forests, and epiphytic plant species have their richest diversity and abundance in old-growth forests.

At present, the main approach to management of reserved old forests is to minimise disturbance and provide opportunities for people to understand, appreciate and enjoy them. In dry forests, management burning for ecological and fuel reduction purposes is undertaken. Buttongrass moorland burning is undertaken partly to protect fire-sensitive forests from wildfire. However, planned management burning is rarely undertaken in rainforest, wet eucalypt forests or swamp forests. No logging is permitted in national parks and state reserves and, aside from hydro-electric power generation and some beekeeping, there is little resource use. A wide variety of services and facilities are provided for people to learn about and experience park values, including our web site, interpretation and education publications, discovery ranger program, short and long walking tracks, lookouts, scenic drives, nature trails and visitor centres. Research and monitoring programs are facilitated and some active management programs are undertaken.

Current and emerging management issues include fire management, genetic pollution, weeds, feral animals and diseases, illegal wood removal, recreation and tourism, hydro-electric water storage and climate change.

The importance of large-scale interdisciplinary forestry experiments in providing information for emerging management issues in the western United States

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Over the last 20 years, increasing public awareness and ecological understanding has led to a paradigm shift in forestry from timber management to sustainable ecosystem management. Changing societal values are now calling for forest management approaches that simultaneously address socio-cultural, ecological and economic goals. Consequently, many field experiments have become increasingly multi-disciplinary and larger in scale and/or scope. Individually and collectively, these studies in western Washington and Oregon, and southeast Alaska, represent major investments by research and land management organisations, to enhance the science and understanding for sustainable forest management under increasing public scrutiny and demands for safeguarding healthy environments, conserving biological diversity and providing some level of economic prosperity. They also help facilitate the transfer of scientific results into practical applications and to realize a more effective interface between science and policy. Questions addressed include (i) what do we mean by large-scale experiments, (ii) who is investing in these kinds of experiments and why, (iii) where is this information being put to use, and (iv) what does the future hold for these studies?

Conservation of threatened invertebrates in Tasmania's production forests

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Although many formal reservation targets have been attained under Tasmania's Comprehensive, Adequate and Representative (CAR) reserve system, a large proportion of habitats important for threatened species, particularly invertebrates, remain in the off-reserve landscape. Hence the conservation requirements of threatened invertebrates largely need to be met by off-reserve mechanisms for habitat conservation, complemented by existing reserved habitat. The development of conservation management strategies for species whose old forest habitat coincides with areas subject to intensive forestry practices has been severely hampered by a lack of knowledge of the characteristics, spatial distribution and extent of habitats they occupy, and of the impacts of planned disturbance regimes.

This talk outlines the process developed to take into account the 99 forest-dependent invertebrate species listed under the schedules of the Tasmanian *Threatened Species Protection Act 1995* in areas subject to production forestry activities. Case studies will be presented including work on the development and implementation of management actions for a number of species. The conservation requirements of such threatened species illustrate the need to expand the focus of habitat conservation from static, set-aside approaches to strategies that ensure retention of habitat in time and space across the species range. The feasibility of 'off-reserve' conservation, and the value of the threatened species approach to the conservation of forest invertebrate biodiversity in general, will be discussed.

Research informs the improvement of hollow tree retention measures in Tasmania's production forests

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Tree hollows provide an essential resource for a range of fauna, both in Australia and worldwide. There is concern over the future availability of the hollow resource in forests managed for timber harvesting because the time required for hollows to form is generally longer than the interval between harvest rotations. One of the strategies used to maintain the hollow resource is to retain specific trees to provide habitat for fauna.

A number of research programs have been undertaken in the last few years to assess the availability and importance of tree hollows in Tasmania and the types of trees that are most important to retain for fauna. One of the main studies examined 391 trees before and after felling in forestry coupes throughout Tasmania. The trees were located at 39 sites in two broad forest types important to the Tasmanian forest industry: wet and dry *Eucalyptus obliqua* forest. Data were collected on tree growth rings, hollow occurrence and whether the trees were being used by fauna.

The main factors associated with both hollow presence and abundance were the number of hollows observed on the standing tree, tree diameter and the amount of dead wood in the canopy. While tree age was strongly associated with presence of hollows, it had less bearing on hollow abundance. Although hollow-using fauna are a major component of vertebrate fauna in Tasmania, the number of hollow-using species found in Tasmania (42) is at the lower end of the range found in other areas of Australia. The rate at which trees were used by vertebrate fauna in Tasmania was also at the lower end of the scale found in other areas of Australia, with only 28% of hollow-bearing trees examined showing evidence of use. The variables most strongly related to the use of a tree were hollow abundance, tree size and senescence. The likelihood of a hollow being used increased with hollow size and, in particular, hollow depth.

The results of this and other studies have improved descriptions of the types of trees that need to be retained and given a better indication of the rate of tree retention required to ensure an ongoing supply of hollows in the production forest landscape.

When nature takes over from man: How fast are old-growth characteristics re-appearing in strict forest reserves in Flanders and north-west Europe?

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Forests in North-West-Europe and in Flanders in particular, have all been intensively used and altered by man. Primary old-growth forests are therefore nonexistent. Two structural characteristics of old-growth forests - overmature trees and coarse woody debris – are analysed. Statistics from forest inventories in Flanders and other countries are compared to figures from old-growth remnants in Central Europe.This clearly illustrates that the differences are dramatic, with differences up to a factor 100.

Over the last decades, strict forest reserves have been declared in previously managed forests all over northwest Europe, and produce intermediate figures dependent on age and status of the stands at the time of designation and the period of non-intervention. Based on data from a number of reserves, an average estimate can be given on the rate of development of coarse woody debris and overmature trees. Finally some case studies also illustrate the response potential of old-growth related organisms (fungi, insects).

Measuring forest maturity within an experimental forest landscape to inform conservation planning in Tasmania

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There is increasing recognition of the need to ensure the continued representation of late successional forests in production forestry landscapes for conservation purposes. Yet native forestry rotation lengths are typically too short to allow for late successional forest to develop between successive harvests. Addressing these potentially conflicting management objectives requires a landscape-level approach. In Tasmania, about 1.4 million hectares of forest lie within the Comprehensive, Adequate and Representative (CAR) reserve system, of which nearly one million hectares are oldgrowth forest. Further areas of forest, outside the reserve system, are not intended for wood production. While not all of this forest is late successional, that which isn't has the potential to become so over time. Given this scenario, it is timely to consider how to measure and monitor the distribution and configuration of late successional forests across the landscape. Such a perspective could help set directions for research as well as aid in reporting, planning and decision-making within the forestry and conservation sectors.

The current project uses spatial analytical techniques to develop a preliminary set of landscape metrics that quantify the extent and pattern of mature forests (>110 years old), indicative of late successional forests, in the Experimental Forest Landscape in southern Tasmania. This landscape includes 155,000 ha of public and private land spanning a west-to-east gradient of increasing land-use intensity. Sets of patch, class and landscape metrics, and potential reporting measures, are being evaluated to determine their utility.

Restoration of a degraded coast redwood forest in north-west California

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Effective protection and restoration of the world's forests requires we create, document and evaluate model programs, and communicate results to key stakeholders. Geographic information systems and advanced visualization tools are being used to evaluate threats and restore 10,000 hectares of degraded coast redwood / coastal Douglas-fir forests in northwestern California. Transferred from and an industrial owner to the state park system in 2002, the Mill Creek Property is now managed to restore the forests' late seral characteristics. A coalition of public and private partners has created a program of integrated, ecologically based restoration to protect and improve the exceptional natural values present on the property. The program has become a model in California because (a) the purpose of the property is clear, (b) private interests have been leveraged to compliment the strengths inherent in state and federal programs (c) there is continual and effective communication between field staff, funding managers and policy makers and (d) continual collaboration with the academic community. The challenge to grow more old forests exists world-wide and the essential elements of erosion control, forest restoration and habitat protection are all being tested in the world's tallest forest. Our desire is to create a world-class program, from which the relevant parts may be shared and applied elsewhere.

Theme 5: Toward ecological silviculture

Keynote Address

Implementation and monitoring of variable retention harvesting in old-growth forests of coastal British Columbia, Canada

William J. (Bill) Beese

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In response to changing public values and scientific knowledge, the variable retention (VR) approach to forest harvesting has become widespread on forest lands in coastal British Columbia (BC). Variable retention maintains structural diversity of forests – an important element for conservation of biodiversity. Long-term retention of structure is intended to produce future forest stands that more closely resemble conditions following natural disturbances, thereby maintaining greater diversity of habitat for a variety of organisms. Among the old-growth features maintained through retention are large trees, multi-layered canopies, snags and coarse woody debris, and diverse understory plants. The VR approach can be applied using the retention silvicultural system or by adapting traditional systems with long-term reserves.

Western Forest Products is implementing a forest management strategy that includes landscape zoning, variable retention and adaptive management to balance ecological, social and economic objectives. Variable retention is being applied with a range of ground-based, cable and helicopter harvesting methods. The program includes monitoring of both operational cutblocks and experimental comparisons. The company is monitoring both the implementation and effectiveness of various approaches to assess the amount and characteristics of retention and achievement of goals. Studies of the impacts of retention on selected groups of species are underway as part of research and adaptive management programs. Initial results suggest that a number of organisms can utilize the habitat provided by both aggregated and dispersed retention. Results of monitoring are communicated to field foresters to provide feedback for continuous improvement of VR layout and planning. Challenges to implementing ecosystem-based management in coastal BC include: costs, wind damage, predicting forest growth and managing future stand health.

The potential for uneven-aged silviculture in restoration and management of old forests

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The origins of uneven-aged silviculture in North America, and elsewhere in the world, are based in ecological concepts regarding nature maintaining a certain order. Many of these concepts were rooted in notions of unmanaged or old-growth forests. As a result, the guidance for uneven-aged stand management has favoured predefined stand structures that were perceived to be "balanced" and "natural", or in a "steady state". Old-growth stands are often perceived to be in similar conditions of "balance" and "steady state" to generally possess uneven-aged or even all-aged structures. Hence, traditional uneven-aged silviculture is often seen as a logical model to guide the restoration and management of old-growth forests. However, the typical model for uneven-aged stands is a negative exponential diameter distribution that presents little options for variation. Using these diameter distributions in old-growth stands would tend to homogenize these stands to a constant or similar set of stand structures. This homogeneity would occur over both temporal and spatial scales. Old-growth forests, and individual old-growth stands, are noted for their unique features that can be highly variable from one stand to another. What is needed are tools that integrate existing stand structure features into guidelines for management and maintain the unique characteristics of individual old-growth stands. These would include capacity to adjust stand structures to accommodate unusual stocking requirements or species compositions.

Forest management and conservation of *Nothofagus* forests in south Patagonia, Argentina

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Nothofagus forests in south Patagonia (Santa Cruz and Tierra del Fuego provinces, Argentina) that cover 1.05 million hectares are being used in multiple ways, for example timber production, cattle grazing, firewood extraction, tourism and recreation activities, and conservation. Between 700 and 1000 ha of the forest has been logged annually with a mean log volume of 63.2 thousand m^3 yr^{-1}. The sustainable management of these forests has been legally declared as an objective. However, there is a number of issues in *Nothofagus* forest management that may affect long-term sustainability: the lack of long-term policies and planning, weak control from the government, incomplete implementation of management plans and silvicultural practices, and livestock damage to regeneration. In this context, we propose an industry adaptation to a biodiversity program with an alternative regeneration method. In *N. pumilio* forest, the proposed method leaves 30% of the timber-quality forest area as aggregated retention and 15 m^2 ha^{-1} basal area (BA) as dispersed retention. This regeneration method maintained the same yield rate as the first cut of the shelterwood cut system, the harvesting costs decreased and the original diversity of primary forest was better conserved. Furthermore, *N. antarctica* forests have been used as silvopastoral systems where natural pastures grown under the tree canopy are grazed by cattle and sheep. There are ecological and economic interactions (positive and/or negative) between the woody, non-woody and animal components of these systems. Data on above-and below-ground biomass, carbon and nutrient accumulation in different tree components, dry matter production and quality of pastures, wood production from thinning schedules, animal performance (stocking rates, live weight gains) and regeneration have been evaluated to determine the impact of silvopastoral system practices. A monitoring program was established to find an equilibrium between economic and biodiversity conservation. Thus, in harvested stands it has been evaluating the ecological functionality of the applied regeneration system such as forest structure, climate changes, ecophysiology of regeneration dynamics, habitat quality, abiotic cycles, and insect, understorey and birds biodiversity.

Process domains: A useful concept for characterising disturbance and successional trajectories in temperate rain forests.

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Process domains are landscape sub-units whose topography, geology and climate result in distinct suites of geomorphic processes. These geomorphic disturbances influence local ecosystem productivity and successional dynamics. The concept of process domains has been applied to aquatic ecosystems in the Pacific Northwest, and could be extended to terrestrial and riparian ecosystems in storm exposed temperate rainforests. Colluvial and fluvial processes disturb existing vegetation. They also mix and redistribute soil mineral and organic material, producing local areas of high fertility in depositional zones. Like colluvial and fluvial processes, windthrow results from the interaction of severe weather with local topography and soils. Windthrow disturbance ranges from small gap creation and partial soil turnover, to whole stand replacement and extensive soil turnover. Studies on northern Vancouver Island and southeast Alaska have shown that soil fertility is higher in areas of recurrent whole stand replacing windthrow. In the absence of soil turnover through windthrow or geomorphic disturbance, long term accumulation of organic matter in these humid forests leads to paludification. Extending the concept of process domains to include both recurrent windthrow and paludification processes would provide a spatial framework for projecting successional trajectories in temperate rainforest ecosystems. Surface geomorphology is routinely classified during ecosystem mapping. We have produced predictive models of windthrow susceptibility using digital elevation models, numerical weather prediction results and forest cover maps. Bog forest types are represented in the forest cover database and are readily visible on aerial photos and satellite imagery. It would therefore be relatively easy to produce landscape level maps showing the distribution of process domains. Using numerical prediction modelling results for analysis of severe weather return periods would clarify disturbance timing and frequency. The resulting maps would be useful for understanding landscape level patterns of forest succession and productivity and as a foundation for ecosystem based management.

Is single tree selection suitable for harvesting in Tasmania's tall wet eucalypt forests? Lessons from the European experience

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Drawing on Central European experiences single-tree harvesting and regeneration techniques have been proposed by some advocates as a suitable alternative to clearfelling in Tasmania's wet eucalypt forests. However such proposals do not sufficiently consider the ecology and structure of that forest type, which differs markedly to those European forests wherein single tree selection is successfully practised.

The outcome of single-tree harvesting and regeneration methods strongly differs among forest types and tree species. Single-tree selection methods have been successfully used for (semi-) shade tolerant tree species like European beech, silver fir and Norway spruce. However such methods do not work for light demanding species like Scots pine or Pedunculate oak since the light conditions in small openings strongly discriminate against the regeneration of these species. Inventory data from the Bavarian State Forest clearly indicate a marked reduction of shade-intolerant pine regeneration due to the widespread application of single tree methods. It follows that single-tree selection will not work for *Eucalyptus obliqua* and *E. regnans*, which are also very shade intolerant. At the Warra silvicultural systems trial a single tree/small group selection treatment resulted in poor eucalypt regeneration, serious safety problems and unsustainable economic outcomes. Similarly to light demanding European species, *E. obliqua* and *E. regnans* require a minimum opening width to regenerate. A group selection treatment has recently been established at Warra, using gap and fairway widths of around 80 m (two tree widths). The silvicultural system involves removing about 30% of the canopy at 30-year intervals so that the rotation time is 90 years; 10% of the stand would be retained for more than 90 years to retain late-successional species and structures. Worker safety and harvest economics were both much improved in this group selection treatment, compared to the single-tree selection treatment, and there is a reasonable expectation of adequate eucalypt regeneration in the 80 m wide openings. This form of group selection may offer an acceptable social, ecological and economic alternative to clearfelling, particularly in areas of high visibility or, if the cutting interval is substantially lengthened, for forests that are managed to produce large dimension eucalypts and other special timbers.

Feasibility of burning debris from wet eucalypt forest harvested with the aggregated form of variable retention.

Richard Chuter

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Variable retention forest harvesting aims to retain a representative part of the original forest, interspersed with harvested sections, so that a 'forest edge' influence is maintained over the whole coupe.

These harvesting systems present a challenge for effective regeneration treatment with fire.

Traditional convection burning, practiced on clear felled coupes, cannot be directly applied to retention harvesting, without severely affecting the retained forest.

Twelve aggregate retention coupes were presented for post-harvest burning, with the aim of developing a method and prescriptions suitable for routine application.

Fuel dryness was identified as the key to a successful outcome. The drying of fine fuels occurs until the relative humidity reaches its daily minimum and starts to rise. This usually happens late in the afternoon. Propagation of fire in dry fuel, by slow progression, can be achieved if convection activity is moderated by a combination of the lighting method and rising relative humidity.

Aerial lighting with a helitorch is efficient and effective but depends on skilled operators applying fewer targeted ignition points to help in moderating the fire behaviour.

The design and preparation of variable retention coupes is integral to the facilitation of effective burning. Coupes should look more like golfing fairways and less like football fields. Narrower slash fields can be burnt out by single lines of sparsely applied ignition which, under the right conditions, will progress slowly.

Stocking and early growth of the regeneration in the Warra silvicultural systems trial

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The stocking and density of the seedling regeneration in a silvicultural systems trial located at the Warra Long-Term Ecological Research site in southern Tasmania was monitored for three years after harvesting and regeneration treatments were applied from 1998 to 2003. The treatments were patchfell (a 5 ha patch completely felled), stripfelling (strips about 250 m long by 80 m wide), clearfelling with understorey islands (40 m by 20 m), dispersed retention (retaining about 10% of the original standing forest by basal area as evenly dispersed trees), aggregated retention (retaining about 30% of the original forest in aggregates of about 1 ha), and single tree/small group selection). Most treatments were replicated twice; the patchfell was not replicated, and the second replicate of the single tree/small group selection treatment was harvested as a group selection treatment, single tree selection having been found to be too dangerous. Early seedling growth was monitored for three years, and where possible for six years, after establishment of the treatments.

Regeneration in all the treatments except the single tree selection met or very nearly met current stocking standards (greater than 65% of plots stocked), although seedling density (stems per hectare) in some treatments was low compared to levels required for possible future intensive stand management. By age three years, stocking of the regeneration in the single tree selection treatment was still only about half the desired level for commercial wood production.

The nature and condition of the seedbed in each coupe was related to the harvesting and regeneration treatment. Where high intensity burns could be (or were, sometimes inadvertently) applied (CBS with understorey islands, patchfell, stripfells, the second dispersed retention treatment) there was a significantly higher proportion of burnt seedbed available than in coupes where low intensity burns were applied (first dispersed retention treatment, aggregated retention and single tree small group selection).

Seedling height growth across the trial was significantly related to the nature of the seedbed in which each seedling had established. Seedlings growing on hotly burnt seedbed, created by intense burning of harvesting debris, were growing significantly more quickly in height than seedlings on most other seedbed types. Seedlings on unburnt and compacted seedbed grew significantly more slowly in height than seedlings on most other seedbed types.

Aggregated retention is currently considered a potential alternative to clearfelling for harvesting of tall oldgrowth wet eucalypt forests in Tasmania. Traditional high intensity burns cannot be conducted in coupes with retained aggregates. If aggregated retention is to be successfully applied, as measured by the stocking and height growth of the regeneration, finding ways of successfully and consistently burning such coupes post-harvesting will be essential.

Using variable retention harvesting to manipulate canopy species dominance and regeneration in *Nothofagus-Ceratopetalum* cool temperate rainforest

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Variable retention harvesting which removed 0, 25, 50 and 75% of the overstorey tree basal area was applied in 1 hectare treatments in 1960 to manipulate canopy tree dominance and regeneration in *Nothofagus-Ceratopetalum* cool temperate rainforest in northern NSW. This rainforest type exhibits only two discernible tree strata and has a tendency to be dominated at maturity by *Nothofagus moorei* with large tall trees ($\bar{x}$ tree ht 45 m, $\bar{x}$ tree diameter 80 cm, 16% of the total number of trees > 10 cm dbh) and *Ceratopetalum apetalum* forming a sub-dominant stratum ($\bar{x}$ tree ht 20 m, $\bar{x}$ tree diameter 30 cm, 79% of the total number of trees > 10 cm dbh). Despite their different structure and dominance patterns, *Nothofagus* and *Ceratopetalum* contribute very similar amounts to total stand basal area (46 and 49% respectively). The hypothesis, that the existing structure and dominance patterns are a function of differing regeneration and growth responses to retention harvests, was examined with twelve plot measurements between 1960 and 2006.

An increasing intensity of tree basal area removal led to different recruitment, regeneration, growth and dieback responses in the two canopy tree dominants. *Nothofagus* exploited the more intensive removal treatments with vigorous stump coppice growth, increased seedling height growth and increased diameter growth increment on retained trees compared to *Ceratopetalum.* While in *Nothofagus* the density of new seedling recruits diminished as the overstorey canopy re-established, in *Ceratopetalum* the density of new seedlings increased, although with relatively lower height growth rates. *Ceratopetalum* was characterised by a higher density of slower growing root and stump coppice, which persisted in the lower height categories and was therefore subject to further resource competition with the 15 other small tree species present. Dieback and mortality occurred across all treatments with the frequency of moderate to severe dieback in *Nothofagus* increasing in proportion to the percentage of basal area removed. For *Ceratopetalum* however all treatments exhibited low levels of dieback. Wind throw for retained *Nothofagus* was significant with 47% mortality by basal area in the 50% removal treatment. The dynamic relationship between *Nothofagus* and *Ceratopetalum* was related directly to their relative recruitment and growth rate strategies, as expressed within the different retention harvests treatments.

Variable retention and old-growth biodiversity: Forestry Tasmania's goals and monitoring program

Sue Baker, Simon Grove, Steve Read, Tim Wardlaw

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Forestry Tasmania (FT) has been assessing several forms of variable retention as an alternative to clearfelling for harvesting of oldgrowth wet eucalypt forest. Research comparing these alternatives has focussed on studies done in the Warra Silvicultural Systems Trial, established in 1997. Aggregated retention is the form of variable retention that has been suggested as the most promising alternative to clearfelling in wet oldgrowth forest. It is now being deployed operationally as part of FT's commitment for at least 80% of oldgrowth harvesting to be by non-clearfell methods by 2010. FT has developed interim biodiversity goals for variable retention:

- 'To more closely emulate natural ecological processes within managed tall oldgrowth forest by retaining late-successional species and structures (biological legacies) for at least a full rotation.'
- 'To maintain a forest edge influence over the majority of the felled area thereby differentiating the regenerating stand ecologically from stands regenerating following clearfelling.'

Specific guidelines are provided for how to achieve these goals in aggregated retention harvesting. They include:

- retaining patches of trees (usually >1 ha), called aggregates, for at least one rotation;
- the majority of the coupe area to be no more than the length of one mature tree-height away from adjacent areas of mature forest;

Where possible, aggregates should be anchored on locations of ecological value.

Monitoring in newly harvested and burnt operational aggregated retention coupes commenced in 2007. Parameters monitored include: habitat tree assessment, mammal scat counts, vascular plants, health of rainforest elements, burn impact, and structural attributes. These were chosen to be feasible to use operationally, and will be integrated with the more detailed findings from SST studies. The SST research evaluated responses of birds, beetles, bryophytes, lichens and vascular plants. Ongoing monitoring and management will be refined following synthesis of findings from these studies.

Early responses of bird assemblages to clearfelling and its alternatives at Warra, Tasmania

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Birds have been the subject of several studies at Warra over the past decade, as part of Forestry Tasmania's ecological assessment of the silvicultural systems trial, which is exploring alternatives to clearfelling. Different bird species have different habitat requirements, yet the occurrence of most forest species is readily assessed using standard transect- or point-based survey techniques. While both approaches have been used extensively at Warra, the practical and statistical advantages of the latter have lead to its adoption as the long-term monitoring standard. The current survey protocol makes use of a network of some 250 sample points, distributed through the main treatments (silvicultural systems) and in adjacent unharvested mature forest; each point is visited at least six times over the course of a spring/summer survey period. This intensity of survey has been shown to be sufficient to allow the detection, if present, of all but the rarest of the 50 or so species recorded from the study area, while allowing the derivation of measures of relative incidence for each species. The successive data-sets jointly constitute a before-after control-impact design, and have been compiled and standardised accordingly, allowing analyses of treatment and time effects. Preliminary analyses point to some clear treatment effects for individual species, guilds and entire assemblages. The results will contribute to a synthesis of ecological research findings arising from the Warra silvicultural systems trial.

Early responses of ground-active beetle assemblages to clearfelling and its alternatives at Warra, Tasmania

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Ground-active beetles have been sampled continuously at Warra for a decade as part of Forestry Tasmania's ecological assessment of the silvicultural systems trial exploring alternatives to clearfelling. Arrays of standard pitfall traps were set up at multiple locations for each of three main silvicultural systems and in adjacent unharvested mature forest, in a before-after control-impact design. Sampling was carried out for a year pre-harvest, and for the first and third years post-harvest. Over 10,000 samples were collected and sorted. We have restricted our analyses to three main silvicultural systems: clearfell, burn and sow with 'understorey islands', dispersed retention, and aggregated retention; and to three indicator beetle families: Curculionidae, Leiodidae and Carabidae. These provide a dataset of 18,530 beetles comprising 144 species. Beetles were responsive to the different treatments. Most species in clearfelled areas could be characterised as young forest affiliates, while those in unharvested mature forest were characterised as mature forest affiliates. In understorey islands, in dispersed retention and in the harvested areas of aggregated retention, beetle assemblage composition was dominated by young forest affiliates, although with sufficient influence of mature forest affiliates for assemblages to differ slightly from those of clearfelled areas. In retained aggregates, assemblage composition mostly consisted of mature forest affiliates, although with sufficient influence of young forest affiliates for assemblages to differ from unlogged forest. For all treatments except aggregates, assemblage compositions deviated more from unlogged forest in their third year than in their first year post-harvesting. Aggregate assemblage composition appeared stable over the same period.

Creating dead wood in commercial forests to mimic features in natural forest

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To try mitigating species loss and increasing the amount of dead wood in Sweden, high-stumps (snags) are created when forest operations are carried out. We here present a study on saproxylic beetles in high-stumps of spruce (*Picea abies*) and birch (*Betula pendula/pubescens*) and what effect the surrounding landscape has on the beetle assemblages. Many wood living beetle species are only found in certain areas with higher overall biodiversity, so called hotspots. It has been argued that conservation actions should be allocated to hotspot areas and perhaps it would be more efficient to concentrate efforts like high-stumps to hotspot areas instead of spreading them out in the landscape (in the matrix). We compared the saproxylic beetle fauna, collected with window traps mounted on spruce and birch high-stumps, between spruce and birch high-stumps on 20 clearcuts in hotspots and the matrix. We also compiled data on forest composition and landscape configuration around the clearcuts to confirm differences between the two landscape types. The hotspot variable could not explain the species composition of saproxylic beetles to a significant degree in the analysis. There were however several forest composition variables that contributed significantly in explaining beetle species composition, for instance the amount of broadleaved trees within 500 m of the clearcut. Our study could not show that high-stumps in hotspots attract more saproxylic beetle species than high-stumps in the matrix do. There was a tendency for more rare beetle species in the hotspots. Considering the lack of difference between the landscape types in our study, and that high-stumps probably is a rather cost effective conservation action that can be created everywhere in the landscape, we suggest that they should be created on all types of landscapes.

Victorian Salvage Harvesting Prescriptions – juggling timber and environmental recovery after megafire

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On 1st December 2006 lightning sparked the second megafire in the Victorian High Country in four years. The Great Divide Fire Complex burnt for 85 days, extending through over one million hectares of forested country, including over 20 000 hectares of valuable public timber resource. The Victorian Government quickly committed to recovering timber resources from the fire affected area, returning the eastern Victorian forest industry focus once again to salvage harvesting.

The Victorian Code of Forest Practices requires salvage plans take into account the urgency of timber recovery, and the need to modify prescriptions to meet environmental care goals and recovery of other forest values. To ensure the application of a consistent approach to salvage operations, the Department of Sustainability and Environment (DSE) led a project to develop Salvage Harvesting Prescriptions.

With the fires still burning, a multi-disciplinary team of foresters, biologists, soil and water scientists and policy makers collaborated to formulate the 2007 Salvage Harvesting Prescriptions. Team members identified focus areas and developed solutions during several workshops and meetings. The prescriptions drew where possible on relevant research and the experience and advice of practitioners.

The March 2007 Salvage Harvesting Prescriptions include changes to coupe size and aggregation rules, increased protection of soil, water and regeneration values, and a range of measures to facilitate recovery of forest ecosystems. DSE scheduled a prescription review in spring 2007 to account for recovering forest conditions, and to address emerging implementation issues.

Whilst developing the 2007 Salvage Harvesting Prescriptions, information gaps and the need for practical compromise between economic and environmental outcomes presented challenges for team members. With salvage harvesting now in full swing, operational foresters must apply the prescriptions in various forest environments with rapidly changing conditions.

This presentation discusses the factors considered in the development of the prescriptions, the challenges encountered in developing and implementing the Salvage Harvest Prescriptions and the outcomes of the review process. DSE's experiences and learnings may inform other forest managers faced with the unfortunate, but increasingly prevalent task of juggling timber salvage and environmental recovery in the aftermath of major forest fires.

Modelling of timber yield implications of variable retention

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The 2005 Tasmanian Community Forest Agreement (TCFA) requires Forestry Tasmania to achieve non-clearfell silviculture over a minimum 80% of the annual harvest area of oldgrowth forest on public land by 2010.

Modelling undertaken for the Final Advice to Government (Forestry Tasmania 2005) assumed that the impact of Variable Retention (VR), when compared to the prevailing clearfell system, would be a 20% reduction in *area* (modelled as a 20% reduction in *yield per hectare*) at initial harvest due to the additional retention, and a 10% reduction in subsequent silvicultural regeneration *growth* due to suppression and lower stocking. In addition, the impact of VR on high quality eucalypt sawlog woodflow over a 30 year time horizon was described in terms of the reduced supply from oldgrowth forest, and increased supply from plantations, to ensure an ongoing legislated total supply of 300,000 m^3 per year.

A current project aims to:

1. Conduct sensitivity analyses of a range of retention levels and regeneration productivity levels to determine the implications for the supply of high quality eucalypt sawlogs at the public native forest estate level; and
2. Investigate sampling operational VR coupes to determine if retained aggregates contain a different volume per hectare compared to their forest class average. If possible, a statistical comparison of forest class plot average volumes, and their related aggregate plot average volumes, would be undertaken to clarify the potential bias in the use of forest class average values for specific areas.

Results from the two components of this project are presented.

Researching high-value markets for eucalypt timber from old-growth forests

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The 2005 Tasmanian Community Forest Agreement increased the protection of oldgrowth forests to some 973,000 ha, which is 79% of Tasmania's oldgrowth forest. Oldgrowth forests on areas designated for wood production are planned to meet about one quarter of the State's legislated eucalypt sawlog supply, of 300,000 m^3 per year, until 2030. An increasing proportion of the future hardwood supply will be processed from smaller diameter sawlogs from regrowth forest and plantations.

The Agreement also recognises the particular value of special species timbers for Tasmanian craft and design industries and noted that selected areas of State forest will continue to be managed for the long-term production of such timbers. Tasmania's highly prized special timbers including blackwood, myrtle, celery-top pine, sassafras, Huon pine, silver wattle, and leatherwood have well established markets. Considerable efforts are being made to increase the value of the small volume of these timbers that can be provided on an ongoing basis.

Currently supplies of large-dimension eucalypt sawlogs are relatively abundant and not substantially differentiated in price or product to smaller diameter logs. The timber properties of large-dimension sawlogs have not been clearly distinguished from younger, smaller material but include properties such as stability, hardness, natural feature, percentage recovery and the ability to produce wide and long sawn material. Large-dimension timber from oldgrowth eucalypt trees may increasingly be recognised as special timber as the supply of this material becomes less common.

A current project seeks to determine: if there is market niche for an ongoing low-volume supply of large-dimension eucalypts to supply specialised high value markets; and, are there relevant examples internationally where niche markets have been created to attract premium prices for specialised products from reducing supplies of large-dimension timber. The project is being undertaken on the basis of a supply of slow-grown, large-dimension eucalypt sawlogs of at least 10,000 m^3/year that could be made available in perpetuity.

Results from the project will help inform the management of Tasmania's unreserved public oldgrowth forests by exploring the option of managing a portion of this estate for low-volume high-value eucalypt timber production consistent with production of other currently recognised special timbers and for leatherwood honey.

Timber from mature eucalypts: We like it and will miss it when it's gone

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With supply constraints and competition from cheaper pine products, solid eucalypt hardwood timber has largely shifted from being a general construction material to become primarily an architectural selection in building. Yet, this section of Australia's construction and fabrication industry has an established preference and pays a premium for the relatively clear, stable, and larger section timber recovered from mature eucalypt logs. This material was the base resource for the Tasmanian solid hardwood production industry traditionally. Over the last two decades, the transition from this resource to younger native forest regrowth forced significant industry changes but these are likely to be relatively minor compared to the changes that are and will occur as native forest logs become increasingly rare and the base resource for industry becomes smaller eucalypt plantation logs grown for speed and not for the characteristics of their wood. This paper will report on recent work at the Centre for Sustainable Architecture with Wood on the comparative properties of the mature, regrowth and likely plantation resource available for the Tasmanian solid hardwood production industry. It will discuss the likely implications these different properties have for profitable processing, value adding and use, and identify priority areas for research, technical and market development.

The safety implications of aggregated retention harvesting in tall wet eucalypt forests in Tasmania, Australia

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The safety outcomes of aggregated retention harvesting, where patches of undisturbed forest of half to two hectares were retained undisturbed within otherwise harvested coupes, were investigated in 12 operational and two experimental coupes. The coupes were inspected post-harvesting, and the harvesting crews interviewed. No safety incidents or accidents related to aggregated retention harvesting were reported. The harvesting contractors reported initial concern due to unfamiliarity with the system, but as familiarity grew so did their comfort levels.

There is a small increase in exposure (and hence risk) to tree fallers due to the need to fall more trees away from their direction of lean and to harvesting machine operators due to an increased edge effect arising from retained aggregates. There is a comparative increase for contractors involved in on-site preparation for burning and other post-harvest operations.

Windthrow was identified as an issue, although it largely affected the understorey (80% understorey, 15% regrowth, 5% oldgrowth). Windthrow was worse in smaller aggregates and those exposed to westerly winds. The regrowth that was windthrown suggests that there may be an issue if aggregated retention harvesting moves into regrowth forests.

Investigations into the practicalities of regeneration burning in aggregated retention coupes have suggested that future harvesting patterns should incorporate wider fairways and larger aggregates, as this will facilitate burning. Such changes are supported by the current investigations as they will reduce the exposure to retained trees post-harvesting and may also reduce the extent of windthrow in the retained aggregates.

Integrated farm forestry: Stand structure and diversity in five silvicultural regimes including old-growth *Eucalyptus obliqua* forest, northern Tasmania

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The aim of the presentation is to report on the analysis of forest structure, floristic diversity and habitat condition for five contemporary silvicultural regimes applied on a small-scale, family-sized landholding in northern Tasmania. The location is a diverse 760 ha forested property in the Northern Midlands, on the eastern foothills of the Great Western Tiers. Outcomes for stand structural and spatial variation, and consequently for floristic diversity and habitat quality, are examined within the overall wood production strategies of the farm forest enterprise.

The comparative analysis is based on a recent survey of structural attributes such as stand density, tree basal area distribution, canopy profiles and crown projections in replicated small plot samples in silviculturally managed eucalypt forest and young plantations. Patterns of floristic diversity and habitat condition were compared for the same series of plot samples. Silvicultural regimes included thinned *Eucalyptus obliqua* high forest; advanced regrowth *E. obliqua* forest; remnant (old-growth) *E. obliqua* forest; and young (12-15 year) *E. nitens* plantations on ex-bushland and ex-pasture sites, respectively. Forest management and production goals were also assessed in terms of economic and social outcomes for the landholders and for the local community.

Indices of floristic diversity and habitat condition strongly favoured the silviculturally managed native high forest and remnant old-growth forest. Results for both native forests and plantations were closely aligned with altered regeneration dynamics following respective (and notably different) histories of disturbance. The study demonstrates that at the farm forest scale, there is opportunity for an integrated mix of native regrowth and remnant old-growth eucalypt forests to be silviculturally managed alongside young eucalypt plantations, to achieve favourable outcomes for both wood production and biodiversity protection across the landholding as a whole. With careful planning and skilled forest management, this is creating a broad basket of social and community benefits without compromising either the environmental or commercial goals of the enterprise.

Effect of agricultural land management on the health of old-growth eucalypts in the Midlands of Tasmania

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Maintaining biodiversity in poorly reserved woodland remnants within agricultural landscapes is a priority. Overstorey trees are cornerstone species in these remnants, as they are essential for ameliorating microclimate, providing a seed source for regeneration, preventing soil erosion and providing a structurally diverse habitat, but many remnants contain trees that are rapidly deteriorating in health. In temperate Australia, decline is commonly attributed to three decades of below average rainfall. However, instances where trees are healthy on one side of a management boundary and in decline on the other side, indicate a key role for management in the condition of woodland remnants. Our study investigated the effects of past management on soil properties and understorey, and linked these with tree health across 49 sites within the Midlands of Tasmania. Sixty percent of the variation in tree health was associated with low native shrubs, litter, moss and lichen in healthy sites and with exotic pasture species in declining sites. Soil attributes explained 72% of the variation in tree health with healthy sites having lower soil total nitrogen, higher organic carbon and lower pH. A combination of soil and understorey vegetation attributes entirely separated healthy, declining and poor sites in a canonical analysis. Regression tree analysis indicated that grazing history (fencing, grazing frequency and intensity) was the primary management factor in separating healthy and poor sites, whilst patch size, fire frequency and wood gathering were secondary but significant factors. Sites that were ungrazed or only lightly grazed had fire frequency > 10 years, and did not have course woody debris removed were healthy, indicating that the drying and warming climate of the past three decades is within the bioenvelope of the species examined.

Forestry and agriculture are co-existent issues in most countries in developing regions

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This paper presents an overview of the process of change in the forests brought about by agricultural activities, and the intertwining issues of forestry and upland agriculture in most developing countries in the tropics.

In the developing regions like in tropical Asia, population and economic growth are the most important determinants in the demand for forest products and services. Since agriculture is the most important sector in the economies, agriculture is always an integral part of the forests. The conversion of forests into agricultural land is one way of increasing the agricultural production. In Asia, forest conversion to agriculture is equally divided between permanent and shifting cultivation. Due to inaccessibility of primary forests, people now clear secondary forests at different and even shorter stages of succession (like the bush or grass fallows).

When communities derive their livelihood from forests, simply forbidding access to this resource is not an option. The rural poor in the country, especially whose agricultural productivity is low, access to available land and information is limited, are most likely to continue to put pressure on forest areas that will result in a continuing loss of forests.

As part of an integrated effort to conserve the remaining natural forests for the non-renewable values they represent, forest production management options in currently cultivated forest areas is investigated. It is relevant if development efforts are directed towards the improvement in productivity and the sustainability of the production systems of the people who are directly dependent on forests for their livelihood.

Forest management based on traditional community in Papua, Indonesia

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In Indonesia, Papua is one of the provinces that has amazingly diverse flora and fauna. Papua's biodiversity contributes to more than 50% of Indonesia's biodiversity. Specifically, Papua's forests account for approximately 34.6 million hectares or 24 percent of Indonesia's total forested area of 143 million hectares. This data indicates that most of the traditional communities in Papua depend on their natural resources for their livelihood. This paper aims to explore the importance of utilizing forest management based on traditional community approach.

Most traditional communities in Papua live in forests and depend on them for their livelihood. They call their land "traditional land" or "traditional community forest".Traditional communities of Papua have the right to own, develop, control and use their lands. They depend on forest resources for their economic, social, cultural and spiritual well-being. They manage their forest with traditional methods that directly protect ecological and biodiversity sustainability because they have thousands of years of knowledge about the forest in which they live. Forest conservation is also included within their traditional laws, as they realize the necessity of conserving the forest for future generations. However, for the last three decades, forest and natural resources management in Papua has been controlled and monopolized by big corporations without community consultation, and this process has threatened ecological and biodiversity sustainability. Illegal logging is one of the major causes of forest destruction in Papua. *Merbau*, for example, is one of the most valuable timber species in Southeast Asia and is sold illegally to China. The smuggling is getting worse, despite Indonesia and China signing a Memorandum of Understanding on Forest Law Enforcement and Governance.

Recently, the government of Papua through the Forest Department has developed a draft on Special Region Rules (PERDASUS). This draft regulates the participation of traditional communities to manage the biodiversity of their forests in sustainable ways. Government, business, and scientists need to work collaboratively with traditional communities who are actually a part of the management process.

Designing old forest for the future: Informing policy and practice

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Most native Australian forests are old, even those with few old trees. Public policy must cater for diverse visions for how these forests should be in future. Robust information is needed to assess the merits of different strategies to achieve accepted biodiversity conservation goals. This requires imaginative research and interpretation, e.g. using retrospective studies and modelling to make long-term predictions in practical time-frames. Strategic questions concern the merits of strategies to integrate or segregate conservation and economic production at different spatial scales (small or large patches); the value of retaining scattered trees or clumps of trees among regrowth, and the implications of extreme spatial segregation of wood production (growing it in tree plantations on cleared land). Similar questions arise for management of fire, water and rural landscapes.

Some conclusions can be made from case studies in Victorian forests and farmland. Large retained forest patches (>100 ha) are more likely to support arboreal mammals and large owls than small patches. Densities of diurnal birds are low in small patches of forest in farmland, but show no such relationship in patches of old forest of varying size in ash forests. Edge effects between age classes of regrowth ash forests are small, except along roads and fire-breaks. Some fauna species show preferences for scattered old trees among regrowth, or large patches of mature forest, but many respond to numbers of old trees regardless of spatial arrangement: quantity is more important than pattern. Tree plantations provide habitat for many but not all fauna species, and may be especially valuable when adjacent to remnant forest.

Generally, the quantity and quality of retained habitat seems more important than its spatial distribution. The most effective planning processes are those that involve public consultation and biological research across land tenures.

Learning from the past, surviving the present and managing for the future: Logging, restoration and conservation on the Tongass National Forest

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At over 6.9 million hectares the Tongass National Forest in Alaska is over three times larger than any other national forest in the United States and contains the largest relatively unaltered temperate rainforest in the world. The Tongass accounts for 80 percent of the land base in Southeast Alaska, and includes a narrow strip of coastal mainland, over 2,000 islands and more than 30,000 kilometres of marine coastline. Scattered amongst this vast geography are 32 human communities only one of which has a population over 10,000, and 75 percent of which have populations less than 1,000. Because many of these communities have traditionally been heavily dependent on the harvest of the old-growth forests, some hold deep animosity to decreases in this harvest. Other interested public, both within and outside the region, are expressing their preference to protect some or all of the remaining unprotected old-growth from harvest.

In this presentation I will outline the political, economic and institutional factors that influenced past management regimes on the Tongass and describe the effects of these regimes on current forest structure, as well as on the industries and communities that derive benefits from the forest. Next I will describe the manner in which the globalization of markets and products along with increasing pressure to manage forests for both market and non-market goods and services have led to political struggles between conservationists who favour old-growth reserves, restoration and harvest from second growth, and the local forest products industries and their supporters who stress that they need to harvest old-growth to survive. Finally, I will discuss the alternative strategies land managers have in addressing these conflicting concerns and some of the possible short and long term tradeoffs of choosing one strategy over another.

Design of variable retention harvesting and monitoring programs in old-growth *Nothofagus pumilio* forests of South Patagonia, Argentina

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Nothofagus pumilio forests cover 483,700 hectares, and are located in public and private lands in South Patagonia, Argentina. Old-growth forests are harvested to satisfy the sawmill industry. Currently, there is a lack of long-term forest policies, but recently sustainable management has been legally declared as an objective. Despite this, private land-owners and companies are interested in long-term sustainability, mainly to achieve forest certification demands (e.g. FSC). For this, impacts of traditional forestry (shelterwood cuts) were analyzed (overstorey, regeneration, plants, birds, insects and mammals). Remnant overstorey (30 $m^2.ha^{-1}$) lost 50% basal area during the first years after harvesting due to machine damage. However, regeneration was successfully established after ten years (168,000 $plants.ha^{-1}$ with 38 cm height). Diversity increased after harvesting, but insects abruptly decreased with one morpho-species lost every 11 years. In a second study, species assemblage at the landscape level was analyzed. Unproductive associated environments (*N. antarctica* forests, edge with grasslands, stream-sides, wetlands) included most of timber forest diversity. However, many insects (e.g. coleoptera, flies) were only found in primary old-growth timber forests. For these, it was necessary to develop a new conservation strategy to assure biodiversity conservation. Variable retention harvesting with aggregated (30% timber forests using 30 m radius circular patches) and dispersed retention (15 $m^2.ha^{-1}$) was proposed. Aggregated retention assured to maintain old-growth forest species assemblages (density or abundance) as well as species richness (up to 80% of insects) during the first years after harvesting. A long-term monitoring program based on economic (yield in harvesting and sawmill), forest (overstorey, flowering and seeding cycles, regeneration dynamics), abiotic (climate, soil properties, nutrient cycling) and biotic (understorey species dynamics, habitat quality indicators) variables was designed to monitor variable retention harvesting design. This system is applied at industrial scales in private and public lands combining ecological, social and economical demands.

Managing the tree hollow resource in the matrix: From guiding principles to on-ground practices

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General principles for matrix management to enhance the conservation of biodiversity include maintaining connectivity, landscape heterogeneity and stand complexity, and risk-spreading. This approach involves adopting multiple strategies at different spatial and temporal scales to cater for different species, and contrasts with both the traditional 'set-aside' approach to conservation and the primary aim of production forestry. Translating this risk-spreading approach into on-ground practice is often a difficult task for those involved in forest management.

Using the management of habitat for hollow-using fauna in Tasmania's production forests as a case study, we explore the issues associated with adopting the theory and applying it to on-ground practice. The results of studies undertaken to monitor the implementation and effectiveness of actions taken to maintain the hollow resource at different spatial scales will be discussed. These studies highlight the inadequacy of the existing reserve system to fully cater for the conservation of threatened hollow-users, problems associated with the current 'off-reserve' measures, impediments to effective implementation, and the slow nature of effective adaptive change to management practices.

The implications of intensification of forest management and the outcomes of a recent legal challenge are also discussed. The results of our work may be used to develop some general principles to guide more effective implementation. The development of clear objectives, strategies and user-friendly planning tools, training and communication programs are all important. In our experience a multi-scaled approach to the conservation of particular habitats in the matrix, such as hollow-bearing trees, will be most successful if it is a collaborative effort between researchers, policy developers, forest managers and practitioners. The ongoing success of such an approach depends on a higher level of commitment to monitoring and adaptive management than that currently achieved.

Aligning social values and management of old forests

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This paper outlines research into values and beliefs underlying people's judgements of the social acceptability of forest management systems. It discusses ways in which understanding social values might contribute to the management of old forests. Drawing on initial field research and two theories: the theory of reasoned action and the value belief norm theory, it was predicted that in judging a practice such as clearfelling people would draw on value orientations toward the natural environment. These would lead them to value objects in the forest and to develop beliefs about the consequences of harvesting for those objects, which would in turn lead to acceptability judgements. Approximately 550 Tasmanians were shown images of clearfell harvesting and asked to judge its acceptability. On average, industry-affiliated participants rated clearfelling much more acceptable than did non-affiliated and conservation-affiliated participants. Participants also responded to questions that measured their value orientations, valued objects and beliefs about consequences. Structural equation modelling was used to test whether these data were consistent with the theoretical model. There was no basis to reject the model. This result suggests that differences in people's judgements of the social acceptability of forest management can be explained by differences in their values and beliefs. It places debates about the acceptability of forest practices such as clearfelling within broader value contexts in society, specifically the increasing prevalence of eco-centric values in opposition to more traditional values which emphasise resource use. While this knowledge adds depth to our understanding of debates about the management of old forests, it is not easy to translate into policy and practices. This paper touches on some ways in which forest management and social values might be better aligned. One approach is to align management objectives with the relative importance given by members of the community to different valued objects such as the natural environment (including old-growth forest) and timber resource (including regrowth forest).

A Western Australian solution? A plan for a sustainable estate of old-growth forests.

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Aging karri trees in the Warren National Park have significant crown decline as they approach their natural lifespan of 300 years. Before European settlement, karri forests depended on nature's intense fires for renewal, but for the Warren National Park gazetted in 1915 there is still no plan for its renewal.

Cuts in funding for regular controlled burning have caused massive increases in fuel loads and as these build up, waiting for nature to provide a wildfire for regeneration presents an unacceptable risk to life and property. But without nature's action, the end result of the present *leave it to nature* approach will see older parks closed to visitors because of falling dead branches.

Dr Jacobs [*Growth Habits of the Eucalypts*] proposed clear falling followed by intense fire as the best means to successfully regenerate very tall eucalypt forest.

We propose to mimic nature by clear falling senescent old-growth forest areas followed by intense fire and installing healthy mature regrowth forests as replacement old-growth. The Boranup National Park is one of a number of iconic karri forests that were clear felled more than 100 years ago, demonstrating their ability to recover from severe logging disturbance.

After karri harvesting, the intensity of regeneration burning is presently kept to a minimum by heaping the debris. But damage from insect borers and the armillaria fungus is approaching alarming proportions, far more than in forest blocks regenerated by severe intensity broadcast fire in the '20s. Has this departure from intense fire led to increases in damage from pathogens?

Frank Batini [*Australian Forestry Dec.2007*] records falling water tables and reduced water flows from jarrah catchment forests and climate change has already brought severe moisture stress to the tuart and wandoo forests. Recent management policies that have reduced fuel reduction burning and restricted thinning have each added to the crisis making a review of those practices urgent.

The uncertainty of public funding to manage increased old-growth reserves means that a self-funding approach should be targeted. A proposal to provide additional funds by applying intensive silviculture, disease and pest control, commercial thinning and a regular burning program to a small area of productive forest, has not been accepted.

Give foresters the opportunity to manage sustainable forests for profitable timber production and water conservation, without the loss of biodiversity, while minimising the negative effects of climate change and increased timber imports.

Forest management and regulation in Gondwana's southern outposts: Tasmania and Tierra del Fuego

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Tasmania and Tierra del Fuego are substantial island archipelagos (about 70,000 km^2) connected by the cold currents of the Southern Ocean, a flora with a shared Gondwanan ancestry and a comparable history of settlement. The distribution and characteristics of their forests are strongly influenced by southwesterly weather patterns; topography; and permutations of drainage, soil fertility and fire. The forests of Tierra del Fuego are dominated by *Nothofagus* species and have relatively low species diversity – reflecting their southern latitudes (54–56°S). The forests of Tasmania (40–44°S) are more diverse in structure and composition, with eucalypts and rainforest trees (including *Nothofagus* species) being the main dominants.

Forests and forest products are important to the well-being and economy of Tasmania and Tierra del Fuego, and there are parallels in their history of use. In Tierra del Fuego, forests have been more heavily exploited in the western (Argentinean) sector of the island than in the more sparsely populated eastern (Chilean) sector. A similar situation exists in Tasmania, with its humid western regions proving a barrier to settlement and exploitation of resources.

Forest Practices Plans are required for forestry operations in Tasmania and Tierra del Fuego – on both public and private land. These are prepared by accredited officers, and are approved by government agencies. Regulation of forest management has evolved to take better account of the physical and natural environment. More emphasis is placed on natural and cultural values in Tasmania; in Tierra del Fuego plans incorporate detailed information on forest stocking and regeneration requirements. Fire plays an integral part in the ecology and regeneration of eucalypt forests, but is not required for regeneration of *Nothofagus* forests. Introduced and native animals damage regenerating forests in both places, but Tasmania has been spared the industrial-scale operations of the North American beaver, which have affected about 5% of Tierra del Fuego's forests since being introduced in 1946.

In Tierra del Fuego, high-grading and over-cutting in the past have influenced current practices and encouraged research into alternative silvicultural treatments. Silvicultural techniques in Tasmania reflect different forest structures and ecologies – but adoption of partial logging systems (dry forests) and variable retention (wet forests) have also been promoted to maintain biodiversity and to cater for community concerns about clearfell, burn-and-sow silviculture. Decisions about forest management in Tasmania and Tierra del Fuego have also been influenced by local, national and international concerns about logging in native forests – particularly those with old-growth characteristics. In Australia, Argentina and Chile, programs have been implemented to increase the extent and representativeness of reserved forest – this has been achieved to a greater degree in Tasmania (45% of forest reserved) than in Chile (29%) and Argentina (13%); and in Tierra del Fuego itself (about 20% overall).

Reductions in forest available for wood production – because of reservation, community pressures and regulatory requirements – have resulted in intensification of management, reduction in annual cuts and development of alternative practices in the evolving forest landscapes of Tasmania and Tierra del Fuego.

Theme 6: Shaping old-growth forest management regimes

Ecosystem-based management in British Columbia, Canada's coastal temperate rainforests

Andy MacKinnon

BC Ministry of Forests and Range, Coast Region, Victoria, British Columbia, Canada

British Columbia (BC) is adopting some very different approaches to managing old-growth forests in central and north coast BC - an area commonly known as the 'Great Bear Rainforest'. Approximately 5000 people live in this area of about 5 million hectares. The new land use plan protects about 1/3 of the area, and applies an approach the plan calls "ecosystem-based management" (EBM) to the rest. EBM is defined as "An adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and human communities." Managing for "healthy, fully functioning ecosystems" includes the following elements: protecting representative old-growth forests at the landscape scale; maintaining forest structure at the stand level; protecting threatened and endangered species and ecosystems; protecting wetlands; and doing all of this in an adaptive management framework.

Evolving management of Tasmania's tall old-growth forests

John Hickey

Forestry Tasmania, Hobart, Tasmania

Tasmania's tall oldgrowth eucalypt forests have been logged for 200 years. Systematic harvesting and regeneration of eucalypt forests did not occur until silvicultural research in the late 1950s, and emerging pulpwood markets, resulted in development of the clearfell, burn and sow system that has been successfully applied to wet eucalypt forests ever since, albeit raising significant social and ecological issues. Social, ecological and silvicultural research at the Warra LTER site was used to inform a 2005 Tasmanian Community Forest Agreement (TCFA) that required non-clearfell silviculture to be applied to a minimum of 80% of the annual oldgrowth harvest on public land by 2010. If proven feasible, variable retention will become the primary silvicultural technique in tall oldgrowth forests. Compared to clearfelling, variable retention should better emulate natural regeneration processes, usually initiated by massive wildfires, that typically retain some late successional species and structures at the stand level.

The TCFA increased the reservation of Tasmania's 1.2M ha of oldgrowth forests, including rainforests and tall and short eucalypt oldgrowth forests, to 79% of the 1996 extent. The Agreement provided funding for intensive plantations to offset a reduced timber supply from oldgrowth forests and also set an end to broadscale clearing of native forest on public land by 2010, with conversion of oldgrowth forest ending in 2005. Forestry Tasmania voluntarily ended its conversion program early, with no broadscale clearing of native forest on State forests to be initiated after December 2006. Since 2005, the annual harvest of oldgrowth forest on public land has been about 2000 ha per year, with less than 400 ha/year to be clearfelled by 2010. Oldgrowth forests designated for wood production are planned to meet about one quarter of the State's legislated eucalypt sawlog supply, of 300,000 m^3 per year, until 2030.

Variable retention, from the experience of some 10 coupes established to date, has proven operationally complex and practitioners are asking if the gain is worth the pain, especially where significant levels of landscape reservation of oldgrowth have already been achieved. Conversely, others have asked, if variable retention makes sense in oldgrowth forests, should it also be applied to non-oldgrowth forests, particularly as harvested forests lose their oldgrowth status by definition, even where late successional species and structures have been retained?

Another theme has been some recognition that roaded oldgrowth forest offers particular values that are not delivered by most wood production or reservation landscapes. These values include special timbers, leatherwood nectar and car-based tourism among majestic stands.

It is also becoming relevant to ask if active management is needed to maintain tall oldgrowth in ecological reserves. Many areas have been reserved to protect tall oldgrowth forests that are now 3-4 centuries old. Given that eucalypts live for some 400 years, will the public be content if many of these areas will, in the absence of wildfire or active management, progress towards rainforest (already very well reserved) within a current human lifespan?

Such questions indicate the need for clear long-term objectives for tall oldgrowth forests in wood production and reserved landscapes.

Combining old-growth, regrowth and plantation timber for sustainable trade

Ivan Tomaselli

Federal University of Paraná State/ Sustainable Tree Crop Program, Curitiba, Parana, Brazil

Trade is critical to global economic development and it has major implications for ecological sustainability and equity issues. Sustainable trade implies a trading system that does not harm the environment or deteriorate social conditions while promoting economical growth. Links between trade and sustainable development has been recognized in many international fora and is part of de Doha Agenda, that considers among the 21 subjects under negotiation several aspects that have implications for the forest industry.

In dealing with forests and forestry industry, sustainable trade depends on forest management practices to ensure continuous raw material supply and an efficient conversion, distribution and use of the timber products and other forest goods. A side issue, but also important, are environmental services that can be enhanced by good management practices and trade, even in dealing with production forests.

Old-growth forests are a source of valuable goods for the industry and provides important environmental services. Sustainable trade of old-growth goods and services can ensure the continuous flow of revenues and make available finance to further improve forest practices. Investing to continuously increase the value of the resource and maximize the revenues should therefore be a priority of forests policies.

Regrowth forests and forest plantations are becoming an important source of goods for the industry and can also provide environmental services. Timber produced in these forests have different properties of that coming from old-growth forests. The challenge for the industry is to develop alternatives, to combine the two types of raw materials and to make available competitive high quality products for the market.

This will lead to a new forest industry, able to compete in the market with non-wood products, while at the same time maintaining sound forest environments and enhancing the contribution of forest to the global environment.

Keynote Address

Age discrimination – a regulatory dilemma for the management of old-growth

Graham Wilkinson

Forest Practices Authority, Tasmania

Old-growth forests are increasingly venerated as the highest, most noble form of forest growth, a far cry from their previous status as "overmature" or "decadent" forest. It is ironic that trees become most respected and admired when they become old, unlike other life forms such as *Homo sapiens*. Simplistic strategies that seek to maximise and protect all old-growth forests are at odds with ecological principles and they would be impossible to achieve, in much the same way that a human society made up entirely of senior citizens would be biologically unsustainable. Our current forest estate is a function of past disturbance regimes, both natural and human-induced. Our future forests will similarly comprise an age class structure that reflects the presence and nature of disturbance regimes over time. Forest managers have the tools to generate various age class structures, but first society needs to make some informed decisions as to what structures will best meet our future environmental, cultural and economic aspirations. This paper explores the extent to which the conservation of old-growth forests should dictate the future of forest management.

New solutions for old-growth?

Ben Cashore

Yale School of Forestry and Environmental Studies, USA

An array of scientific evidence makes it clear that the world's forests are under stress. Increasing economic globalization and consumption has led to economic volatility and shifts in forest use; environmental challenges, including habitat degradation and species loss are accelerating; and social concerns, including the future of indigenous peoples and forest-dependent communities are at risk. Arguably no other issue illustrates the interaction and tension of these pressures better than debates and deliberations over what to do about the world's "old-growth" forests. Some argue that the state of the world's forests pre-industrialization have been so altered that the few remaining pre-industrial forests ought to be preserved and that plantation or intensive forest management elsewhere ought to make up the difference in fibre supply demanded by the global consumers. Others argue that sensitive logging in "old-growth" forests not only better replicates and respects natural systems, but removes pressure to convert such forests to plantations. Still others argue that the effects of the broad results of 100s of years of industrialization, including urbanization and agricultural development, mean that even the few remaining "untouched by logging" forest ecosystems have been so inexorably affected by human impacts (such as fire suppression), that active management is needed to maintain very dynamic "old-growth" ecosystem features.

And to confuse matters, various groups tend to emphasize arguments that conform to their own strategic interests, rather than those aimed at enhancing ecosystem structure and function.

My presentation seeks to offer an approach designed to move all groups' and organisations' approaches away from short-term strategic decisions towards a longer-term focus – where the opportunity for learning and cross-coalitional consensus is strongest. I identify whether and how institutions might be developed that push outward strategic decisions towards the long term. I focus on two specific phenomeona. First, I assess whether the "California effect", the phenomenon whereby business interests see it in their self-interest to champion increased standards on their less regulated competitors, might be fostered in a way that leads to the maintenance and rehabilitation of "old-growth" forest ecosystems. Second, I assess whether institutional innovations, that explicitly and simultaneously champion preservation and production, might offer new solutions to old problems.

Closing Plenary Address

Silviculture for old-growthness

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Silviculture of old-growth forests appears to be an oxymoron, since the late developmental phases of forest dynamics described by the term old-growth represent forests that have not experienced human intervention and timber removal for long periods of time. In the past, silvicultural systems applied to old-growth have aimed to convert these forests into more productive regrowth forests, substantially different in forest structure and composition. It is now recognised that the maintenance of biodiversity associated with the structures provided by late-successional stages of forest development cannot rely solely on old-growth forests in reserves. It is therefore important to develop silvicultural systems that can accommodate to some extent the elements of old-growth forests also in regrowth forests. In this paper, the structural attributes unique to old-growth forests are identified and silvicultural approaches to promote or maintain these attributes at the level of forests stands are discussed. Using examples from a range of forest ecosystem types representing different disturbance regimes, the experiences with silvicultural approaches to maintain old-growth attributes in forests managed for timber production are presented and the trade-offs between production and conservation goals are explored. In addition, the approach to promote old-growthness in regrowth forests is discussed in the context of developing more resilient forest ecosystems that would be better adapted to future climates.

Poster Abstracts

Assessment of forest naturalness in the Czech Republic and its use in policy and management

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Old-growth temperate forests are the last refugiums of primary biodiversity in the human landscape of Central Europe (Parviainen et al. 1999). The definition of parameters of old-growth forests and assessment of their naturalness can be the key for the decision in i) forest and nature conservation policy and strategy, ii) management of old-growth forests etc (Frank et al. 2007).

The aims of the presentation are i) to introduce the methodology and results of old-growth forests mapping and naturalness assessment in the Czech Republic and ii) to use the results in the forest and nature conservation policy and law.

Three degrees of naturalness were clarified and defined: i) original (virgin) forest, ii) natural forest and iii) near-natural forest. Every degree is characterized by 23 parameters, which were arranged in 4 groups – i) direct impact on stand development by forest management measures (15 parameters); ii) dead wood (3 parameters); iii) indirect human impact on stand development (2 parameters); iv) current tree species composition as compared with the potential natural tree species composition (3 parameters) (tab. 1). The assessment sheet for every parameter was developed and 50 field-workers were looking for and assessing old-growth forests stands (larger than 10 ha) across the Czech Republic in 2004-5. Old-growth forests databank of the Czech Republic was developed according to the primary dataset provided by respondents in 2006.

Two examples of general results are presented in the tab. 2 and fig. I. The mapping and assessment of old-growth forests were used for the preparation of second Czech National Forest Program (2007) and for the executing notice of Nature Conservation Law (2007). As a result, particular management plans for the old-growth forest reserves are currently adapted according to the naturalness parameters gathered in the Old-growth forests databank of the Czech Republic.

Recreating the eucalypt regeneration niche in degraded remnants in production landscapes

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This poster is a summary of the proposed research and some preliminary results of a PhD study that was begun earlier this year. Tree decline is particularly severe in the low rainfall districts of Tasmania. In these districts over 95% of the original vegetation has been modified and remnant vegetation exists within a matrix of agricultural and forestry land. Strategies for the reversal of the degradation of these remnants and the development of restoration techniques are needed to conserve biodiversity within production landscapes. The development of restoration methods can be informed through the study of the natural regenerative processes of healthy forest by identifying the attributes of the microsites in which eucalypts establish (the regeneration niche) and survive (persistence niche). The aim of this PhD study is to facilitate eucalypt recruitment within native vegetation remnants in production landscapes by developing methodologies for establishing the regeneration and persistence niches in degraded remnants. The first phase of the study will focus on describing regeneration and persistence niches of eucalypts in the Midlands of Tasmania through a survey of structural complexity and microsite attributes in naturally regenerating bushland remnants. The second phase will focus on trialing techniques for establishing regeneration and persistence niches within degraded remnants. The initial survey will take place in 3 dry forest sites within the Midlands of Tasmania that have been burnt within the last 5 years and display natural eucalypt seedling recruitment. Initial investigations have revealed that the ashbed of large burnt logs is an important microsite in which eucalypt seedlings establish in dry forests and that the protection provided by nearby woody debris aids seedling persistence.

The sites to be used for experimental work will be in degraded remnants within plantations in the Evercreech valley near Fingal and within another farming area yet to be decided. Microsite plots will be treated to re-align ecological processes.

The treatments to be used will be driven by hypotheses generated in the first descriptive phase of the study.

Habitat tree retention in alternatives to clearfelling

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Trees rarely produce hollows suitable for denning and nesting by fauna within the standard harvesting rotation period. Maintaining habitat trees for hollow-dependent vertebrate fauna is therefore very important. Forestry Tasmania is assessing alternatives to clearfelling at the Warra Silvicultural Systems Trial (SST). Aggregated retention has begun to be the main harvesting system in oldgrowth wet eucalypt forest. Habitat tree assessment at the Warra SST compared the numbers, diameters and form categories of trees retained in 'aggregated retention', 'dispersed retention' and 'clearfelling with understorey islands'. For trees >100 cm dbhob, there were 11.3 ha^{-1} of coupe area for aggregated retention, 3.1 ha^{-1} in dispersed retention and 0.3 ha^{-1} in clearfelling with understorey islands. Habitat tree assessment and mammal scat surveys have commenced in recently harvested and burnt operational aggregated retention coupes. Scats of ringtail and brushtail possums have been found in aggregates, suggesting that these species are able to make immediate use of the aggregates. Helicopter-based surveys of aggregates at eight coupes counted the numbers of 'oldgrowth' eucalypts with visible hollows. These studies indicate that habitat tree numbers retained under aggregated retention are closer to the requirements of vertebrates than with clearfelling or dispersed retention. The research has also demonstrated that this habitat is used by at least some hollow-dependent species in the years immediately following harvest, although further research is required to assess the actual use of retained hollows.

Beetle assemblages in streamside reserves are edge-affected compared to unlogged forest

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Reservation of forest in riparian buffers is common practice in commercial forestry areas worldwide, potentially providing valuable habitat for biodiversity dependent on mature forest. However, the habitat value of narrow reserve corridors can be compromised by edge effects. We investigated the habitat value of streamside buffers in wet eucalypt forest for ground-dwelling beetles in Tasmania. Beetles were collected with pitfall traps in five replicates of four habitats: unlogged corridors of mature forest in streamside reserves (buffers) with clearfelled logging regeneration either side; continuous mature upslope forest; continuous mature riparian forest; and < 20-year-old upslope logging regeneration. Streamside reserve widths on each side of the stream were on average 40 ± 6 m (95% CI) from reserve edge to stream. During a four-week trapping period in October-November 2002, 6,530 beetles were collected. Beetle assemblages in logging regeneration differed substantially from those in the unlogged habitats including the streamside reserves. Edge-tolerant mature forest species were not disadvantaged by the streamside reserves. Streamside reserve assemblages nevertheless differed from those of the continuous unlogged areas (both riparian and upslope), with a lesser preponderance of edge-avoiding mature forest species. Edge-avoiding mature forest specialist species may be disadvantaged in streamside reserves, and wider reserves would be required to provide habitat equivalent to continuous forest.

Management of Tasmania's giant trees

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Tasmania is home to the world's largest hardwood trees. A giant tree Consultative Committee (GTCC) (www.gianttrees.com.au) was established in 2003 to promote the conservation of giant trees and advise Forestry Tasmania, and other land managers, on the protection requirements of giant trees in Tasmania. Giant trees are defined as trees that are at least 85 metres tall or 280 cubic metres in estimated stem volume.

Some 88 extant giant trees are now known in Tasmania, many of which have been discovered since the inception of a formal giant trees Register in 2003. The giant trees of Tasmania are all eucalypts and include five species: *E. delegatensis, E. globulus*, *E. obliqua, E. regnans* and *E. viminalis*. Most of the giant trees (85%) and the 19 tallest are *E. regnans* but the largest tree by volume is currently a *Eucalyptus globulus*.

At least 83 giant trees are now protected in reserves that vary in size from small set-asides among wood production areas to large ecological reserves that include extensive tracts of tall oldgrowth eucalypt forests. Fifty percent are reserved in formal reserves, including forest reserves and national parks that confer permanent reservation unless that status is changed by Parliament. Another 40 giant trees are within informal reserves on state forest. Five trees are being protected on an interim basis and are planned for reservation subject to confirmation of their giant tree status. All giant trees are managed for protection in compliance with Forestry Tasmania's giant trees policy for the duration of their existence as giant trees (www.forestrytas.com.au).

Despite these protection measures, giant trees are still subject to threats from fire, disease, wind-throw and climate change, as well as natural mortality through senescence. Tasmania's giant trees are relatively short-lived compared to the world's largest trees- the giant conifers of the Pacific North West of America. The former are unlikely to exceed 450 years whereas the latter can exceed 1000 years. Tasmania's wet eucalypt forests with giant trees are reliant on infrequent wildfire, or other major disturbances, for their regeneration and if undisturbed will eventually be replaced by rainforest. Such stands may never again produce giant trees if no eucalypt seed trees occur in the close vicinity. The giant tree policy for Tasmania does not currently ensure the continuing supply of giant trees into the future, since it does not as yet include measures that allow for the identification and protection of regrowth trees with the potential to reach giant tree status. Within formal reserves there are no active fire management policies to regenerate stands of wet eucalypt forests but rather there is an assumption that at some point within their prime reproductive life-span a wildfire will occur and result in their regeneration. This assumption may be reasonable but the great majority of Tasmania's currently known giant trees are unlikely to survive beyond the next century and are becoming more diminutive with age as senescence results in crown dieback. Outside reserves, trees with the potential to become giant trees are unlikely to ever reach giant status as most stands are managed for wood production on rotations of less than 100 years. The GTCC in co-operation with forest managers, researchers and giant tree enthusiasts, is responsible for the development of strategies that enable the identification, protection and recruitment of giant trees.

This poster documents the environmental footprint of Tasmania's giant trees, as well as the size, design and management of the reserves protecting giant trees.

Will pollen-mediated gene flow from industrial *Eucalyptus* plantations impact on the genetic integrity of native eucalypt forests in Australia?

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With the large increase in industrial eucalypt plantations in Australia over the last decade, there is growing concern that native eucalypt gene pools may be contaminated by pollen flow from locally exotic eucalypt species or provenances. We are studying the risk of hybridisation from the two most commonly planted hardwood species in industrial plantations in Australia, *Eucalyptus nitens* and *E. globulus*. While both species are native to Australia, they are frequently planted outside their natural range and in close proximity to species with which they do not co-occur naturally. While hybridisation will not occur when adjacent species belong to different subgenera to the plantation species, barriers to hybridisation within subgenera of *Eucalyptus* are frequently weak and exotic gene flow is then possible. A number of steps in the process of pollen-mediated gene flow have therefore been assessed. Firstly, field surveys across the entire temperate hardwood estate have confirmed that many compatible native eucalypts are found adjacent to plantations and that most older plantations are reproductively active. Secondly, open-pollinated seed collections have demonstrated that plantations can hybridise with some native species (most notably *E. camaldulensis* and *E. ovata*) and exotic F_1 hybrid seedlings involving native *E. ovata* have been identified in the wild. Thirdly, artificial pollination studies have confirmed that numerous other hybrid combinations are possible involving species from the same subgenus as *E. globulus* and *E. nitens*. Fourthly, there is evidence to suggest that flowering time asynchrony and spatial isolation are important barriers which will reduce or prevent hybridisation in many cases. Fifthly, despite evidence that first generation hybrids are often less fit than parental species, some hybrids may survive to reproduction and backcross with native species. Full assessment of the impact of such hybridisation will depend on long-term studies of hybrid fitness. Strategies to identify species most at risk of exotic gene flow have been developed and practical measures to minimise this risk have been identified.

The usefulness (and otherwise) of measuring ecosystem processes in small headwater streams

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Small headwater streams within forested catchments in south-eastern Tasmania generally have a naturally depauperate flora and fauna. However, such streams make up a large proportion of the total length of the stream network in river catchments, and microbially driven processes are important in the community metabolism of these streams, and, therefore, to the reaches downstream of these headwaters.

Space-for-time surveys were used in unlogged and logged catchments of various ages in the Southern Forests to assess the usefulness to long-term monitoring of process-based measurements (e.g. bacterial carbon production, net daily metabolism) and some more conventional measures of microbial biomass and community structure. Some of the process measures gave clear signals of forestry impacts, while others showed little change. Microbial community structure was, however, extremely variable, and may be of limited use for monitoring. How long these streams take to recover from clearfell, burn and sow harvesting under current Forest Practices Code prescriptions remains hard to determine from our data because the current prescriptions have only operated for <20 years. Long-term monitoring, combined with more intensive "before-after" studies of selected catchments, will be the only way that these issues can be resolved fully.

Cryptogamic diversity on coarse woody debris

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Cryptogams are significant components of forest ecosystems worldwide, contributing to forest biodiversity, structure and ecosystem function. Cryptogam diversity and abundance is largely associated with abundance and variation of coarse woody debris.

The aim of this study was to examine cryptogam communities on coarse woody debris in temperate wet eucalypt forest. Cryptogam species on coarse woody debris were sampled to determine species diversity and abundance at 12 sites representing four forest ages (old-growth, and regrowth from wildfire of the years 1898, 1934 and 1966) in the Warra Long Term Ecological Research site in southern Tasmania. A chronosequence approach was adopted for examining species succession in temperate wet eucalypt forest regenerating following wildfire.

A total of 88 bryophyte and fern species were identified on coarse woody debris within four age classes of regenerating temperate wet eucalypt forest. Bryophyte and fern species presence on a log was used to determine cryptogam community composition on coarse woody debris. The study revealed significant species diversity changes with forest age. Old-growth forest supported a greater diversity of cryptogam species on coarse woody debris than younger forests. Cryptogam diversity was largely influenced by the ageing vascular community structure and its effects on microhabitat variables at the cryptogam species substrate level.

Cryptogam species distribution was analysed in relation to forest age and position on a log. Species richness was generally higher on the eastern sides of logs and lower on the top due to different microhabitat qualities between log positions. However this varied between taxonomic groups and at the individual species level. Microhabitat variation on coarse woody debris determines species distribution relative to a number of factors including moisture and insolation.

The present study provides valuable insight into the significance of coarse woody debris as a substrate for cryptogamic diversity. Establishment of appropriate forest management for maintenance of coarse woody debris and conservation of this integral part of temperate wet eucalypt forest biodiversity is discussed.

Den use by the common brushtail possum *Trichosurus vulpecula fuliginosus* in logged and unlogged dry forest in SE Tasmania

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Tree hollows are a critical resource for many Australian animals, but the availability of hollows has declined in many landscapes due to timber production and land clearance. This study used radio-telemetry to compare den use by the common brushtail possum (*Trichosurus vulpecula fuliginosus*) in unlogged and logged forest (3-9 years after harvest) in southeast Tasmania between March – July 2007. Results revealed that brushtail possums use multiple dens, primarily located in standing hollow-bearing trees. Modelling showed that possums select trees with a large hollow (>10 cm). Direct observations showed that this hollow was not necessarily used, but rather indicated the presence of other suitable cavities, suggesting that trees selected for retention should contain a least one large hollow.

Brushtail possums selected for mature forest in unlogged and logged sites even though animals foraged in logged regrowth where hollow logs and windrows were available. Dens were randomly distributed within unlogged forest, which contained only mature stands. In contrast, in logged regrowth forest, dens were restricted to mature stands in a wildlife habitat strip and informal reserves along coupe boundaries. This was reflected in smaller den ranges of brushtail possum in logged forest. Selection against isolated trees and patches of hollow-bearing trees (wildlife habitat clumps) that had been specifically retained for hollow-using fauna within the harvest area suggests that such trees and/or the spatial arrangements of retained clumps of trees may be unsuitable. These results suggest that current 'in-coupe' management prescriptions for maintaining hollow-bearing trees may be inadequate for some hollow-using species, at least in the 3-9 year period after harvest. Further studies are required to determine whether hollow-using species will use retained trees in coupes when the regenerating forest is older. However this study illustrates the importance of the network of informal reserves such as wildlife habitat strips outside harvest boundaries.

Silvicultural treatments for old-growth forests dominated by *Nothofagus betuloides* in southern Patagonia, Chile

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Naturally old-growth forests dominated by *Nothofagus betuloides* are uneven-aged. Since the 19th century these forest types have been selectively logged in South Patagonia and Tierra del Fuego, leaving productive forests with a lack of regeneration. Furthermore the silvicultural prescriptions that are allowed by the Chilean Forest Law are either a shelterwood or a selection system. In the scarcely managed forests only the shelterwood system has been applied, which has produced a homogenization and simplification of the stand structure. Therefore the aim of this research was to analyze the application of a first cut into a shelterwood system and a first cut into a selection system, the latter being a new silvicultural approach in old-growth forests dominated by *Nothofagus betuloides* in southern Patagonia.

Both treatments were applied in two representative stands of approximately 2 ha each. Tree density, basal area, and stand volume before and after the cutting, was measured for each stand. The status of the regeneration was also described. The results show the sawn wood yield for different levels of canopy retention.

Because the management of forests requires a long-term commitment, these units have been implemented as "permanent demonstration forest areas" to provide scientific and technological knowledge for sustainable forest management in the old-growth *Nothofagus* forests of southern Patagonia.

Effectiveness of wildlife habitat strips in maintaining vegetation structure and composition in Tasmanian wet eucalypt forest

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Wildlife habitat strips (WHSs) are corridors, prescribed in Tasmania's Forest Practices Code, designed to maintain native forest biodiversity and linkages across the landscape. WHSs are typically 100 m in width, spaced every few kilometres through large tracts of production forest, and connect areas of native forest which are reserved or otherwise excluded from logging.

A long-term research project was established in wet eucalypt forest, in Tasmania's central highlands, to assess the effectiveness of WHSs in maintaining the fauna and flora of mature forest. 52 vegetation plots were established in 1992 in old-growth *Eucalyptus delegatensis* forest with understoreys dominated by rainforest trees, broad-leaved shrubs and a diverse range of pteridophytes. The plots were re-sampled in 2005. The plots were located in:

- four coupes which were intensively logged in 1993–6, followed by regeneration establishment burning and aerial sowing of eucalypt seed;
- two WHSs, each passing between intensively logged coupes; and
- an unlogged control area with vegetation similar to the WHSs and coupes prior to logging.

Classificatory analyses and ordinations were used to compare the 1993 and 2005 data sets. Plots in the control area showed no significant differences in vegetation attributes over the sampling period. There were significant changes in the intensively logged coupes, with several species characteristic of late-successional forest being sparse or absent in 2005, though many mid-successional species were regenerating. Species typical of drier or more open environments were common.

Overall floristic and structural changes in the WHSs were not significant. However, there were marked changes in composition on some sites, which were correlated with localised changes in forest structure or microclimate. These plots typically contained drier forest species and opportunistic forbs and graminoids, and were located at the edge of WHSs (resulting in drying effects) or on sites affected by wind-throw of tall trees (resulting in light gaps and localised ground disturbance).

The study suggests that WHSs can fulfil a useful role in maintaining old-growth forest structure and composition, at least in the short-term, in areas subject to intensive forest management. Similar results are reported from fauna studies from the Tarraleah sites. However, the long-term benefits of WHSs are less certain for some flora and fauna groups which depend on mature forest habitat. Edge effects and wind-throw can favour species that are also associated with the regenerating forest in adjacent coupes. The edge effect is likely to decrease as the regenerating forest develops, but wind-throw and damage to emergent trees in WHSs could persist for many decades, resulting in cumulative reduction of old-growth elements of the biota.

The width of WHSs and their placement in the landscape needs careful evaluation. Late-successional forests should be preferentially retained in production areas where such forests are uncommon. Similar comments may apply to other "new management" systems designed to retain biodiversity in older forests.

Where's Wally's wattle? Management of old-growth stands of *Acacia pataczekii* in north-east Tasmania

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Wally's wattle (*Acacia pataczekii*) is an endemic Tasmanian species that is listed as 'rare' on the state's threatened species legislation. It occurs in upland eucalypt forests, mostly in the north-east of Tasmania. It is a distinctive shrub or small tree, which is named after Wolfgang (Wally) Pataczeki, the forest worker who first discovered the species.

In 2005 an area of State forest in the Tyne forest block (in north-east Tasmania near Mathinna) was proposed for a selective harvesting operation – the removal of the overstorey following shelterwood logging in the 1980s. The proposed coupe (coupe TY042N) included areas of *Eucalyptus delegatensis* forest with Wally's wattle locally abundant in the shrub layer. The presence of this rare species in the coupe led to the involvement of the Forest Practices Authority, who provide specialist advice on management of special values including threatened species. Their interest was heightened because of the presence of unusually tall plants of the species – typically occurring in clumps with individuals from 5 to 9 m in height.

Wally's wattle regenerates well after logging and fire disturbance – in fact it is likely to rely on disturbance for its long-term persistence at a site (as is the case for most wattles). Based on what was known of the ecology of this species, specialists in the relevant agencies decided that the selective harvesting operation could proceed with certain constraints – the main objective of the constraints being to minimise damage or loss of the unusually tall mature stands of Wally's wattle ('old-growth' Wally's wattle). It was also decided that these old-growth stands in the coupe would be monitored to assess the success of this approach and guide future decisions regarding appropriate management of this rare species.

Ten monitoring plots were established within the proposed operational area and marked in a way that did not draw attention to them. These plots were located to capture stands of Wally's wattle that were over 5 m tall and were distributed as evenly as possible across the coupe. By keeping the plots inconspicuous it was hoped that harvesting contactors would not be able to give them any preferential treatment when implementing the prescriptions for the species (e.g. minimising physical damage). Data (including shrub height, health and signs of physical damage) were recorded for 10 trees in each plot before and after the logging operation.

This monitoring project tests the degree to which physical damage to the understorey can be minimised during selective harvesting operations through careful planning prescriptions and the cooperation of harvesting contractors. Observations suggest that physical damage to *Acacia pataczekii* during harvesting has been minimal.

Native earthworm species diversity, abundance and biomass in a wet eucalypt forest ecosystem (Warra LTER Site)

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The short-term effects of forest management practices on native earthworms and other soil biological properties are examined in a mixed old-growth forest stand dominated by *Eucalyptus obliqua* (*Messmate Stringybark*). Effects of forest management are evaluated by pre- and post- sampling of different disturbance intensities including compaction and burning on native earthworm populations at the Warra (LTER) Site in Tasmania. This study forms part of a research project investigating the effects of soil properties (chemical, physical and biological) and management disturbance on native earthworms at three tall eucalypt sites in southeastern Australia including Bago/Maragle State Forest, NSW, Tanjil Bren State Forest, Victoria, and the Warra (LTER) Site. This presentation is an initial analysis of the research findings at the Warra LTER Site.

The study was carried out at three coupes (WR001B, WR008B and WR008C) located in the Warra LTER Site Silvicultural Systems Trial (SST). Earthworms were collected by digging a square pit of 50 cm on a side and 45 cm depth, which was stratified into three layers, each of 15 cm depth. Earthworms were separated from the soil by hand and were killed in ethanol and later sorted. At all three coupes soil samples were collected for soil microbial biomass determination and soil cores were collected for soil bulk density analyses.

From sampling, five earthworm species are common to all three coupes. Two species are surface-dwelling earthworms and are generally located at depths of 0-15 cm in the soil profile. The remaining three species include two previously undescribed species, *Aporodrilus warrai* (sp. nov.) (Blakemore 2000), and *Megascolides tener* (sp. nov.) (Blakemore 2000): both deep-burrowing earthworms commonly found at depths of 15-30 cm and 30-45 cm, respectively. Cocoons of these deep-burrowing species are also found at depths of 30 to 45 cm.

When compared to the surrounding forest, earthworm species diversity, abundance and biomass per hectare varies across the three coupes without any obvious edaphic variation. Statistical analysis of transformed earthworm data indicates a strong temporal and functional variation of earthworms within the forest soil profile ($p < 0.05$), with earthworm biomass (measured as fresh weight of earthworm tissue), abundance and species richness decreasing significantly with increasing depth ($p < 0.05$). For the three treatment coupes, mature earthworms are commonly located in all three soil layers (0 to 45 cm in depth), with immature earthworms located in the top two soil layers (0-15 and 15-30 cm in depth), respectively. In addition, presence of immature earthworms is strongly correlated with presence of mature earthworms, indicating that young earthworms are commonly situated with their older counterparts ($p < 0.05$).

Assessing the effect of habitat type and disturbance on population size and structure, and physiological parameters, in the common brushtail possum (*Trichosurus vulpecula*)

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Brushtail possums (*Trichosurus vulpecula*) are one of the most widely recognised hollow-users in Australia. However, despite the species being regarded as 'common', little is known of the impacts of habitat disturbance on brushtail possum physiology or ecology. This study will investigate the size and structure of brushtail possum populations in disturbed and undisturbed areas and the relationship with tree-hollow availability. It also aims to explore the influence of habitat disturbance upon measures of physiological well-being in adult brushtail possums. Sites have been established in dry *Eucalyptus* forest disturbed (logged/burned) and control (unlogged) sites in south-east Tasmania and wet *Eucalyptus* forest disturbed (logged) and control sites in north-east Tasmania. Animals are trapped at each site seasonally; data (sex, body size, blood samples) are gathered on brushtail possums, and species diversity is assessed via bycatch.

White blood cell differentials in the brushtail possum are measured as a secondary indicator of physiological stress and preliminary results suggest differences between sex, forest type, and control and disturbed sites. Possum population sizes are similar at the dry forest sites but at the wet forest sites, the disturbed site population is substantially lower than that of the control site. Adult brushtail sex ratios are significantly different, with a 50:50 sex ratio for the control populations and a 70:30 male:female ratio for the disturbed population in both forest types. This male bias may reflect intraspecific competition for prime den sites at the disturbed sites. Preliminary results also indicate that species composition is similar between dry forest sites. In the wet forest sites, although native species were found in higher numbers at the control site, species diversity is higher at the disturbed site. This contrasts with other studies which have found that fauna diversity is negatively impacted by logging disturbance.

Macrofungal diversity as a tool in the sustainable management of coarse woody debris

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Many species of fungi grow on and in coarse woody debris (CWD), facilitating the decomposition process that releases carbon and other elements back into the environment. Industries using biofuel are a threat to the quantity, continuity and connectivity of CWD. Conservation of CWD to maintain and prevent loss of biodiversity should be a prime concern for forestry managers. The aim of this study was to examine the macrofungal assemblages associated with CWD in plots at different ages of forest regeneration since the natural disturbance of wildfire. Four 50x50m plots of the same native *Eucalyptus obliqua* forest type were selected at the Warra LTER, Tasmania, viz. Old-growth (>250 years), 1898 (108) years, 1934 (72 years) and 1898/1934, a plot that was burnt both in 1898 and 1934 (also 72 years). The CWD ≥ 10cm in diameter and ≥ 1m in length was mapped and the length, diameter, decay class, % bryophyte cover and species of wood (where possible) were recorded. In each plot the substrates CWD, other wood (including living trees), soil and litter were surveyed fortnightly for macrofungi for a period of 15 months from April 2006 to July 2007. A total of 16,489 records was obtained and comprised 850 macrofungal species: 296 spp. on CWD, 251 spp. on other wood, 495 spp. on soil and 146 spp. on litter. Canonical analysis of principal coordinates (CAP) revealed that each plot supports a very different mycota for all substrates combined and for CWD, other wood and soil separately. CWD and other wood have a similar number of species, but the mycota differs. Long length CWD and large surface area CWD each have an observed species richness greater than that predicted by an overall model. The results suggest that multi-aged stands and CWD in all sizes and decay stages are necessary to preserve macrofungal diversity in the forest landscape.

The effectiveness of wildlife habitat strips in maintaining mature forest carabid beetle assemblages

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A long-term research project was established in wet eucalypt forest at Tarraleah in Tasmania's central highlands, to assess the effectiveness of wildlife habitat strips (WHS) in maintaining the fauna of intact mature native forest. The present study examined carabid beetles sampled by means of pitfall traps. Samples were collected at multiple locations at one control site and two treatment sites, firstly before harvesting and then again five to six years after harvesting and regeneration and the establishment of WHS. Areas that had been logged showed decreases in abundance of carabid beetles, but great increases in species richness as pioneer or open-country species colonised. Assemblages in the control site remained essentially unchanged. Assemblages in the WHS areas remained little changed overall compared to their pre-harvest condition, but some sampling locations showed some degree of perturbation, though not always in a way comparable to the logged areas. It seems that for carabid beetles at least, WHS are largely fulfilling one of their functions of maintaining the fauna of mature native forest in a production forest landscape dominated by younger forest age-classes. Further monitoring will be required in coming decades to assess the long-term viability of WHS as a conservation strategy for these and other species of mature native forest. For instance, it is not yet apparent whether WHS can act as sources for recolonisation of surrounding regenerating forest as it matures, nor whether they can maintain their structural and functional integrity over time.

Long-term responses of mollusc assemblages to partial harvesting, wildlife habitat strip retention and wildfire

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A long-term study site near Pioneer in northeast Tasmania was established in 1989 to allow research on the effectiveness of wildlife habitat strips in maintaining fauna in dry sclerophyll production forests. As part of this research, mollusc surveys were conducted around the time of establishment before any logging had taken place. Comparable surveys were then conducted ten years later, several years after selective logging. Logging had involved the retention of mature forest in wildlife habitat strips and streamside reserves in the logged forest matrix. An unlogged control area nearby was surveyed on both occasions for comparison. Wildfires burnt a significant proportion of the study area post-logging, providing an opportunity to examine its effects but confounding interpretation of logging impacts. Overall, the mollusc fauna appeared robust to the effects of selective logging and wildfire over the time-scale of this project. Assemblage composition varied most noticeably according to the vegetation community, a pattern that largely persisted despite the logging and wildfire disturbances. Assemblages in sheltered riparian vegetation differed most markedly from those in exposed heathy vegetation. The effects of wildfire were easier to detect than those attributable to logging or to fragmentation of retained mature forest. Streamside reserves appeared more vulnerable to disturbance than wildlife habitat strips, perhaps because their narrower width and dominant vegetation types made them more susceptible to drying out once exposed by logging or wildfire. These findings point to wildlife habitat strips having a useful function in maintaining local mollusc assemblages in forests exposed to logging and wildfires. It is too early to conclude that the disturbance caused by logging is insignificant compared to what nature can provide, though the signs are encouraging. Logging-induced and natural effects are likely to be synergistic, but their relative importance may only become apparent over a time scale of decades.

A long-term experimental study of saproxylic beetle succession in Tasmanian *Eucalyptus obliqua* logs

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Concern over the conservation implications of declining availability of large logs in Tasmania's wet eucalypt production forests led to a long-term experiment examining succession of saproxylic (dead wood-dependent) beetles. This paper reports on the first sampling cycle, which spanned the first five years following the felling of six mature-aged and six regrowth-aged *Eucalyptus obliqua* trees growing in a multi-aged forest. These were felled over three seasons from May 1999 to February 2000. Five emergence traps were progressively fitted to each resultant log at roughly three-monthly intervals; and each was left in place for about three years. At total of 11546 individuals and 311 species of saproxylic beetles were sampled from the twelve logs. Twenty species made up 75% of the individuals, while 66 were represented by singletons. Seasonal patterns in abundance, species richness and assemblage composition were evident. The sampling cycle coincided with an initial pulse in abundance; the time-lag between felling and trap fitting did not noticeably influence this pattern. However, the height of the summer abundance peaks was weakly related to the date of felling. Different species showed different patterns in their annual peaks over this period. Obligately saproxylic species were more numerous than facultatively saproxylic species; species able to disperse by flight were much more numerous than crawlers; predators comprised the most abundant feeding guild; and there were roughly equal numbers of litter/surface dwelling and log interior-dwelling species. The lower collecting bottles tended to preferentially sample 'crawlers' and the upper collecting bottles 'fliers'. This paper documents the findings from merely the first sampling cycle of many that will be undertaken as the logs decay over coming decades or centuries. It provides a baseline assessment of the fauna, and gives the context for future studies, including those assessing relationships of this fauna with log size.

Engendering ecological research at broad spatial and temporal scales through establishing an Experimental Forest Landscape

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Tasmania's Southern Forests have been a significant source of forest products for more than a century. Over this period, a major part of the attraction of forestry to the region has been the abundance of tall regrowth wet eucalypt forest, which is highly valued for its sawlogs. The forest is fire-derived, and in this region represents a seral stage on a successional trajectory towards rainforest. However, the succession is sometimes re-set by wildfire before rainforest can establish. Spatial and temporal variation in the fire return interval means that different successional stages of forest dominate in different parts of the landscape. As the forestry industry has pushed westwards into wetter country, so it has encountered more and more old-growth forest and rainforest. The contemporary landscape is thus a mixture of fire-derived and harvesting-derived forest of various ages, from recently re-seeded eucalypt forest through to old-growth eucalypt and rainforest. As such, it offers many possibilities in applying landscape ecological principles to help inform forest management. With this in mind, we have recently formalised the concept of an Experimental Forest Landscape in this region, extending from the World Heritage Area and Warra LTER site in the west to the long-settled Geeveston and Franklin region in the east. Our efforts so far have focused on consolidating already-collected data-sets (e.g. forest inventory plot data; wildfire chronosequence plot data; LiDAR) and in developing appropriate GIS layers to help future researchers make the most of this landscape. Possible subjects for future research include exploration of landscape metrics, development and testing of spatially explicit models of forest and coarse woody debris dynamics, simulation of different management scenarios, exploration of landscape-scale threshold effects in bird assemblages, and population viability analyses of threatened species.

Saproxylic beetles and industrial fuelwood harvesting: retrospective studies in Tasmania's Southern Forests

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Harvesting of wood residues following clearfelling has been proposed as a means of reducing wastage, generating bioenergy, and improving the potential for eucalypt seedling establishment while decreasing the need for high-intensity regeneration burns. While these aims may paint industrial-scale fuelwood harvesting in a positive light, the dependence of a vast array of invertebrates and fungi on coarse woody debris suggests there may be negative impacts too. This paper outlines two studies aimed at understanding the potential impacts on saproxylic beetles, a key component of this cryptic biodiversity. One study used flight intercept and pitfall traps to compare the fauna in regenerating stands that had been exposed (in the 1980's) to clearfelling with those of a similar vintage in which clearfelling was accompanied by experimental fuelwood harvesting. The other study used these same sites (and others nearby) to look at genetic structure within a single species of dispersal-limited (flightless) saproxylic beetle. The findings fit with expectations, in that they suggest a negative impact of past fuelwood harvesting on at least some species of saproxylic beetles. Given the studies' limited scope, they are perhaps best viewed as supportive evidence that can be combined with findings from related research projects to give guidance as to the likely effects of any future fuelwood harvesting, and ways in which potential negative impacts can be avoided or mitigated.

Projections for coarse woody debris in Tasmanian wet eucalypt forest under a range of disturbance regimes

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In forests subjected to periodic catastrophic disturbance (such as wildfire or clearfelling), inputs of coarse woody debris (CWD) vary drastically over time. Even if CWD decay rates remain constant, this pulsed input greatly affects CWD volume and mass over the course of subsequent stand regeneration. Understanding the dynamics of CWD enables the development of models that can explore the effects of natural disturbance regimes and of forest management interventions on CWD. This in turn allows consideration of the effects of altering disturbance regimes on CWD and its dependent biodiversity, as well as on carbon stocks. This paper presents some outputs from a model of CWD dynamics developed for Tasmania's commercially important lowland wet *Eucalyptus obliqua* forests, which are naturally fire-derived and typically managed through clearfelling. The model allows a comparison of the effects of clearfelling with those of periodic stand-replacing wildfire under similar return intervals (100 years), and can explore the effects on CWD dynamics of increasing and decreasing these disturbance return intervals and intensities. Validation of the model output is currently in process.

Estimating decay rates for *Eucalyptus obliqua* coarse woody debris in Tasmania using a chronosequence approach

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One of the key pieces of information required to understand the dynamics of coarse woody debris (CWD) is its rate of decay. Yet this is one of the hardest pieces of information to obtain because the process happens very slowly and cannot be observed directly. As part of our efforts to understand CWD dynamics in Tasmanian *Eucalyptus obliqua* forests, we used a space-for-time approach, by examining fallen logs at a range of sites representing different times since disturbance (generally either wildfire or logging) and assigning them to one of five decay-classes. Previous work had established a clear relationship between CWD decay-class and relative mass, allowing one to be a surrogate for the other. Finding logs that unequivocally dated from a known disturbance event involved a substantial amount of ecological and silvicultural detective work, but our data-set eventually comprised 900 logs (or log-sections). We used these to plot the relationship between decay-class and time, and hence between time and relative mass, allowing the estimation of an overall decay rate for *E. obliqua* CWD. As for forest systems studied elsewhere, decay in *E. obliqua* CWD can be approximated with a negative exponential function, implying a rate of mass loss that is proportional to remaining mass. In our study, we found no evidence that smaller diameter material decays more rapidly than larger diameter material, but we did find that CWD in harvested forests may decay more rapidly than in unharvested forests. We also used the data from this study to estimate residence times for each decay-class, and have since incorporated these into our model of CWD dynamics.

Successional pathways in the development of wood decay in Tasmanian *Eucalyptus obliqua*: from living tree to rotten log

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Several related studies on living *Eucalyptus obliqua* trees and on logs of this species have been conducted in Tasmania's Southern Forests in recent years. One of the outcomes of this research activity has been a greater understanding of the ecological processes involved in the development and progression of wood decay in this species. The recognition and classification of distinct rotten wood types opens a window on this complex range of processes. This paper describes the rotten wood types so far recognised, and charts their position in the overall decay process from living trees to rotten logs. Reference is made to some of the characteristic species of fungi and invertebrates involved in this process.

Succession-based management of blackwood swamp forests in north-west Tasmania

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Swamp forests are dominated by blackwood (*Acacia melanoxylon*), paperbarks *(Melaleuca* spp.) and teatrees (*Leptospermum* spp.). Blackwood swamp forests occupy about 9,000 ha –about half of their pre-European extent. They are most extensive on poorly-drained flats in north-west Tasmania, where they have been logged for over a century, mainly for blackwood (a valuable timber species). Most remaining swamp forests occur on State forest (i.e. public forest) – much of the swamp forest on private land has been cleared for agriculture.

Analysis of data from over 250 plots (1992) resulted in 24 swamp forest communities being identified. Disclimax or early successional communities are dominated by sclerophyllous species (*Melaleuca* spp., *Leptospermum* spp.) and recover rapidly after disturbance. Mesophytic species, including rainforest tree species (e.g. *Nothofagus cunninghamii*, *Phyllocladus aspleniifolius*), increase in prominence as the disturbance-free interval lengthens. Blackwood has seeds with which remain viable for decades, and the species can maintain itself by gap-phase replacement in rainforest-rich communities.

Selective logging, often followed by firing, was responsible for the composition and structure of much of the extant swamp forest. After the late 1970s, silvicultural practice in most swamp forest coupes consisted of clearfelling in dry summers, followed by slash-burning. Since 1987, logged areas have been fenced to prevent wallabies browsing the palatable blackwood seedlings. A rotation of about 70 years is envisaged for forests treated by these prescriptions. These practices would promote the development of sclerophyllous communities at the expense of more diverse communities with a strong rainforest element. This would be reinforced in subsequent rotations.

The results of the 1992 study, and subsequent monitoring, have seen the evolution of silvicultural prescriptions that maintain habitat diversity by taking into account the attributes and successional stage of the swamp forest stand. Features of these prescriptions include:

Sclerophyllous forests (early successional forests)

- Clearfelling permitted, but cull trees usually retained;
- Some coupes may be burnt to facilitate regeneration.

Rainforest-rich forests (late successional forests)

- Selective harvesting of blackwoods;
- Protection of peat and patches of rainforest that do not contain blackwood;
- Retention of canopy to foster good form in regenerating blackwoods, reduce windthrow; and provide structural and floristic diversity;
- Coupe not burnt;
- Temporary fencing to reduce wallaby browsing.

Other environmental constraints required by the Tasmanian Forest Practices Code also assist in maintaining diversity in swamp forests. They include habitat management for white goshawks, protection of historic features, and restrictions to prevent unacceptable damage to soils, peat or drainage systems. There has also been an increase in reservation of swamp forests, with a focus on poorly reserved communities.

The effect of climate change and atmospheric CO_2 elevation on carbon dynamics of mountain ash forests

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Temperate forests play an important role in the global carbon cycle, because of their extensive area, large carbon pool and fluxes, and are also a potentially important carbon sink in Australia.

In order to investigate and quantify the coupled carbon and water cycles of Australian temperate forests from hourly to centennial time scales a project was initiated under an Australian Research Council grant at Wallaby Creek, Victoria. A flux tower has been established at a 277 years old (since fire) Mountain Ash (*Eucalyptus regnans)* old-growth site to collect carbon and water fluxes using eddy covariance method. Additional re-growth sites, 25 and 81 years old, have also been established, providing a chronosequence.

It had been assumed that net uptake of carbon of a forest generally decreases with stand age and carbon exchange in old-growth forest to be near equilibrium. However recent studies show varying results, and it is suggested that carbon to be more variable in response to climatic and other factors than formerly assumed for old-growth forests. The role of temperate old-growth forests in Australian carbon dynamics is not well understood.

Within the broader project, the objective of this study is to determine the current carbon inventory of the old-growth forest and to investigate the effect of climate change on the carbon dynamics of temperate (*E.regnans*) forests. Biometric and meteorological data collections are being employed in conjunction with two models (TEM: Terrestrial Ecosystem Model and CAR4D). TEM is a process-based global-scale eco-system simulation model that incorporates carbon and nitrogen cycles on monthly to centennial time scales. Major data used to parameterise and run TEM include, carbon and nitrogen in vegetation, soil carbon and nitrogen, GPP, and NPP, together with climate data. Scenarios with different levels of atmospheric CO_2 concentration, air temperature and rainfall are being simulated. CAR4D is a landscape-level model that simulates carbon sequestration of *Eucalyptus regnans* forests with varying environments, fire and management regimes at an annual time step.

Implications of new management of old-growth forests for the leatherwood nectar resource

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Leatherwood trees (*Eucryphia lucida*) provide the main nectar resource for a honey industry with an annual production of 1000 tonnes per year and an annual value of A$2M. Most leatherwood trees occur in the oldgrowth forests of western and southern Tasmania.

The 2005 Tasmanian Supplementary Regional Forest Agreement (also known as the Tasmanian Community Forest Agreement or TCFA) increased the protection of oldgrowth forests to about 973,000 ha. The TCFA also requires Forestry Tasmania to achieve non-clearfelling silviculture in a minimum of 80% of its annual harvest area of couped oldgrowth forest on State forest by 2010, which will result in improved retention of leatherwood in production areas. The TCFA included funding to support access to and management of selected areas of special timbers management units for selective harvest of special timbers and will also provide beekeepers with rotating access to apiary sites to maintain sustainable supplies of leatherwood honey.

A spatial analysis, designed in consultation with the Tasmanian Beekeepers Association, will estimate the leatherwood resource available in Tasmania. It will investigate the implications for nectar supply with the recently expanded reserve system, the shift to variable retention (non-clearfell) silviculture in tall old-growth forests, and the potential for accessing additional leatherwood areas by recent or planned roading funded under the TCFA.

A key result of the project will be the production of an agreed map of leatherwood-rich forests for reporting trends over time (due to timber harvesting, reservation increases, wildfires etc). This map could be revised, as better on-ground information becomes available.

Changes in structure and composition in an old-growth temperate rainforest stand in British Columbia, Canada

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A series of monitoring plots of various sizes (quarter hectare to one hectare) were established along the coast of British Columbia, Canada in 1992 and 1993. All plots were established in old-growth temperate rainforests. The vegetation was described, and all trees, snags and coarse woody debris were measured, mapped and tagged. The intent was to describe the structure and composition of these forests, and to provide a baseline for monitoring changes in structure and composition over time. In summer 2007 we re-located and re-measured one of these plots, in a riparian Sitka Spruce (*Picea sitchensis*) forest in the Carmanah Valley, on the southwest coast of Vancouver Island.

FORESTCHECK – monitoring biodiversity in jarrah (*Eucalyptus marginata*) forest managed for timber harvesting

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Monitoring forms the basis for adaptive management, which is recognized as an appropriate strategy for managing under conditions of uncertainty and change. FORESTCHECK is an integrated monitoring system that has been developed to provide information to forest managers in the southwest of Western Australia about changes and trends in key elements of forest biodiversity associated with management activities. Integrated monitoring is a fundamental component of Ecologically Sustainable Forest Management (ESFM) and is necessary for reporting against the Montreal Process criteria and indicators for ESFM. FORESTCHECK is included as an operational program in the current Forest Management Plan 2004-2013. Monitoring protocols were developed over 2 yrs with input from scientists and managers in the Department of Environment and Conservation (DEC) and a number of external scientific agencies. The Science Division of DEC is responsible for implementation of the project. The FORESTCHECK Concept Plan, Operations Plan and Annual Progress Reports may be viewed on the DEC Naturebase website at http://www.naturebase.net.

The initial focus of FORESTCHECK is on timber harvesting and silvicultural treatment in jarrah (*Eucalyptus marginata*) forest which includes shelterwood cutting, gap creation and post-harvest burning. The sampling design includes external reference sites in old-growth stands, and mature stands that have not been harvested for at least four decades. Between 2002 and 2006 a total of 48 monitoring grids were established at five locations chosen to reflect underlying patterns of moisture availability and fertility across the southwest forest landscape. Each 2 ha monitoring grid is assessed for attributes including forest structure, soil disturbance, litter and woody debris, and elements of biodiversity including vascular flora, vertebrate fauna (birds, mammals and reptiles), cryptogams (lichens, liverworts and moss), macrofungi and invertebrate fauna. Results from the initial five years of monitoring are currently being analysed in preparation for publication.

FORESTCHECK has been nominated for inclusion in the network of Australian Long Term Ecological Research (LTER) sites, and good opportunities exist for collaborative research with other LTER sites in Mediterranean and temperate forest ecosystems.

The legal requirements of sustainable forest management

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Implementing sustainable forest management involves many areas of the law. The concept of sustainable forest management is an ever evolving concept which attempts to incorporate and recognise all values associated with forests and further attempts to give equal weighting to all of these varying and potentially conflicting forest values. Common values identified in forest areas include: ecological and environmental values; social and cultural values and trade and development values. Providing recognition for all of these forest values within a legal framework has proven to be challenging for policy makers.

A single legal instrument providing for all aspects of sustainable forest management is most unlikely. A combination of legal instruments including legislation, regulation, policy, standards and codes of conduct will need to be created. Additionally in common law systems, judicial decisions will also contribute to the implementation of sustainable forest management. The following areas of law are related to the implementation of sustainable forest management:

- Environmental Law: the body of law concerned with the use and management of natural resources.
- Planning and Development Law: The largest cause of deforestation worldwide is the clearing of forest areas for urban/agricultural growth. The area of law which regulates urban/agricultural developments is planning and development law.
- Property Law: is significant in two main ways: Firstly the tenure of the forest area, categories include public ownership, private ownership, community ownership, native title and temporary ownership (lease or license arrangement). Secondly the individual property rights associated with forest areas.
- Constitutional law: Constitutions are central legal instruments. In federal countries, such as Australia, constitutions broadly define the role of federal and state governments.

Genome sharing patterns in south-east Australian eucalypts

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Interspecific hybridization and introgression appears to have played an important role in the evolution of *Eucalyptus* species. Previous studies, mostly on subgenus *Symphyomyrtus* species, have found high levels of intraspecific chloroplast DNA (cpDNA) polymorphism and extensive sharing of chloroplast haplotypes between species. Similar to *Quercus*, geographical location is more important than species when it comes to determining chloroplast type in subgenus *Symphyomyrtus* species. Less is known about the extent of cpDNA sharing between subgenus *Eucalyptus* species and the level of sharing of the nuclear genome between *Eucalyptus* species. In this study we examined sharing of the nuclear and cytoplasmic genome between 200 individuals from 10 species at 25 locations using nuclear and chloroplast microsatellite markers designed for eucalypt species. Preliminary results indicate that cpDNA haplotypes are extensively shared between subgenus *Eucalyptus* species. Twenty five different haplotypes were found in 10 different species at 25 locations where the species admixed. All species at a location were more likely to share exact haplotypes in areas thought to have been treeless during the Last Glacial Maximum (LGM) than hypothesized glacial refugia. Preliminary results on the sharing of the nuclear genome indicate extensive sharing of alleles between some species, and little sharing between other species. Further work will help to elucidate the patterns of sharing of both nuclear and cytoplasmic genetic markers.

The impact of harvesting disturbance on the floristics of the Warra silvicultural systems trial

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The response of the vascular flora (higher plants only, not including the bryophytes or lichens) has been monitored for at least three years, and where possible for six years, following establishment of a range of different harvesting treatments in a silvicultural systems trial located at the Warra Long-Term Ecological Research site in Tasmania, established from 1998 to 2003. The treatments were patchfell (a 5 ha patch completely felled), stripfelling (strips about 250 m long by 80 m wide), clearfelling with understorey islands (40 m by 20 m), dispersed retention (retaining about 10% of the original standing forest by basal area as evenly dispersed trees), aggregated retention (retaining about 30% of the original forest in aggregates of about 1 ha), and single tree/small group selection. Undisturbed control plots that were established one year prior to commencing any operations within the trial were remeasured after ten years. No significant change in the flora of control plots was detected over that time period, indicating that natural or temporal variation was of little significance compared to treatment effects.

The post-disturbance response of the vascular flora showed a strong relationship with both the nature of the pre-harvest vegetation and the intensity of the disturbance. Where the pre-disturbance vegetation was dominated by sclerophyllous species it was apparent that the post-disturbance vegetation was rapidly returning to a similar species composition, with a majority of the pre-disturbance species again dominating the plots by age 3 years (and 6 where monitored). Sclerophyll plots that were only lightly disturbed and/or exposed to higher than pre-disturbance levels of light and wind have shown little change over the period and seem likely to return to their pre-harvest condition rapidly as the regeneration establishes around them. Where the pre-harvest vegetation was dominated by rainforest species (whether callidendrous or thamnic), it is apparent that, where heavily disturbed, the post-harvest vegetation by age 3 (or 6) years does not include many of the species that dominated the plots pre-disturbance but that the plots are now dominated by a suite of 'early colonisers' similar to those species that have recolonised the sclerophyll plots, and that for the first few decades at least post-disturbance these ex-rainforest plots will be dominated by a distinctly different suite of plants, and that it will only be by subsequent re-invasion that the rainforest species can reoccupy the site. Again, the least disturbed plots, such as those that were retained partly undisturbed within understorey islands, show the most promise of recovering their pre-disturbance species composition and structure relatively quickly.

At the plot level, there was little relationship between the vegetation response and the silvicultural system applied to that plot. However, at the coupe level, alternative silvicultural systems that retain areas of relatively undisturbed vegetation within the coupe contribute additional structural and floristic elements to the post-harvest coupe. In the stripfells, where mixed forest was retained in harvested strips between felled strips of similar width, rainforest species are common within the regenerating area. In aggregated retention, the retained aggregates of half to one hectare remained mostly undisturbed at the completion of regeneration treatments, and have retained structural elements such as oldgrowth and mature trees within the regenerating coupe. Further studies into the benefits of retaining aggregates within the coupe are required but at this early stage it appears that, of the systems trialled at Warra, aggregated retention in particular holds promise both as a practical alternative to traditional clearfell burn and sow systems and in retaining additional structural and floristic elements within the post-harvest coupe.

Forest carbon use efficiency: Is net primary production a constant fraction of gross primary production?

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Changes in carbon use efficiency (CUE), which is defined as the ratio of net primary production (NPP) to gross primary production (GPP), with respect to stand development were analyzed for the aerial parts of the Hinoki Cypress (*Chamaecyparis obtusa* (Sieb. et Zucc.) Endl.) including the early stage of development of the stand or the seedling stage of the cypress. For this analysis, a simple mathematical model to assess the changes in CUE was developed by incorporating data on the physiological and mass balance of woody species. CUE tended to increase with aboveground stand biomass, and then decrease gradually with increasing aboveground biomass. The CUE-value (0.28-0.39) of seedling stage was much lower than that (0.48-0.58) of younger or mature trees. To examine the effect of physiological and mass balance on CUE, the ratios of specific respiration rate to specific photosynthetic rate (*r/a*) and leaf biomass to aboveground biomass or leaf mass ratio (y_L/y_T) were calculated. The low value of CUE at the seedling stage is not due to the ratio of specific respiration rate to specific photosynthetic rate *r/a*, but due to the low value of the leaf mass ratio y_L/y_T. In addition, the decline in CUE associated with older stages of stand development was due to the decreasing changes in y_L/y_T, and the *r/a* ratio did not influence the change in CUE. Because the range of y_L/y_T (0.079-0.43) was higher than the range of *r/a* (0.048-0.18), CUE was influenced by y_L/y_T more than *r/a*. Therefore, the relationship between CUE and y_L/y_T was examined by using a hyperbolic formula. The results of this calculation indicate that CUE reaches an upper limit of about 0.6 when y_L/y_T approaches its limit.

Protected forest areas in Europe: Different backgrounds and different approaches for similar goals.

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European statistics on Protected Forest Area have been produced in the framework of the FAO Forest Resource Assessment 2000 and 2005, and the MCPFE state of Europe's forests 2003 and 2007. The reported data are compared and evaluated, using the input of a group of country experts from 23 countries in the framework of EU COST-action E27, gathered by means of questionnaires and standardised country reports.

The most important results of this analysis are presented.

The European concept of forest protection is much more complex and varied than in other continents with huge areas of untouched forests. In Europe protected areas are often small, located in majority on land owned by state, but also other local authorities and even private persons or organisations. The management and upkeep of protected areas is often linked with aims of multiple forest use.

Even within Europe there are big differences in historic use, surface, socio-economic importance and public pressure on forests. This is also reflected in the approaches to protection and conservation of forests and forest biodiversity.

In remote, sparsely populated areas (like Carpathian Mountains, Nordic countries), vast forest areas, not significantly altered by human interventions, are still present. Conservation there is primarily focused on rather large, non-intervention areas.

In densely populated areas of Europe (e.g. Germany, UK, Netherlands) forests have always been very intensively used and altered by man. Forest area was also strongly reduced. This resulted in fragmented forest areas, heavily altered by human interference. Also the ownership of the forest is very fragmented. Conservation is mainly focused on small areas with high conservation value. Also restrictions and protection regimes are different to the large, non-intervention areas, and are linked to the management history and public pressure on the areas. Management can include non-intervention, but also mitigating measures for negative influences from outside the area, and even continuation of ancient forest management practices, as many (rare) species over the centuries adopted to, and are now even exclusively linked to these management regimes.

Also the relevance and importance of other aspects like 'sustainable grazing' or 'risks for fire outbreaks' or 'protective functions against slope erosion' are very different within Europe. This is also reflected in differing policies for protection in forests.

All these, and many other reasons explain the wide diversity of approaches to Protected Forest Areas in Europe. This very complicated situation is not necessarily problematic: this 'local perspective' is important and reflects the reality on the ground. This diversity of approaches is in occurrence with, and maybe even enhances the diversity in the forest.

Because of very diverse approaches and local conditions, classification of protected forests into 'international' categories is however often difficult and not straightforward.

Variation in coarse woody debris attributes in Tasmanian tall wet *Eucalyptus obliqua* forest

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Coarse woody debris (CWD) is a key structural element of forest ecosystems. While it is therefore important to be able to measure and monitor it, it is not always clear how to do this efficiently and effectively. This study aimed to quantify a range of attributes of CWD in Tasmanian tall wet *Eucalyptus obliqua* forest (TWEF) and to use the findings to draw recommendations for future survey approaches. The assessment took place at five 50 x 50 m long-term 'wildfire chronosequence' sites, all located on S-facing aspects in the Warra region and representing different successional stages following natural and anthropogenic disturbances. The following CWD attributes were measured and/or calculated: CWD type, diameter (>10cm), length (>1m), volume, decay class diversity, bryophyte/litter cover, and regeneration abundance. The site representing 40 year old silvicultural regeneration following clearfelling contained the highest volume of CWD (1131 $m^3 ha^{-1}$). Volumes in the wildfire-regenerated sites (representing 40, 70 and 110 years post-stand-replacing wildfire) were 579, 569 and 386 $m^3 ha^{-1}$ respectively, while the oldest stand ('old-growth': time since fire uncertain) contained 919 $m^3 ha^{-1}$. Large logs (>40 cm diameter) generally contributed about 70% of the total CWD volume. There was a trend towards a greater preponderance of logs in more advanced stages of decay with time since disturbance. The use made of CWD as a tree and fern regeneration site was positively correlated with its diameter. Based on subplot-level (=0.01 ha) analyses, it appeared that 50 x 50 m was an adequate area and configuration for assessing local CWD volume and decay class diversity, and for capturing the local range of variation in ecologically relevant CWD attributes. For TWEF, sampling effort could be reduced, with little information loss, by increasing the piece diameter threshold to 40 cm and by limiting measurement to logs only.

Woodland caribou and mountain pine beetle – A challenge for Alberta forest managers

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Within the old-growth forests of Alberta, Canada there exists a threatened charismatic creature on the landscape. The woodland caribou (*Rangifer tarandus caribou)* has made Alberta its home for centuries, however due to industrial development such as forestry, agriculture, and oil and gas extraction the species is now at risk of becoming extinct. However, there is a less obvious issue that has an even greater potential to influence the survival of the caribou.

The "old-growth" component of Alberta's forest is increasing every year due to successful fire suppression over the past ~50 years. These forests are now old, even-age targets for the mountain pine beetle (*Dendroctonus ponderosae*) which has raised havoc in neighbouring British Columbia. The recent influx of mountain pine beetle across the Rocky Mountains and into Alberta has especially created a challenge for forest managers in regions where woodland caribou exist. If Alberta's forests face the same fate as their neighbours in the west, it could spell the end of woodland caribou populations even if all current industrial development is ceased. In an effort to limit the destruction by mountain pine beetle and to minimize economic loss, it may be necessary to adjust management of Alberta's old-growth forests.

The objective of our poster will be to outline the circumstances leading to and potential management strategies of the pine beetle epidemic and then to tie these into the controversial issue of habitat management in the caribou zone.

A five-point decay-class system for coarse woody debris in Tasmanian wet eucalypt forests

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Assessment of coarse woody debris (CWD) and associated carbon stocks and flows, and of associated biodiversity, requires explicit recognition of the progress of CWD decomposition from freshly fallen material to a state in which it merges with the forest soil. This is usually achieved through allocating CWD to one of several decay-classes whose incremental numbering is assumed to reflect increasing states of decomposition. In Tasmania, a five-point decay-class system has been developed to fill this role. It was based entirely on an examination of the external appearance of CWD, on the assumption that external appearance reliably reflected internal changes. Analyses of 169 'biscuits' cut from 64 *E. obliqua* logs in lowland wet eucalypt forest demonstrate that a five-point classification has ecological validity, because it reflects the underlying changes in rotten wood type composition and in wood density as decomposition progresses, both of which have great relevance for the ecological processes at work and for dependent biodiversity. This paper describes the current classification.

A framework for modelling downed woody debris dynamics, and a case study from Tasmania

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Coarse woody debris (CWD) is an important structural component in most forest systems. Understanding its dynamics is a prerequisite to understanding the effects of different forms of management on CWD, on dependent biodiversity and on carbon. In this paper we outline an approach for modelling CWD in forests subjected to periodic stand-replacing disturbance events such as wildfire or clearfelling. The model essentially combines a growth submodel with a decay submodel, linking the two through a mortality submodel and a 'CWD cylinderisation' submodel. This last component is both innovative and critical for correctly allocating wood to the appropriate diameter-class of CWD following tree death, at least for the usual style of growth model where the output is in the form of wood volumes by diameter at breast height (dbh). In doing so, it allows the model output to be more closely matched with data derived from line intersect sampling of CWD, which typically apportions overall CWD amounts to the diameter-class at the point of intersect rather than to the notional dbh of the logs intersected. While the framework described here was developed for use in modelling CWD in Tasmanian wet *Eucalyptus obliqua* forest, we suggest that it has advantages over other frameworks that lend it to more general applicability.

Sensitivity of saproxylic Coleopterans to modern forestry: Implications for conservation strategies

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Modern forestry has reduced the amount of dead wood drastically. This has had major effects on the biodiversity and the existence of saproxylic species in managed forest landscapes in Sweden and many saproxylic species have become isolated to old-growth forests. To understand and reverse this process it is important to determine if young managed forests at all serve as habitat for saproxylic species (and for which species or groups), and to determine the importance of dead wood availability in these forests for the resilience, i.e. the occurrence and dispersal, of the same species. Identifying community responses will give us a chance to identify which functional groups of species are sensitive to modern forestry and the causes for this. To determine the resilience of saproxylic Coleopterans and their sensitivity to disturbance by modern forestry, we compared the species composition between reserves, mature managed forests, thinned managed, unthinned managed and clear-cuts. We collected beetles during the summer of 2006 with Polish IBL2-traps (i.e. window-traps), and totally we caught >700 species, of which 35 species were red-listed, and >40 000 individuals. Naturally there were clear differences in species assemblages between the forest types, e.g. differences between clear-cuts compared to reserves and mature forests, which in turn were similar. Thinned managed forests were more similar to older stands than to clear-cuts, while unthinned forests are somewhat a mix of all the other forest types in species composition. When it comes to species richness and abundance reserves supported most saproxylics and red-listed species, while unthinned forests clearly supported the lowest abundance and the lowest number of red-listed species. Our results may be connected to the dead wood volumes we measured in the different forest types and we underline the importance of continuity of dead wood also in young managed stands to maintain saproxylic communities.

Effect of taking in the atmosphere of the Old Forest

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It is often pointed out that many people living in cities feel stressed for different reasons, lose their sense of the seasons, and lack sufficient physical activity. The term "Taking in the Atmosphere of the Forest" (Shinrin-yoku in Japanese) was proposed in 1982 by the Japanese Forestry Agency to resolve such problems and help people to relax and revitalize their body and soul (healing effect). In Japan, many people visit forests every year to alleviate stress, to feel refreshed or to improve health, and have high expectations for the effect of Shinrin-yoku (hereunder "the Effect").

Previously, the healing effect has been based on only empirical evidence. However, thanks to the rapid improvement of measurement technology and equipment, the government has been examining the healing effect of forests (the Effect) scientifically and using this effect for the benefit of the public.

The Effect is thought to differ depending on the kind of trees, the spatial structure and the specific atmosphere of the forest environment. Therefore, we decided to study the Effect in old forests.

We chose two old forests as examples. The first is a forest in Wakayama Prefecture owned by a temple (Koya-cho), consisting mainly of Japan cedars 250 years old or older, located in Koya Mountain, planted by Kukai in 816 and managed by Kongobuji Temple, the head temple of the Shingon sect of Buddhism. The second is the Akazawa Recreation Forest in Nagano Prefecture (Agematsu-cho), consisting of around 300-year-old Japanese cypresses, giving the illusion of a virgin forest and having a mysterious atmosphere. As a control, we selected a well-maintained artificial forest in Gifu Prefecture of Japan cedars and Japanese cypresses planted about 50 years ago (Gero-shi). We measured and compared the Effect on the subjects, paying attention to: 1) the impression of the forest space and 2) how their feeling changed after walking through each forest.

Consequently, we found that, in terms of the impression of the forest space, old forests with huge trees were appreciated as holier, more comfortable, more serene and more natural than the control. Moreover, when we compared the feelings before and after walking through each forest, in the control forest there was no difference in any of the indicators used in the survey, while in old forests the healing effect was confirmed in several indicators. These results suggest that the holy nature and natural atmosphere of huge trees, as well as the historical aspect of the site itself, may contribute to a greater Effect.

Just scratching the surface? The impact of the superb lyrebird (*Menura novaehollandiae*) in Tasmanian forest ecosystems

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The superb lyrebird *Menura novaehollandiae* was introduced to Tasmania during the 1930s and 40s to save the bird from the perceived threat of foxes and habitat loss on the Australian mainland. Since then, the bird has successfully colonized much of the moist forest in southern and western Tasmania. Very little is known about the effect that lyrebirds are having in Tasmania, but since there is no native equivalent of this large, ground-foraging bird, conservation managers are concerned that lyrebirds could have a significant negative impact on forest ecosystems.

The lyrebird has the potential to affect Tasmanian forest ecosystems in two ways: firstly, as a predator of invertebrates, the lyrebird may influence the ecosystem through altering trophic interactions. Secondly, lyrebirds are ecosystem engineers (organisms that create, modify or maintain habitats) which are capable of disturbing up to 200 t ha^{-1} soil and leaf litter a year when scratching for soil invertebrates. Such disturbance could alter habitat structure and resource availability and quality with flow on effects for the structure of invertebrate and plant community and possible consequences for the function of the ecosystem as a whole.

This multi-scale investigation will quantify the effect of lyrebird disturbance through a comparative analysis of invertebrate community structure, vegetation structure, soil structure and chemistry at sites with and without lyrebirds. Simulated lyrebird disturbance plots and lyrebird exclosures will also be used to examine the effect of lyrebird disturbance and the recovery of the community at a small spatial scale. The outcomes of this study will provide a basis for developing appropriate management prescriptions.

Epiphytic soil characterisation in emergent trees *Eucryphia cordifolia* (Eucryphiaceae), in a coastal temperate forest of Chiloé, Chile.

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Epiphytic soil comes mainly from the accumulation of organic matter on trees and could be play an important role as a source of nutrients in temperate forest. Temperate evergreen rainforests of southern South America are characterized by an multistratified canopy and emergent trees densely covered by epiphytes. The biodiversity associated with this forest canopy remains largely unknown. Our objective is characterizing the epiphytic soil of a valdivian coastal temperate forest, Chilóe island (42ºS). This study was done in Guabún, 30 km northwest from Ancud, in a 400 year-old forest without anthropic perturbation. We accessed the forest canopy using tree-climbing techniques. We calculated the epiphytic biomass (plants + soil) per ha over emergent *Eucryphia cordifolia* trees (DBH higher than 1m) and compared the water, pH, organic matter, ammonium and nitrate content in both epiphytic (8, 12 and 16m high) and forest ground soil (ground level). Our results indicated that the epiphytic biomass is higher than 15 tons per ha (dry weight), with 70% of this value due to epiphytic soil. We did not observe significant differences in ammonium and nitrate content between epiphytic and forest ground soil, therefore epiphytic soil could be an abundant nutrient source not estimated in this ecosystem, and under-considered in forest ecosystem studies. Due to this soil development in emergent trees of the forest, the conservation of them could be important to retain the process, functions and services that they do.

Ecology and habitat use of the Tasmanian masked owl *Tyto novaehollandiae castanops*

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The Tasmanian masked owl *Tyto novaehollandiae castanops* is Tasmania's largest nocturnal bird-of-prey. It is regarded as Endangered in Tasmania (TSPA 1995) and in the Action Plan for Australian Birds (2000). For nesting, the species requires cavities in large, mature eucalypt trees of dimensions between 95-191 cm in diameter and over 165 years of age. Current and past forest management practices inevitably change the structure and age characteristics of forests. To what extent this is affecting the masked owl remains unclear, largely because the species is difficult to detect and there is a dearth of knowledge on the species ecological requirements. In Tasmania, its breeding behaviour, distribution and habitat have been reported upon but not in sufficient detail to adequately manage the species.

This study will meet the need for research into territory size and habitat use of the Tasmanian masked owl to better plan for its conservation management, particularly in relation to habitat fragmentation and production forestry. The breeding requirements, territory size, habitat use and their relationship to each other will be investigated. Forest stand variables that define suitable nesting habitat and the value of habitat retained after logging will be investigated. A key question to be answered will be whether the masked owl is occurring in areas with an above-average density of large owl-suitable tree hollows and whether a specific density of tree hollows is required for their survival. The project will combine previously used techniques (pellet analysis, call playback surveys) with the latest technology (satellite tracking and GIS) to provide definitive information on the masked owl's ecological requirements and use of habitat in relation to forestry practices.

Establishment of a set of wildfire chronosequence benchmark plots in southern Tasmania

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The Wildfire Chronosequence Project is a joint initiative of the Bushfire CRC, the University of Tasmania (School of Plant Science) and Forestry Tasmania. The overall aim of the project is to investigate successional processes in the fire-adapted wet eucalypt forest landscape of southern Tasmania, to enable the development of methods for managing structural complexity and fire-dependent biodiversity in the production forest landscape and adjacent protected areas. The project incorporates a set of permanent research plots in forest regrowing following past stand-replacing disturbance events (wildfire or timber harvesting). There are six disturbance treatments in total, each represented by a 50 x 50 m plot (with 100 m external buffer) on a northerly to westerly aspect and another on a southerly to easterly aspect. These encompass regrowth forest following wildfires in 1898, 1934 and 1966/67, as well as equivalent plots in forest that has not experienced wildfire for over 150 years (old-growth) and forest regenerating following clearfell, burn and sow silviculture in 1966 and 2000. Six of the sites are within the Warra Long Term Ecological Research (LTER) site, with the remaining six sites within an adjacent area of State Forest recently designated as an Experimental Forest Landscape. For each of these twelve sites, stand structural, coarse woody debris and biodiversity surveys are being undertaken; further collaborative research by interested individuals or agencies is encouraged. This poster outlines the process of site selection and establishment, presents some preliminary interpretations of the stand structural data, and considers future research directions.

Managing threatened flora in wood production forests in Tasmania: a pragmatic approach

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Tasmania supports c. 1850 native vascular species of which c. 450 are listed as threatened under Tasmania's *Threatened Species Protection Act*. About 200 species are considered forest-dependent, and many more are associated with other vegetation types but may extend into forests.

Forestry operations in Tasmania are regulated by the Forest Practices Authority (FPA), an independent statutory authority. Most operations require a Forest Practices Plan (FPP), which is prepared and certified by a Forest Practices Officer (FPO) trained and accredited by the FPA. FPOs evaluate proposed logging coupes using planning tools to assess natural and cultural values. These planning tools include databases with locality information and manuals that identify habitats strongly associated with threatened flora. Under the Tasmanian Forest Practices Code, the FPO must seek advice from FPA specialist staff if a significant value (e.g. threatened plant species) is known or likely to be affected by a logging operation. Botanists from Tasmania's conservation agency (Dept of Primary Industries and Water) are also involved in developing management prescriptions for threatened plant species.

The nature of the proposed operation and the characteristics (ecology, distribution, population size) of the species determine if prescriptions are needed to avoid or reduce adverse effects from the forestry operation. In many cases, FPPs do not require special prescriptions because the species is known to persist (or become more abundant) after forestry disturbance. Examples include two rare species *Odixia achlaena* and *Pimelea filiformis*, which recover readily from typical logging disturbances. In some cases, site-specific prescriptions are developed (such as modified silviculture or machinery hygiene measures) to ensure that the population is maintained on-site. In a few cases, forestry operations are excluded entirely (e.g. for localised species, or species susceptible to pathogens that might be introduced by forestry activities). Examples include the endangered species *Cyathea cunninghamii* – a trunked fern of humid forest environments; and *Tetratheca gunnii* – a highly localised species which is susceptible to the fungus *Phytophthora cinnamomi.*

The Forest Practices Authority monitors the implementation and efficacy of management prescriptions. This contributes to refinement of prescriptions, which is further underpinned by research into the ecological requirements of threatened species.

Local adaptive differentiation within *Eucalyptus obliqua*

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Local adaptive differentiation can have important implications for the conservation of genetic diversity and for the probability of successful regeneration and and growth across the typically heterogeneous native forest coupes in production forests. Results are reported of a study of local adaptation within *Eucalyptus obliqua*, the dominant species in the wet, lowland production forests of Tasmania. Genetic differentiation and selection were examined by reciprocal planting of local and non-local open-pollinated progeny along two steep ecological gradients within two southern. Trials have been monitored from planting to age 15 years. Results indicated that differential selection may result in genetic differences between populations of *E. obliqua* over the scale of hundreds of metres, in addition to the tens or hundreds of kilometres normally associated with broad-scale geographic variation.

How old are old-growth forests? Using dendrochronology to investigate the age and fire history of *Eucalyptus regnans* forests in Tasmania

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As the tallest flowering plants in the world, *Eucalyptus regnans* forests of Tasmania comprise the archetypal old-growth forests of South-Eastern Australia. Periodically, these forests engender highly flammable conditions and individuals are easily killed by high intensity fire. Although *E. regnans* are considered to be fire-sensitive, the species has a superlative capacity for rapid post fire regeneration. Indeed, the persistence of these forests in Tasmania is considered to be related to a particular fire frequency, where under too-infrequent fire they cede to *Nothofagus*-dominated temperate rainforest, and under too-frequent fire seedlings are killed and a conversion to scrub ensues. Consequently it is assumed that high intensity fire events are stand-replacing and that current forests are essentially even-aged. Nonetheless, there is evidence in Victoria and Tasmania that parts of *E. regnans* forest may be multi-aged arising, for example, from low intensity fires.

The aim of this project is to use dendro-ecological techniques to investigate the stand development history and fire regimes of a multi-aged stand of *E. regnans* in southern Tasmania. Assuming that regeneration is limited in the absence of disturbance by fire, the age of old-growth and regeneration cohorts in the study area will be used to infer fire events. Stem discs will be opportunistically sampled from trees felled during normal logging operations. Ring counts will be conducted and cross-dating between trees will be attempted to provide a robust estimate of cohort age. These age estimates will be validated by AMS C^{14} dating of wood samples along the tree-ring chronology and compared with an established *Phyllocladus aspleniifolius* (Celery Top Pine) master chronology from a nearby site. Given it has been demonstrated as a climate proxy, the latter comparison with *P. aspleniifolius* may be used to attribute fire events to past climate anomalies. This will be the first concerted effort to cross-date *E. regnans* in Tasmania and will determine the dendrochronological potential of the species. The study is crucial to advancing our understanding of the inherent stand structure of these old-growth forests and the nature of the fire regimes that maintain them.

Biology and conservation ecology of selected saproxylic beetle species in Tasmania's southern forests

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A long history of forest management in Europe has caused many saproxylic (log-dwelling) species to become rare. Doing something about it once they become rare can be complicated and expensive. European forest practices often resulted in the retention of very little woody debris on the forest floor. It is this woody debris that is a source of food and habitat for saproxylic species. Intensive forestry in Tasmania is a much more recent phenomenon. The philosophy behind this study is that it is preferable to avoid the need for expensive or complicated management interventions where possible. To do this we need to understand enough about these species and their relationships with the forest ecosystem and its management at an early stage.

The log-dwelling beetles that will be chosen for this study include species belonging to families that contain known susceptible species in Europe. A mixture of naturally rare and common species have been chosen to ask the questions 'what traits make them this way?'; 'can we use an understanding of these traits to develop prescriptions or other ways of maintaining these species in the landscape?'; and 'can conservation measures developed for rare species cater for common ones also?'. Life history and habitat data collected in this study will provide framework for a population viability analysis (PVA) to help address these questions. An anticipated outcome is the development of management prescriptions or other measures aimed at enabling log-dwelling species to persist in the forest landscape.

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