COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY

ANNUAL REPORT 97/98

Established and supported under the Australian
Government's Cooperative Research Centre's program

CRC

Mission Statement

The CRC-SPF's role within the forestry sector is:

To sustain the productivity of and enhance the economic benefit from Australia's forests, through excellence in research, training and technology transfer.

Objectives

The CRC for Sustainable Production Forestry will provide the following benefits:

- Ensure the long term viability of Australia's forestry industry through high quality, relevant research in sustainable plantation forestry;
- Produce research outcomes which improve the competitiveness of industry partners, as well as being of interest to a wider range of stakeholders;
- Improve the efficiency and effectiveness of the applied research and development of industry partners through fostering and facilitating cooperative research;
- Provide an avenue to international science to ensure relevant new approaches and techniques are available in Australia;
- Provide innovative and relevant education and training that meets the skill formation needs of the forestry industry and the national forestry objectives;
- Ensure that all stake holders capture the benefits of Centre research through effective technology transfer.

COOPERATIVE RESEARCH CENTRE FOR SUSTAINABLE PRODUCTION FORESTRY

ANNUAL REPORT 97/98

Established and supported
under the Australian Government's
Cooperative Research Centres Program

Australian Forest Growers

Australian National University

Australian Newsprint Mills Ltd

Australian Paper Plantations Pty Ltd

Boral Timber Tasmania Ltd

Bunnings Treefarms Pty Ltd

CSIRO Entomology

CSIRO Forestry and Forest Products

Forestry Tasmania

Griffith University

North Forest Products Ltd

Primary Industries Corporation

Silvagene Pty Ltd

Southern Cross University

Southern Tree Breeding Association Inc

The University of Queensland

University of Tasmania

Contents

Abbreviations

APP	Australian Paper Plantations
ANM	Australian Newsprint Mills
CRC-HFPS	Cooperative Research Centre for Hardwood Fibre and Paper Science
PIC	Primary Industries Corporation
GI	Genetic Improvement
RP	Resource Protection
SM	Sustainable Management
STBA	Southern Tree Breeding Association
FT	Forestry Tasmania
BTf	Bunnings Treefarms
NET	North Eucalypt Technologies
UTas	University of Tasmania
QFRI	Queensland Forestry Research Institute
GU	Griffith University

Chairman's Letter

CRC Secretariat
GPO Box 9839
Canberra City
ACT 2601

Dear Sir

I am pleased to present to you the 1997/98 Annual Report of the Cooperative Research Centre for Sustainable Production Forestry (CRC-SPF).

This is the first report from the new expanded Centre and summarises the activities of a challenging and successful first twelve months.

This year has been one of transition, with the completion of the last objectives of the CRC-THF and the commencement of the new research program of the CRC-SPF. Some staff have left the Centre and we wish to record our appreciation for their work and to wish them well in their new endeavours. However, many new staff have joined the Centre to tackle an exciting new research program.

The First Year Visit by members of the Secretariat was held in March. The resulting report shows the CRC-SPF has strong support. The report made clear that "any fears that the Centre has taken on too much through extending its geography and its area of expertise are of no concern. The Board and the Director have set strategies and priorities to see that the activities are highly focussed and outcome orientated against preset and agreed 'deliverables' ".

At a more personal level, on behalf of the Board of the CRC, I would like to pay credit to the continuing drive and enthusiasm of our Director, Prof Jim Reid, and the dedicated group of program and project leaders who give the CRC the high reputation it deserves.

I endorse the comments made by the Panel that the Centre has made a very sound start and will continue its high level of achievement based on the excellent standards set by the previous CRC for Temperate Hardwood Forestry.

Yours sincerely

John Kerin
Chairman

Director's Report

The new Cooperative Research Centre for Sustainable Production forestry has enjoyed a successful first year of operation. The CRC has successfully integrated nine new members plus eight members from the old CRC for Temperate Hardwood Forestry into a new dynamic structure that has partners in all states of Australia and the ACT. The CRC funds staff located at five sites from Queensland to Tasmania and is therefore a truly national CRC. This has required the development of innovative ways of integrating and focussing the work of the CRC. This was begun through the development of a Strategic Plan, Business Plan and Communication Plan and a set of deliverables for each research program. Implementation of these plans and the focussing of research on the achievement of the deliverables set by industry through the Program Coordinating Committees has meant strong progress has already been made in the key areas.

During the year many new staff have joined the Centre or taken on significant new roles. These include Dr Russell Haines as Deputy-Director, Dr David de Little as Chair of the Advisory Panel, Dr Chris Beadle as Program Manager for Sustainable Management, Dr Rob Floyd as Program Manager for Resource Protection and Ms Corrine Condie as Business Manager. The result has been the continuation of the high level of expertise and leadership amongst senior CRC staff.

The CRC has continued to foster cooperative links throughout the forestry community both in Australia and overseas. This development has been reinforced by the employment of CRC trained post-graduate students and post-doctoral fellows throughout the industry and associated research organisations. This is a pleasing legacy for the CRC and will undoubtedly be one of our long-lasting contributions to the development of the industry. The Education and Technology Transfer Program continues to coordinate over 40 research higher degree students and we have continued to run successful training courses on the outcomes from our research programs. During the year several workshops were held including ones on the genetics of *Eucalyptus globulus*, and the development of the growth model PROMOD. A particular effort was made to repeat the workshops in different regions of Australia so that the widest range possible of industry representatives could attend.

A number of major projects have come to fruition during the year. Collaborative work with the CRC for Hardwood Fibre and Paper Science has resulted in the publication of a major text entitled Sampling Plantation Eucalypts for Wood and Fibre Properties. Our molecular studies on chloroplast genomes have demonstrated the impact that hybridisation has had on the evolution of *Eucalyptus* whilst the impact of vertebrate browsing on eucalypt plantations has been quantified. Our successes were reflected in the positive report received after the First Year Visit to the CRC by the Secretariat. It indicated that 'the Centre will continue the high level of achievement reached to date'.

Finally, I would like to acknowledge the contribution that has been made to the CRC by all past and present staff and students. They should be congratulated since without them the CRC could not have achieved so much.

James B Reid
Director

Management

The Board

The Board of Management of the Centre is comprised of an independent Chairman, Director and Deputy Director of the Centre, Chairman of the Advisory Panel and a representative from each Core Partner organisation. The Board determines policy and strategic direction, and sets guidelines for the effective operation and management of the Centre. The management structure and links are shown in Fig. 1.

Operation of the Centre is facilitated through three committees:

Advisory Panel

The Advisory Panel has the role of providing scientific and technical evaluation and advice to the Board. The Panel consists of an industry chairperson, three external scientific experts and the chairperson of each Program Coordinating Committee.

Management Committee

This committee assists the Director in the day-to-day running of the Centre by implementing the policies set by the Board. It consists of the Director, Deputy Director, Program Managers and the Business Manager.

Prof Jim Reid
Director
Dr Russell Haines
Deputy Director
Mrs Shelley Caswell
Administrative Officer
Ms Corrine Condie
Business Manager
Dr Nuno Borralho
Genetic Improvement Program
Dr Chris Beadle
Sustainable Management Program
Dr Rob Floyd
Resource Protection Program
Dr Neil Davidson
Education and Technology Transfer Program

Ms Jean Richmond is Secretary to the Director and the Board.

CRC Board


Mr John Kerin
Chairman


Prof Jim Reid
Director


Mr Peter Francis
Manager, Production Division
Primary Industries
Corporation Qld


Prof Allan Canty
Acting Pro-Vice Chancellor
(Research)
University of Tasmania


Mr John Cameron
Manager, Business Improvement
and Strategy
Australian Paper Plantations


Mr Allan Jamieson
Manager
North Eucalypt
Technologies


Mr Murray Vitlich
General Manager
Pulpwood Operations
Bunnings Treefarms


Dr Glen Kile
Chief
CSIRO Forestry and Forest
Products


Dr Hans Drielsma
General Manager
(Forest Management)
Forestry Tasmania


Prof Peter Baverstock
Dean, Graduate College and Research
Southern Cross University


Mr Arnold Willems
General Manager
ANM Forest Management


Dr Ron King
Director, Office for Research
Griffith University

Program Coordinating Committee

The Program Coordinating Committees meet at least twice a year to review and preview research with regard to its scientific and technological merit and to set and review research projects for each program. Each committee is chaired by an industry partner representative and consists of the program manager, at least three industry partner representatives, and at least one independent scientific adviser. Project leaders within the program are included as non-voting members but are not included in the lists below.

Genetic Improvement Program

Peter Volker (ANM, Chair)

Nuno Borralho (Program Manager)

Neil Davidson (Program Manager, Education and Technology Transfer)

Ian Bail (Silvagene)

Sandra Hetherington (ANM)

Sue Jarvis (STBA)

Peter Kube (FT)

David Pilbeam (BTf)

Sylvia Pongracic (APP)

Wayne Tibbits (NET)

Sustainable Management Program

Silvia Pongracic (APP, Chair)

Chris Beadle (Program Manager)

Neil Davidson (Program Manager, Education and Technology Transfer)

Peter Francis (PIC)

Russell Haines (QFRI)

Sandra Hetherington (ANM)

Greg Holz (NET)

Bill Neilsen (FT)

Chris Shedley (BTf)

Adrian Wallis (CSIRO)

Resource Protection Program

Humphrey Elliott (FT, Chair)

Rob Floyd (Program Manager)

Neil Davidson (Program Manager, Education and Technology Transfer)

David de Little (NET)

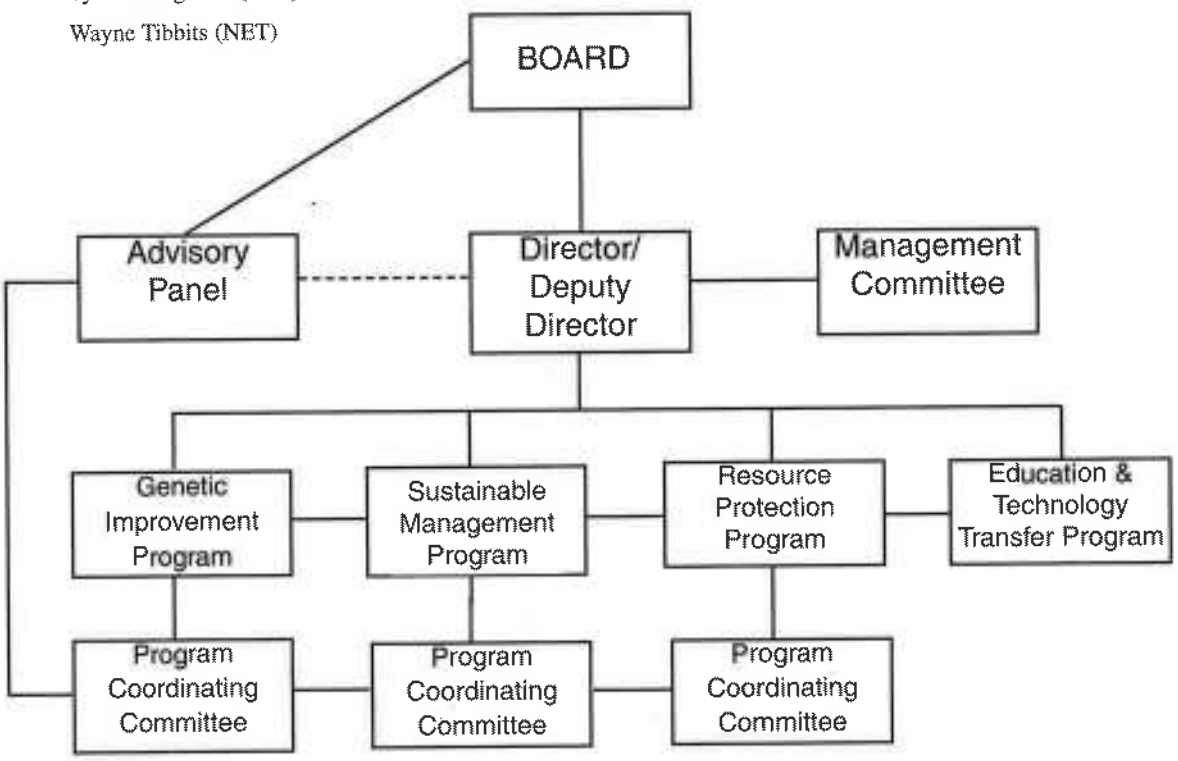
Bill Foley (ANU)

John Madden (Honorary CRC)

Silvia Pongracic (APP)

Ross Wylie (QFRI)

Figure 1 Management Structure



MAJOR DEVELOPMENTS

Sampling plantation eucalypts for wood and fibre properties

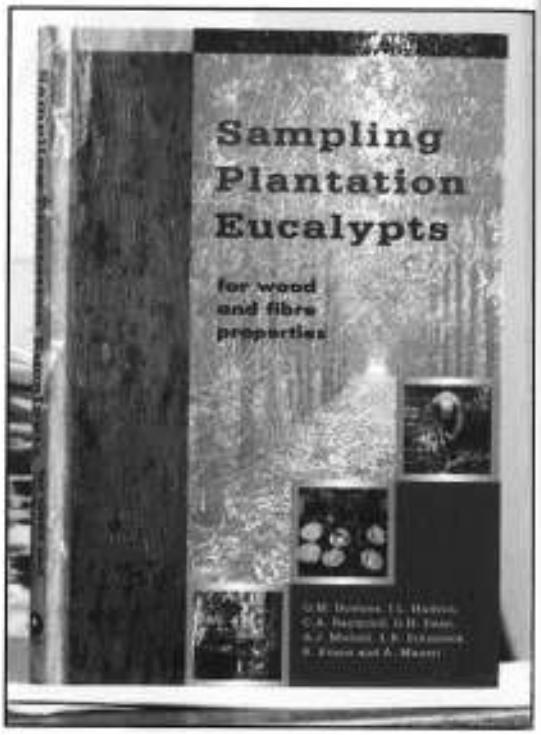
A new book has been produced by the Cooperative Research Centre for Hardwood Fibre and Paper Science and the Cooperative Research Centre for Sustainable Production Forestry in response to an expressed need from forest management and research organisations to be able to predict whole-tree values of wood properties from non-destructive samples taken from specific points within a tree. The potential to manage forests for particular properties and end uses is now a realisable goal.

This book deals with how to assess wood properties in plantation eucalypts using non-destructive samples and focuses on the predominant temperate species, *Eucalyptus globulus* and *E. nitens*. New developments in automated analysis technology now permit extensive sampling studies. Studies on a large scale that were previously infeasible can now be made to determine patterns of variability that are essential for developing meaningful non-destructive methods of sampling.

Sampling Plantation Eucalypts for Wood and Fibre Properties is targeted specifically at those who manage or undertake the sampling of commercial temperate eucalypt plantations to assess the wood properties of the resource. The book provides information needed to design a sampling program, obtain and process wood samples (destructive and non-destructive), and describes how to use the data to predict an average tree value. In addition, sufficient background information is provided to allow the reader to appreciate some of the difficulties, and therefore dangers, involved in defining these procedures. Readers are reminded that many of the studies reported in this book are still in progress. Hence the recommendations should be considered preliminary and subject to revision as more data become available.

Thus, the book provides the following:

- a preliminary model for the estimation of whole-tree property values from a single sampling point;
- a description of within-tree variation of various properties in several eucalypt species;
- a discussion of issues involved in modelling property variation;
- outlines of sampling procedures;
- a summary of existing knowledge as literature reviews.



Book cover: 'Sampling plantation eucalypts for wood and fibre properties', by Downes GM, Hudson IL, Raymond CA, Dean GH, Michell AJ, Schimleck LR, Evans R, and Muneri A (1997). CSIRO Publishing, Melbourne.

MAJOR DEVELOPMENTS

Eucalypt chloroplasts give clues of extensive hybridisation

As part of their studies of *Eucalyptus globulus* and related species, Dorothy Steane and Hamish Jackson have obtained results that will revolutionise our thinking on evolution in eucalypts. Their study of molecular markers that are specific to the DNA found inside the chloroplast suggested that inter-specific hybridisation is much more pervasive than could have been predicted using morphology. They showed an enormous diversity of chloroplast types in *E. globulus*. This diversity is geographically structured with a major divergence between southern and northern populations (see Fig. 2). Surprisingly, many eucalypt species that share the same geographical region also share the same chloroplast type. This was found in Tasmania, and involved all the species tested, *E. globulus*, *E. gunnii*, *E. urnigera*, *E. cordata* and *E. vernicosa*; and also on the mainland of Australia, where *E. globulus* shared the same chloroplast type as *E. aromaphloia*, *E. dalrympleana*, *E. nitens*, *E. cypellocarpa* and *E. quadrangulata*. This sharing of chloroplasts by different species, which in terms of morphology appear quite pure, is best explained by past hybridisation. The maternally inherited chloroplast genes are not as mobile as genes found on the chromosomes, nor do they recombine. Hence the shadow of past hybridisation is more easily detected using chloroplast markers than with nuclear genetic markers. These results imply that eucalypt species are not closed gene pools, but are capable of exchanging genes, potentially on a hitherto unappreciated scale.

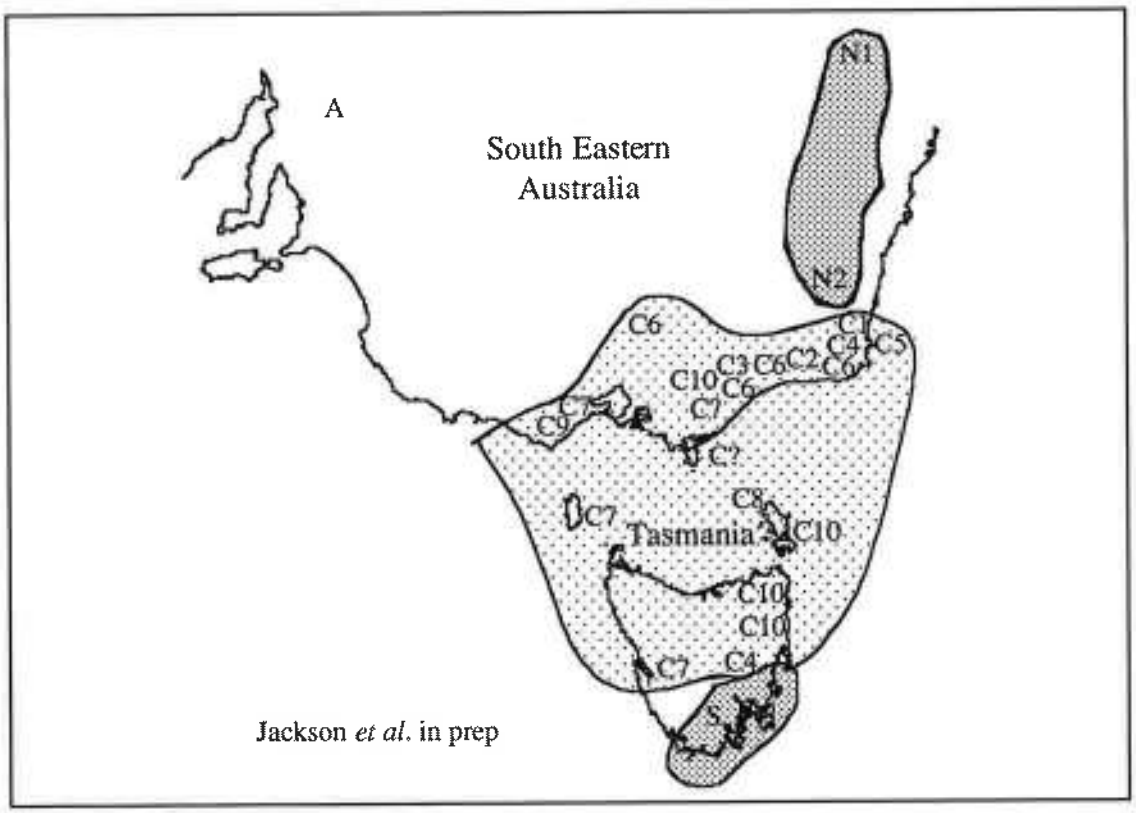


Figure 2
Map showing the great diversity in chloroplast DNA haplotypes of *E. globulus*. Each sample is denoted by a letter for the major type (Northern – N, Southern – S, South Australian – A and Common – C) followed by a number for the subtype.

MAJOR DEVELOPMENTS

Application of PROMOD, a process-based productivity model, to forest management

Process-based models have a long history of use as research tools for studying forest growth. However, few have been extensively applied to forest management. The reasons for this are various: many models fail to address questions of interest to managers, or are too complex, or the manner in which a model is implemented and documented may be out of touch with the needs of the manager.

The site productivity model PROMOD has been constructed in close collaboration with intended users. It has a transparent structure, is simple to operate and uses only readily available data as input. It is appropriately documented and supported by expert advice and services. The developers of PROMOD maintain strong links with actual and potential users, and this interaction is enhancing both the use of the model and its further development.

PROMOD is intended for screening prospective plantation sites. It focuses on the period following canopy closure, and provides a prediction of the closed-canopy leaf area index, annual biomass production and water use by the stand. PROMOD is calibrated to predict peak mean annual increment (MAI) of a plantation following canopy closure, and is used in combination with a conventional empirical model (based on plantation growth data) to predict stand development.

The required input is of a quality and quantity that forest managers can readily and cheaply obtain. Site and soil factors (slope, texture, stoniness, depth, fertility ranking) can be obtained from local knowledge or soil-data map sheets. Climatic factors (maximum and minimum temperature, radiation, rainfall, pan evaporation, rain days) can be obtained from a bioclimatic package (given site location) or from meteorological bureau observations. The initial development of PROMOD demonstrated that it could give good predictions of productivity across Tasmania and for Western Australian research sites. It also demonstrated how PROMOD could be used to determine the degree to which various site-related factors limit production.

PROMOD has been applied to a range of management questions. For example, it was modified to work under conditions in WA where soils are deep and salinity affects growth. This greatly improved its performance under these conditions and allowed the development of criteria being used to assess site suitability.

In another application a hybrid of PROMOD and a conventional empirical forest growth model combined the generality and simplicity of process based models with the robustness and accuracy of traditional empirical forest growth models. It successfully predicted height growth over the first 12 years at 13 sites (r^2=0.78, Fig. 3).

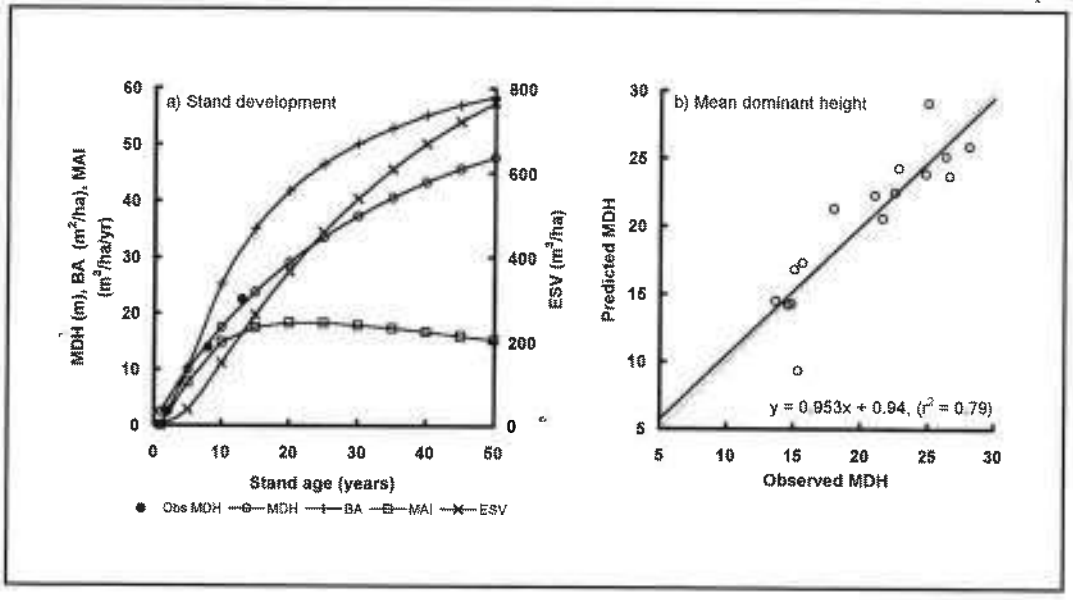


Figure 3
The Forestry Tasmania empirical growth model (NITGRO) and PROMOD can be combined to predict stand development over time given only site data. (a) Time variation of stand mean dominant height (MDH, m), basal area (BA, m²/ha), estimated standing volume (ESV, m³/ha) and mean annual increment (MAI, m³/ha/yr). The (●) are observed MDH. (b) Comparison of predicted and observed MDH for 16 stands in N Tasmania. Regression line is shown as ——, and 1:1 line is shown as .....

MAJOR DEVELOPMENTS

What are acceptable levels of browsing?

Effects of browsing on *Eucalyptus nitens* have been studied to determine how growth is reduced by browsing.

Twelve months after planting, severity of browsing, net growth rate (daily change in height), survival and number of leading shoots was compared between fenced and unfenced seedlings at seven forestry coupes. Browsing damage significantly reduced net growth rate of unfenced seedlings at five sites out of seven plantations around Tasmania. The amount by which net growth is reduced can be described by a linear relationship with a measure of browsing damage severity (r^2=0.907, n=7, $p<0.01$) (see Fig. 4). If a comparison is made within sites rather than between sites, a significant reduction in growth occurs where mean browsing score exceeds 0.9 on a 0-5 scale. Intermediate levels of browsing damage caused development of more leading shoots which results in poor tree form, difficulty in handling and low wood value. Seedling survival was unaffected by browsing damage during their first year of growth. The findings of this study can be used by forestry managers to assign meaningful measures of loss in height growth to observed levels of browsing damage, and to specifically identify 'acceptable' levels of damage.

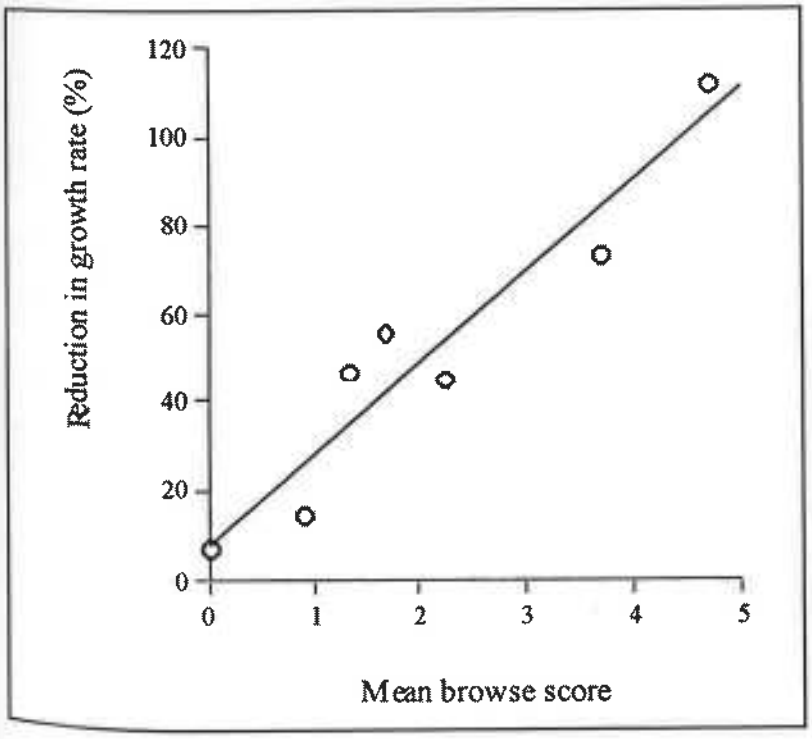


Figure 4
Linear regression relating the percentage reduction in net growth rate of unfenced seedlings to the mean browse score recorded at 12 months after planting for each site.

Heavily browsed *E. nitens* seedling.

Table 1 Cooperative Linkages

Genetic Improvement Program

Project	CRC Staff	Collaborator	Research
Project A1 Genetics and Reproductive Biology of Eucalypts	Brad Potts Heidi Dungey	Tom Whitham (Univ. N. Arizona, USA) Peter Minchin (University of Melbourne)	The effect of forest tree genetics on biodiversity
Project A2 Breeding Strategies	Nuno Borralho (consultant)	RAIZ, Portugal	Genetic control of rooting ability in *E. globulus* cuttings
	Nuno Borralho	Joao Silva, (Arboretum, Denmark)	REML analysis of genetic trials of Norway Spruce
Project A4 Molecular Genetics of Eucalypts	René Vaillancourt Dorothy Steane	Wayne Powell (Cell & Molecular Genetics Dept, Scottish Crop Research Institute)	Develop microsatellite markers in *E. globulus*
Project A6 Hybrid Breeding	Heidi Dungey Kevin Harding Mark Dieters	Bailian Li and Dominic Kain (North Carolina State University, QDPI Forestry, ANU)	Estimation of genetic parameters for wood properties in *Pinus elliottii* var. *elliottii*, F_1 and F_2 hybrids
	National links		
Project A1 Genetics & Reproductive Biology of Eucalypts	Brad Potts Paul Tilyard	Raymond Bereton (DELM)	Flowering patterns in *E. globulus* and their effect on the reproductive success of the swift parrot
Project A2 Breeding Strategies	Nuno Borralho	Kevin Harding and Jon Knight (QDPI), Peter Kanowski (ANU), Hyne and Son	FWPR7DC project on breeding objectives for sawn timber in tropical pines
	Greg Dutkowski	Ian Bail (Victorian Plantations Corporation / Centre for Forest Tree Technology)	Evaluation of spatial analysis for screening for *Dothistroma pinii* resistance
	Greg Dutkowski Nuno Borralho	Arthur Gilmour (NSW Agriculture)	Use of ASREML in forest genetics
	Nuno Borralho	Bruce Greaves, (University of Tasmania)	Genetics of *Pinus radiata*

Project	CRC Staff	Collaborator	Research
Project A5 Wood Quality	Carolyn Raymond	CSIRO Forestry and Forest Products, Melbourne and CRC for Hardwood Fibre and Paper Science	Genotype by environment interactions for wood density, fibre length, fibre coarseness, cellulose content, microfibril angle and density variation in *Eucalyptus nitens*
		Hugo Ilic (CSIRO Forestry and Forest Products, Melbourne)	Use of sound waves for non-destructive assessment of density and modulus of elasticity in standing trees
		CRC for Hardwood Fibre and Paper Science	Mapping genes affecting cambial activity in *Eucalyptus*
Project A6 Hybrid Breeding	Heidi Dungey Mark Dieters	Kevin Harding Jon Knight (QDPI), Peter Kanowski (ANU), Hyne and Son	FWPR&DC project on breeding objectives for sawn timber in tropical pines
		STBA, NZFRI, QDPI Forestry	Production of *Pinus radiata* x *P. tecunumanii* and x *P. oocarpa* hybrids
	Heidi Dungey, Steve Walker, Mark Dieters, Zhihong Xu	QDPI Forestry, Griffith University, Nina Prasolova (ARC)	Use of carbon isotope discrimination to select *P. elliottii* var. *elliottii* x *P. caribaea* var. *hondurensis* clones
	Within Centre links		
Project A1 Genetics & Reproductive Biology of Eucalypts	Brad Potts Greg Dutkowski Andrew MacDonald	Mike Powell Wayne Tibbits (NET)	Age to age correlations and genotype-environment interactions for growth in NET *E. globulus* trials
	Brad Potts	Peter Gore (STBA) David Pilbeam (BTf)	Genetic control of self incompatibility in *E. globulus* (partly STBA funded)
	Brad Potts Greg Dutkowski	Peter Gore (STBA) David Spencer (CSIRO) Wayne Tibbits (NET) David Pilbeam (BTf)	Genetic control and estimation of breeding values for flowering time in *E. globulus* (partly STBA funded)
	Brad Potts Paul Tilyard Dean Williams	Peter Gore (STBA) Peter Kube (FT) Sandra Hetherington (ANM)	Genetic variation in new base population trials of *E. nitens*
	Dean Williams Brad Potts Jim Reid	Philip Smethurst, Chris Beadle Dale Worledge (SM) Kelsey Joyce (NET) Mike Powell (NET) Peter Kube (FT)	Environmental and silvicultural factors affecting the flowering of *E. nitens*
	Brad Potts	Wayne Tibbits (NET) Sandra Hetherington (ANM) Peter Gore (STBA)	Technical manual on reproductive biology and controlled pollination of *Eucalyptus*

Project	CRC Staff	Collaborator	Research
Project A2 Breeding Strategies	Nuno Borralho	Gillian Rasmussen (NET)	Genetic control of rooting ability in *E. globulus* based on tissue culture and cuttings systems
	Greg Dutkowski	STBA	Data modelling for breeding information systems
	Greg Dutkowski	David Pilbeam (BTf)	Genetic analysis of drought in *E. globulus*
Project A3 Molecular Genetics Canberra	Gavin Moran	Carolyn Raymond GI Project 5	Molecular Genetics, Quantitative Trait Loci for wood properties in *E. globulus*
Project A4 Molecular Genetics Hobart	René Vaillancourt	STBA and Forestry Tasmania	Fingerprint *E.nitens* ramets using RAPD markers
Project A5 Wood Quality	Carolyn Raymond	SM Project 3	The Wood Quality Project is a joint project with the Sustainable Management Program
	Carolyn Raymond	Australian Paper Plantations, North Eucalypt Technologies, Bunnings Treefarms	Genotype by environment interactions for wood density, pilodyn penetration and predicted pulp yield in *E. globulus*
	Carolyn Raymond	Forestry Tasmania, ANM Forest Management	Genotype by environment interactions for wood density, fibre length, fibre coarseness, cellulose content, microfibril angle and density variation in *E. nitens*
	Carolyn Raymond	Gavin Moran, Steve Read, Gerd Bossinger, GI Project 3	Mapping genes affecting cambial activity in *Eucalyptus*
Project A7 Tropical Molecular Genetics	Robert Henry Mervyn Shepherd	Heidi Dungey, Mark Dieters, Garth Nikles, Paul Toon GI Project 6	Genetic characterisation of commercial traits in hybrid pines
	Robert Henry Mervyn Shepherd	René Vaillancourt, GI Project 4, Mark Dieters, Paul Toon GI Project 6	Development of an enriched microsatellite library for *E. globulus* and *Pinus* spp.
	Robert Henry, Mervyn Shepherd, Rhonda Stokoe	Brad Potts, GI Project 1	Investigation of putative inter sub-generic *Eucalyptus* hybrid
	Robert Henry, Mervyn Shepherd, Rhonda Stokoe	Garth Nikles, David Lee, GI Project 6	Molecular genetics of *E. cloeziana*
	Robert Henry, Mervyn Shepherd, Leon Scott	Garth Nikles, Mark Dieters, GI Project 6	Molecular genetics of *Araucaria cunninghamii*

Sustainable Management Program

International links

Project	CRC Staff	Collaborator	Research
Project B1 Site productivity	Philip Smethurst	Dr Gunda Matschonat (Uni. Bayreuth, Germany)	Solid-liquid phase partitioning of ammonium
Project B2 Management of tropical soils	Paul Saffigna Xu Zhihong	National NMR Centre Wuhan, PR China	Solid state NMR for characterisation of soil organic matter
Project B4 Modelling plantation systems	Peter Sands	Dr Eberhard Voit (South Carolina Medical University)	Applications of S-systems to forest growth modelling

National links

Project B1 Site productivity	Philip Smethurst	Phil Moody, Jonnie White (QDPI)	Effects of soil water content on K availability and uptake
Project B3 Silvicultural systems	Philip Smethurst Paul Adams Chris Beadle	Neville Mendham (Agricultural Science, Universtiy of Tasmania)	Vegetation management
	Chris Beadle Michael Battaglia	Libby Pinkard (Forestry Tasmania)	Impact of green pruning on *E. globulus*
	Chris Beadle Dale Worledge	CRC for Hardwood Fibre and Paper Science	Impacts of available water on wood quality of *E. globulus* and *E. nitens*
Project B4 Modelling plantation systems	Peter Sands and Michael Battaglia	Bill Rawlins (CSIRO Forestry and Forest Products, Melbourne)	Scheduling irrigation in the Murray-Darling Basin

Within Centre links

Project B1 Site productivity	Philip Smethurst Caroline Mohammed	CSIRO/AgSci UTas	N status and wood decay in pruned and unpruned trees
Project B3 Silvicultural systems	Chris Beadle, Jane Medhurst, Maria Cherry	Boral Timber Tasmania	Development of thinning regimes for *E. nitens* plantations
	Chris Beadle Dale Worledge	ANM Forest Management, NFP Triabunna	Scheduling irrigation in eucalypt plantations and impacts of irrigation on wood quality

Project	CRC Staff	Collaborator	Research
Project B4 **Modelling plantation systems**	Peter Sands	Clare McArthur (RP)	Modelling animal behaviour
	Michael Battaglia	Steve Candy (Forestry Tasmania)	Relationship between site quality and defoliation by *Chrysophtharta bimaculata*

Resource Protection Program

International links

Project C1 **Biology, ecology & economic impact of insect pests**	Martin Steinbauer	Paula Mitchell (Winthrop University, South Carolina, USA)	Coreid research on rosta lengths and their relationship to host plants
	Rob Floyd	Wang Haojie (Research Institute for Subtropical Forestry)	Resistance of provenances and families of *Acacia mearnsii* to insect pest damage
Project C3 **Resistance of planting stock to vertebrate browsers**	Clare McArthur	Bill Foley (ANU), G.R. Iason (Macaulay Land Use Research Institute, Scotland)	Review of role of plant secondary compounds in mammalian ecology
Project C4 **Strategies to reduce vertebrate browsing damage**	Clare McArthur	David Procter (BSc [Hons] student, School of Zoology, University of Tasmania), Paul Dredge (Forestry Tasmania), Cameron Jefferies (Forest Cover, NZ), Conrad Black (Forest Cover, NZ), Sandra Hetherington (ANM)	Preferences of brushtail possums and pademelons for native plant species and introduced cover crops in relation to seedling damage
Project C5 **Strategies to minimise loss due to fungal attack**	Caroline Mohammed Karen Barry	Ray Price (University of Birmingham, UK)	Defense mechanisms of *E. nitens* against stem decay

National links

Project	CRC Staff	Collaborator	Research
Project C1 Biology, ecology and economic impact of insect pests	Bradley Howlett, Zoltan Lukacs, Tara Simmul	Anthony Clarke (University of Queensland)	Ecology of eucalypt defoliators
	Martin Steinbauer	Tania Yonow (CRC Tropical Pest Management, Brisbane)	Distribution modelling of coreids
	Martin Steinbauer	Russell Cant (State Forests, NSW)	Biogeography of Australian coreids
	Rob Floyd	Rod Bird (Agriculture Victoria), Peter Mitchell (Harris Daishowa), David Jamieson (ACT Forests)	Resistance of provenances and families of *Acacia mearnsii* to insect pest damage
	Rob Floyd	George Wall (Goulburn Valley Water), Peter Ebner (Lower Murray Water), David Jamieson (ACT Forests), Nick Collett (Centre for Forest Tree Technology)	Quantification of impact of defoliation on short-term growth of trees
Project C2 Insect control techniques and IPM	Dick Bashford	Lionel Hill (Department of Primary Industry and Fisheries, Devonport, Tasmania)	Light trap monitoring of autumn gum moth
	Rob Floyd John Matthiessen	Industry Pest Management Group (Consortium of Bunnings Treefarms, Integrated Tree Cropping, WA CALM, Pacific Forest Corp, Great Southern Managers), Curtin Consulting, Agriculture Western Australia	Surveillance and monitoring of *E. globulus* plantations in the south west of Western Australia
	John Matthiessen	Industry Pest Management Group (Consortium of Bunnings Treefarms, Integrated Tree Cropping, WA CALM, Pacific Forest Corp, Great Southern Managers)	Preliminary investigation of insecticidal control of African black beetle *(Heteronychus arator)* and spring beetle *(Liparetrus jenkinsi)* in *E. globulus*
Project C3 Resistance of planting stock to vertebrate browsers	Clare McArthur Brad Potts	Bill Foley (ANU)	NIR analysis of foliage in relation to damage and intake
Project C4 Strategies to reduce vertebrate browsing damage	Kirsten le Mar Clare McArthur	Mick Statham (TIAR and University of Tasmania), David de Little and Ian Blanden (North Forest Products)	Use of eucalypt plantations and surrounding habitat by three marsupial herbivore species

Within Centre links

Project	CRC Staff	Collaborator	Research
Project C1 **Biology, ecology and economic impact of insect pests**	Luke Rapley, Geoff Allen, Marina Hurley, Zoltan Lukacs	David de Little (NET)	Feeding performance and diapause in autumn gum moth
	Tara Simmul, Geoff Allen	David de Little (NET)	Biology of fireblight beetle
	Zoltan Lukacs	Rob Floyd (CSIRO Entomology)	Seasonal phenology of autumn gum moth
	Jane Elek	Sandra Hetherington (ANM)	Artificial defoliation of *E. nitens*
Project C2 **Insect control techniques and IPM**	John Madden	Richard Milner (CSIRO Entomology)	Biological control of eucalypt feeding beetles with fungal entomopathogens
	All Project C2 staff	ANM, NET, BTT, FT	Monitoring and experimentation in plantations
Project C3 **Resistance of planting stock to vertebrate browsers**	Clare McArthur	Julianne O'Reilly (School of Zoology, University of Tasmania), Sandra Hetherington (ANM)	Damage to and preferences for plantation seedlings by rabbits
	Nadia Marsh Clare McArthur	David de Little and Ian Blanden (North Forest Products)	Browsing damage to *E. nitens* seedlots
	James Bulinski Clare McArthur	North Forest Products, Forestry Tasmania, ANM, Boral Timber	Determining effect of browsing severity on seedling growth and survival
Project C4 **Strategies to reduce vertebrate browsing damage**	Nadia Marsh Clare McArthur	David de Little and Ian Blanden (North Forest Products)	Relationship between damage to seedlings and herbivore abundance on a poisoned versus unpoisoned plantation
	James Bulinski Clare McArthur	North Forest Products, Forestry Tasmania, ANM, Boral Timber	Damage levels between plantations as a function of descriptive and predictive variables

Education and Technology Transfer Program

National links

CRC Staff	Collaborator	Activity
Neil Davidson, Jane Burrell Corrine Condie	Science Communicators from other CRCs	Interaction and coordination of science communication
Neil Davidson Corrine Condie	Other end users of CRC research across Australia	Communication workshops with other end users
Neil Davidson	Fran Sugden (Greening Australia), Arthur Lyons (Private Forests Tasmania)	'Trees for Dollars and Sense' Workshops
Neil Davidson, Corrine Condie and all programs	Private Forests Tasmania	Farm Forestry Fact Sheets
Jane Burrell Neil Davidson	David Hamilton, Darcy Vickers (Forest Education Foundation) Bevis Yaxley (Education Dept, Tasmania), Judy Chambers (Kingston Primary School)	School Kits
Jane Burrell	Tasonline, State Library of Tasmania	Host server WWW site
Jane Burrell	Mick Brown (Forestry Tasmania), Robert Hill (University of Tasmania), Mark Hovenden (University of Tasmania)	'Vegetation of Tasmania'
Jane Burrell	Alison Walker (National Co-ordinator, National Science Week)	National Science Week event

Within Centre

Neil Davidson, Jane Burrell	Anne Single (QFRI)	WWW site maintenance
Neil Davidson, Jane Burrell	Claire Hiller (University of Tasmania)	Women in Forest Science

RESEARCH

Genetic Improvement Program

Manager
Dr Nuno Borralho

Introduction

The genetic improvement of eucalypts and pines is aimed at reducing the costs of plantation establishment, harvesting and processing, and adding value to pulp and timber. Major tree breeding programs in both tropical and temperate Australia demonstrate the importance placed on tree breeding. The specific aims of the program's research are to:

- determine the molecular and quantitative genetic control of important traits, and how this changes with age, site and silviculture;
- define appropriate breeding objectives for individual firms and the sector, from forest growers to industrial processors;
- identify selection criteria and assessment methods for wood quality, growth, pests and other key traits, and statistical methods for their analysis;
- improve our ability to control and manipulate reproductive characteristics in eucalypts and pines;
- provide training and education, and be a forum for discussion in Australia.

These research outcomes will directly assist breeders in our member organisations of both temperate eucalypts and tropical pines and native species, as well as organisations multiplying and distributing improved seed.

Outcomes

- A major review of North Forest Products' five base population trials of *E. globulus* was completed, resulting in profiles of genetic parameters for 49 traits.
- For the first time in forest trees, it was shown that reproductive and vegetative maturity are genetically completely independent processes. This was the case in both *E. globulus* and the *E. risdonii-E. tenuiramis* complex, where the timing of transition to adult foliage and first flowering are under strong genetic control.
- *E. nitens* x *globulus* F_1 hybrids do not exhibit significant heterosis for stem diameter or pilodyn penetration after six years with the F_1s intermediate between *E. globulus* and the faster growing, lower density, *E. nitens*.
- Variation in relative bark thickness of *E. globulus* was shown to be under strong genetic control and to exhibit little genotype x environment interaction. While races and families differ in their relative bark thickness, this does not appear to impact on the efficiency of using over-bark measurements of diameter for selection.
- Studies of the growth of controlled crosses of *E. globulus* showed very strong age-age correlations between two, four and six year performance, but the heritability dropped with age.
- Genetic effects due to dominance were shown to be comparable in magnitude to additive genetic effects in *E. globulus*, but of little significance in *E. nitens*. In contrast, the non-additive genetic control of pilodyn penetration was low in both *E. globulus* and *E. nitens*.
- A new technique for control pollination of *E. globulus* was developed which may lead to great cost saving by reducing the number of tree visits from three to one.
- A survey of birds and insects visiting *E. globulus* flowers in natural populations in Tasmania was undertaken to help identify major pollinators.

Project 1

Leader
Dr Brad Potts

Staff
Mr Greg Dutkowski
Mr Peter Gore
Ms Sandra Hetherington
Mr Andrew Hingston
Dr Greg Jordan
Ms Corrina Kelly
Ms Rachel Lawrence
Dr David Pilbeam
Mr Mike Powell
Prof Jim Reid
Mr Paul Tilyard
Dr Wayne Tibbits
Dr René Vaillancourt
Mr Peter Volker
Mr Dean Williams

Genetics and reproductive biology of eucalypts

Background

This project aims to provide the basic biological information necessary for effective exploitation of temperate eucalypt species by:

- studying the quantitative genetics of traits of economic and biological importance;
- developing a better understanding of factors affecting sexual reproduction.

Goals

- Complete quantitative genetic analyses of *E. nitens* x *globulus* F_1 hybrids.
- Detail the early performance of advanced generation *E. nitens* x *globulus* hybrids.
- Study age:age correlations, across site and inter-trait genetic correlations for later age growth in open-pollinated and controlled cross trials of *E. globulus*.
- Study the importance of non-additive genetic effects in *E. globulus* and *E. nitens*.
- Determine the genetic control of flowering time and self sterility in *E. globulus*.
- Report on development of one-stop pollination methods for *E. globulus* and *E. nitens*.
- Determine the effects and interactions of nitrogen, phosphorus and paclobutrazol on flowering precocity and abundance in *E. nitens*.
- Determine the effects of spacing on flowering and capsule production in *E. nitens*.
- Commence detailed studies of the pollinators of *E. globulus* and *E. nitens*.

David Jones and Sarah Scott assessing insect damage on *E. globulus* at Tyenna (Florentine Valley, Tasmania).

Project 2

Leader
Dr Nuno Borralho

Staff
Mr Paul Chambers
Mr Greg Dutkowski
Mr Andrew MacDonald
Ms Michelle McGranahan
Mr Mike Powell
Dr Wayne Tibbits
Mr Peter Volker
Mr Xianming Wei

Breeding strategies

Background

The aims of this project are:

- develop more accurate selection procedures, mostly for temperate eucalypts, with emphasis on the use of better statistical models, more appropriate use of pedigree and experimental design information, and appropriate software;
- improve decision-making processes in tree breeding by developing rules for progeny testing, selection and mating, and accounting for costs, gains and inbreeding in breeding programs.

Outcomes

- The first breeding objectives for thermo-mechanical pulping of *Pinus radiata* have been developed. Estimates of the economic weights for a number of key wood traits and breeding objectives for a fully integrated sawntimber and pulp and paper production system are being developed.
- Evaluation of a 'rolling-front' breeding strategy (where all operations are carried out on an annual basis, with expected breeding values being updated regularly using Best Linear Unbiased Prediction) has shown gains between 25% and 30% greater than for traditional discrete generation. The size of the differences were dependent on how much delay there was in the completion of the breeding cycle by such things as poor early flowering. The STBA *Eucalyptus* breeding programs use a 'rolling front' strategy.
- Grafted seed orchards and thinning of existing progeny trials into seedling seed orchards were found to be the most effective deployment strategies for temperate eucalypts in Australia. Family clonal forestry was not recommended because of the high plant costs. A cost lower than $A 0.50 per plant was needed to make this option viable.
- There has been considerable progress in the development of an algorithm to invert the additive relationship matrix used in the prediction of breeding values in the presence of open-pollinated families with varying degrees of self pollination and ancestral inbreeding.
- A simple model has been developed to predict breeding values from measurements at different ages by using the repeatability of annual growth and by accounting for changes in selection accuracy with age. The resulting breeding values are mostly unbiased and strongly correlated with multivariate estimates provided age:age correlations are higher than 0.5 (see Fig. 5).

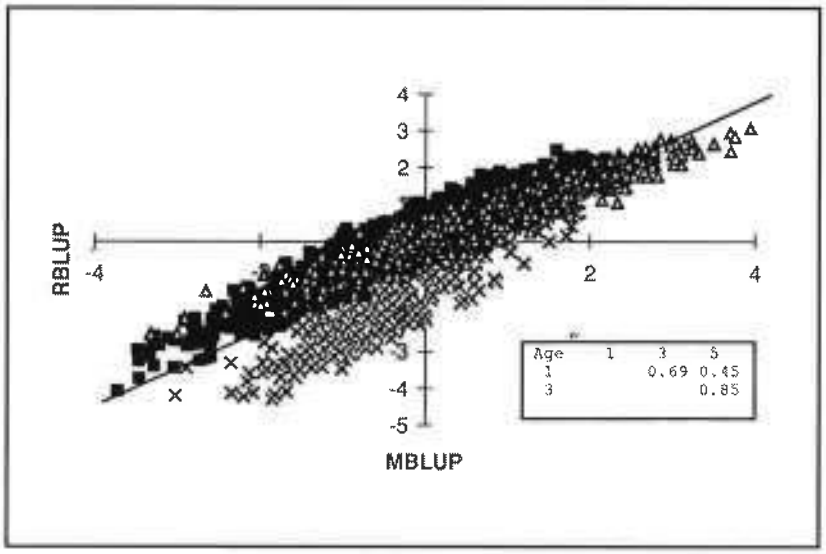


Figure 5
Comparison between breeding values for diameter at age 5, using a repeatability BLUP (RBLUP) for trees measured at age 1 (X), age 3 (Δ), and age 5 (■), compared with a multivariate BLUP (MBLUP) using the measurements at age 1, 3 and 5. Genetic correlations between ages are also given. Only trees measured at age 1 are biased, although correlations remain high.

Goals

- Recommend strategies to account for competition and spatial variation when predicting breeding values from genetic trials.
- Evaluate the impact of accounting for selfing and co-ancestry inbreeding when estimating breeding values in open-pollinated *E. globulus* material from native stands.
- Compare the accuracy of predicted breeding values based on control pollinated and open pollinated information in *E. globulus* and *E. nitens*.
- Complete genetic studies of propagation effects in nursery and later-age trials of *P. radiata* and evaluate deployment strategies using cuttings.

Project 3

Leader
Dr Gavin Moran

Staff
Ms Kylie Groom
Ms Jan Murrell
Dr Karen Thamarus

Molecular approaches to tree improvement

Background

The project aims to study genes controlling commercial traits in *E. globulus* focusing on wood properties.

It will:

- characterise the number and location of QTL determining wood and fibre properties and growth in *E. globulus*;
- map and characterise candidate genes for wood and pulp properties.

This project works closely with Project 5 (wood quality) within the GI program. CSIRO brings to this project a baseline map developed in *E. nitens* consisting of nearly 200 RFLP markers and also a small number of microsatellite and isozyme markers. The project has strong collaborative links with CSIRO staff in the CRC for Hardwood Fibre and Paper Science (CRC-HFPS) with many of the traits to be studied using technologies developed in that CRC. In part the mapping of candidate genes involves mapping cambial specific cDNA sequences developed by researchers at the University of Melbourne within the CRC-HFPS.

Outcomes

- Sampling of progeny from two families of *E. globulus* in the CSIRO/NET hybrid trial for DNA has been completed.
- Three wood cores have been taken from each of the progeny in the families at seven field sites.
- Basic density measurements complete (through GI project 5).
- Approximately 180 molecular markers have been assayed in one family.

Goals

- Complete a framework genetic linkage map for *E. globulus*.
- Map and characterise the QTL segregating for basic density, cellulose content, fibre length and microfibril angle.
- Map cambial specific gene sequences and evaluate the role of known genes as potential QTL.

Kylie Groom loading electrophoresis gels in the molecular genetics laboratory, CSIRO Canberra.

Project 4 Molecular genetics of eucalypts

Leader
Dr René Vaillancourt

Staff
Mr Robert Bennett
Mr Peter Bundock
Mr Andrew Milgate
Ms Alexandra Mitchell
Dr Brad Potts
Mr Mike Powell
Prof Jim Reid
Mr Stuart Skabo
Dr Dorothy Steane

Background

This project focuses on eucalypts and aims to use molecular markers to:

- provide a better knowledge of inbreeding, heterosis and the role of genetic diversity in breeding programs;
- characterise the number and location of major genes (QTLs) affecting commercially important traits (e.g. growth, wood density, and disease resistance);
- quantify factors affecting outcrossing rates and patterns of gene flow, and contamination levels in seed orchards.

Many of the current outcomes flow from previous CRC-THF projects.

Outcomes

- Thirteen microsatellite markers (markers with numerous alleles, ideal for paternity and maternity analysis) were developed. These markers will be used to measure gene flow in *E. globulus*.
- RAPD (random amplified polymorphic DNA) linkage maps were constructed in a *E. globulus* cross using 166 progeny. Currently the work is focusing on adding microsatellite markers to the maps to make them transferable to other crosses and species. These maps will be used to find QTLs for pilodyn penetration and growth.
- As part of the genetic study of disease resistance, a survey of *Mycosphaerella* foliar diseases occurring on *E. globulus* and *E. nitens* plantations in Tasmania was undertaken. Five different species were found. Several isolates of *M. molleriana* and *M. tasmaniensis* were induced to produce asexual spores (conidia) in sufficient quantities for development of a bioassay (method for early screening for resistance to disease).
- Chloroplast DNA (cpDNA) variation was studied in *E. globulus* and eight related species. *E. globulus* has three highly differentiated chloroplast types (with many haplotypes) which surprisingly were also found in sympatric related species. This is best explained by extensive inter-specific hybridisation (see Fig. 2, Major Developments).
- Sequence analysis of the internally transcribed spacers of the nuclear ribosomal DNA has provided valuable information about relationships between sections, subgenera and genera (i.e. *Eucalyptus* and *Corymbia*) of the eucalypts.

Goals

- Screen *E. globulus* and other species with microsatellite DNA markers.
- Finish the *E. globulus* linkage maps and use them in QTL detection.
- Complete an isozyme survey of *E. globulus*.
- Study resistance to *Mycosphaerella* infection in *E. globulus*.
- Use microsatellite and isozyme markers in gene flow studies.
- Find pollen sources with rare allozyme markers for use in mass-pollination experiments in *E. globulus*.

Dr Dorothy Steane at work in the molecular biology laboratory, University of Tasmania, Hobart.

Project 5

Leader
Ms Carolyn Raymond

Staff
Mr Alex Bradley
Mr Peter Kube
Mr Andrew MacDonald
Ms Laura Nagy

Wood quality

Background

This project has strong links to the CRC for Hardwood Fibre and Paper Science (CRC-HFPS). Some of the technologies developed in CRC-HFPS (SilviScan 2, cellulose content analysis and Near Infrared Reflectance Analysis) are being applied to genetic material common to the STBA national breeding programs for both *E. globulus* and *E. nitens*. Research is also conducted in collaboration with the pulping laboratories of the industrial partners.

Work in the Genetic Improvement Program is concentrating on:

- developing non-destructive sampling strategies for wood and fibre properties;
- defining relationships between wood, pulping and sawn timber properties;
- determining the magnitude and importance of genotype by environment interactions for wood properties;
- developing breeding objectives for a range of wood products.

Outcomes

- Book on sampling plantation eucalypts for wood and fibre properties published in October 1997.
- Cellulose determination method developed by CRC-HFPS implemented in Hobart.
- Genotype by environment interactions in *E. globulus* - all wood samples processed for basic density and predicted pulp yield.
- Genotype by environment interactions in *E. nitens* - cores collected from three sites and processed for basic density, fibre length and fibre coarseness. Processing of cores through SilviScan 2 for determination of microfibril angle has commenced.
- QTLs for wood properties - core samples collected from all sites and data for basic density provided to GI Project 3.

Goals

- Genotype by environment interactions in *E. globulus* - complete analysis and reporting of results for basic density, predicted pulp yield and cellulose content.
- Genotype by environment interactions in *E. nitens* - process cores for determining cellulose content, microfibril angle and density variation.
- QTLs for wood properties - complete processing of cores for fibre length, fibre coarseness, predicted pulp yield and cellulose content and provide data to GI Project 3.
- Evaluate the use of sound waves for non-destructive sampling for basic density and modulus of elasticity.
- Evaluate the potential for using NIRA to predict cellulose content.

Alex Bradley preparing a core sample of *E. globulus* for measuring fibre length and coarseness, CSIRO FFP, Hobart.

Project 6

Leader
Dr Mark Dieters

Staff
Dr Heidi Dungey
Dr Kevin Harding
Mr Dominic Kain
Dr Garth Nikles
Mr Paul Toon

Hybrid breeding

Background

The aim of this project is to:

- review the forestry literature on hybrids;
- profile genetic parameter estimates in hybrid populations;
- simulate different hybrid breeding strategies - e. g. reciprocal recurrent selection, and pure-line breeding, selecting for general combining ability (GCA) and/or general hybridising ability (GHA);
- provide recommendations as to the best hybridisation strategies based on the simulations;
- investigate wood properties in tropical pine hybrids.

Outcomes

- Sampling for wood property analysis in tropical pine hybrids completed.
- Publication of genetic parameters in tropical pine hybrids *Pinus caribaea* var. *hondurensis* x *P. oocarpa* and x *P. tecunumannii*.
- Completion of stage 1 in the slash and Caribbean pine structural sawing analysis of Forest and Wood Products Research and Development Corporation (FWPRDC) project.

From left: Dr Rosemary Lott, Dr Mark Dieters, Yetty Setiawati, Dr Philippe Vigneron (from France), Dr Garth Nikles and Dr Heidi Dungey at QFRI, Qld.

Goals

- Complete literature review on hybrid breeding.
- Analysis of *P. elliottii* var. *elliottii* x *P. caribaea* var. *hondurensis* hybrid data.
- Complete densitometry studies on tropical pine hybrids.
- Commence development of breeding objectives for slash and Caribbean pine structural timber analysis (FWPRDC).
- Analysis of pine hybrid data from Zimbabwe with CRC visitor, David Gwaze.
- Undertake analyses to identify exceptional F_1 trees in the *P. caribaea* var. *hondurensis* x *P. tecunumanii* or x *P. oocarpa* hybrid trials.
- Commence simulation studies and develop strategic linkages to streamline simulation development.
- Prepare for symposium on hybrid breeding to be held in early 2000.

Tagging pine seedlings for a trial in the nursery, QFRI Qld.

Project 7

Leader
Prof Robert Henry

Staff
Mr Michael Cross
Dr Mark Dieters
Dr Russell Haines
Mr Leon Scott
Dr Mervyn Shepherd
Mr Paul Toon
Ms Rhonda Stokoe

Molecular genetic improvement for tropical and subtropical production

Background

This project will apply molecular genetic techniques to the improvement of tropical and sub-tropical forestry species, including *Pinus* hybrids, *Araucaria cunninghamii* and *Eucalyptus cloeziana*. Investigations in progress include evaluation of inbreeding in natural populations and investigation of putative inter-subgeneric hybrids. Mapping and QTL analysis are being conducted to attain a greater understanding of the key commercial traits in the *P. elliottii* var *elliottii* x *P. caribaea* var *hondurensis* F_1 hybrid which will allow the incorporation of marker-aided selection into DPI Forestry breeding and propagation programs.

The research strategy for the *Pinus* hybrid project has been defined and aims to:

- generate genetic maps from *P. elliottii* var *elliottii* and *P. caribaea* var *hondurensis* F_1 hybrids;
- generate new populations suitable for genetic mapping to supplement existing resources;
- perform marker-trait co-segregation analysis for growth, form and wood properties traits;
- examine QTL stability in a range of genetic backgrounds, across sites and over different silvicultural conditions;
- investigate markers as a tool for prediction of heterosis;
- explore the use of marker-aided selection (MAS) in the development of breeding and propagation populations.

Outcomes

- Evaluation of genetic resources for mapping and QTL analysis available in the DPI Forestry breeding program.
- Development of new populations more suitable for mapping experiments has commenced. Eight large, interrelated full-sib families have been germinated in preparation for vegetative propagation and establishment in field trials in 1999. This includes several selfed F_2 families. These large, full-sib families should allow more accurate estimates of QTL than is possible with material currently available in field experiments.
- Development of enriched microsatellite libraries for ten forest species including *P. elliottii* and *P. caribaea*, *A. cunninghamii* and *E. cloeziana* has commenced.

Goals

- Develop microsatellite markers for *Pinus* species.
- Develop genetic maps for select hybrid pine parents with both microsatellite and AFLP markers.
- Analyse early growth and form characteristics in a full-sib hybrid family.
- Analyse propagation characteristics in a full-sib family.
- Undertake QTL analysis for growth, form and wood properties in a half-sib array.

Field work in progress, SCU, Lismore, NSW.

Sustainable Management

Manager
Dr Chris Beadle

Introduction

Plantations, including farm forests, can be considered a sustainable resource only if the factors necessary for production remain favourable over successive crop cycles. This program examines the environmental factors and silvicultural practices that influence forest production and cast these into a quantitative framework with the use of process-based models. We play a critical role in delivering the knowledge needed to ensure that practices implemented by forest managers in Australia are sustainable and subject to ongoing improvement in terms of economic and environmental performance. This provides a valuable adjunct to the work of other research organisations involved in the definition of criteria for sustainability.

In temperate Australia, the major research focus is on the expanding resource of eucalypt plantations which is likely to play a significant role in regional development. In subtropical Queensland, research concentrates on the existing coniferous plantation resource. Although the specific crops differ among regions, the basic soil and physiological processes which underlie productivity are the same and provide a unifying theme across the program.

In addition, we aim to produce outcomes of significant benefit to the community through the provision of high quality training for postgraduate students and research which has the potential to enhance regional development.

Project 1 Site productivity

Leader
Dr Philip Smethurst

Staff
Mr Paul Adams
Mr Craig Baillie
Ms Linda Ballard
Dr Chris Beadle
Ms Maria Cherry
Mr Keith Churchill
Mr Robin Cromer
Dr Neil Davidson
Ms Joanne Dingle
Mr Rick Hand

Background

Much research effort has been directed towards establishing eucalypt plantations with high early growth rates. A change in emphasis is required towards (i) sustaining relatively high growth rates throughout the rotation, and (ii) developing systems of slash management which facilitate replanting and promote soil conditions that favour the growth of newly planted seedlings and the maintenance of site productivity. As Australia's plantation estate expands, selection of sites that have the capacity to maintain a satisfactory supply of water will remain an imperative. Studies to be undertaken will lead to an improved understanding of the key soil processes that determine the supply of water and nutrients to trees, and will contribute to an assessment of the sustainability of these systems.

The aims of this project are:

- to determine the extent to which nutrient and water supply can sustain high leaf areas and tree growth rates after canopy closure;
- to evaluate the effects of alternative slash management strategies (during the inter-rotation period) on nutrient supply and other soil conditions that affect productivity;
- to improve our understanding of water storage and access to this water by tree roots as determined by soil profile characteristics, rainfall, and ground water.

Weed control experiment near Penna, Tas - a motorbike and boomspray apparatus alongside a weedy plot with supressed trees and an adjacent weed free plot with large vigorous trees.

Staff continued
Ms Sandra Hetherington
Dr Greg Holz
Ms Ann LaSala
Dr Martin Line
Dr Robert McCormack
Mr Daniel Mendham
Dr Rabi Misra
Mr Martin Moroni
Mr Bill Neilsen
Mr Peter Naughton
Ms Ruth Osborne
Ms Silvia Pongracic
Dr Chris Shedley
Ms Paulina Teixeira

Outcomes

- Rates of N fertiliser that maximise growth rates of one- to three-year-old *Eucalyptus nitens* plantations in Tasmania are relatively high, and split applications are of no advantage. Experience suggests that symptoms of N deficiency in stands of this age include pale foliage and non-light-limited lifting of canopies, low concentrations of soil solution ammonium (<0.05 mM) and, to a lesser extent, nitrate (< 0.2 mM).

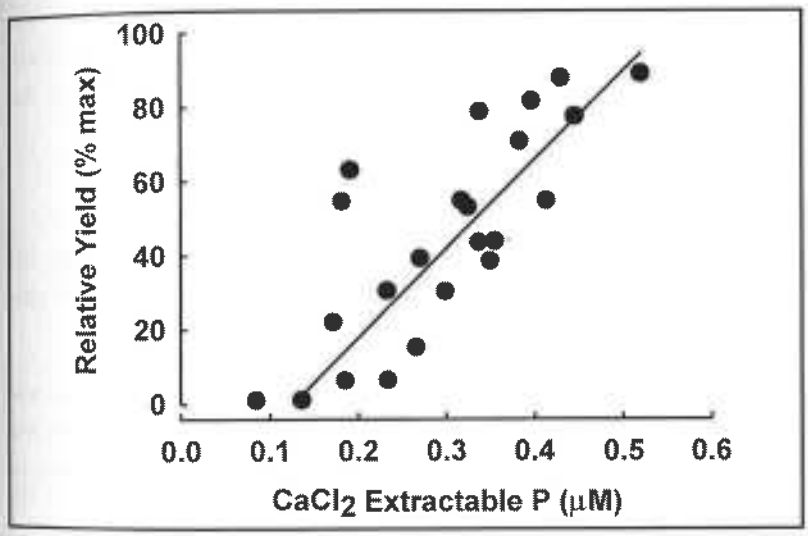


Figure 6
Phosphorus fertiliser is needed at planting to maximise the growth of *E. globulus* and *E. nitens* if the concentration of $CaCl_2$ P is less than 0.5 µM. The relationship includes data from 23 fertiliser experiments in southern Australia.

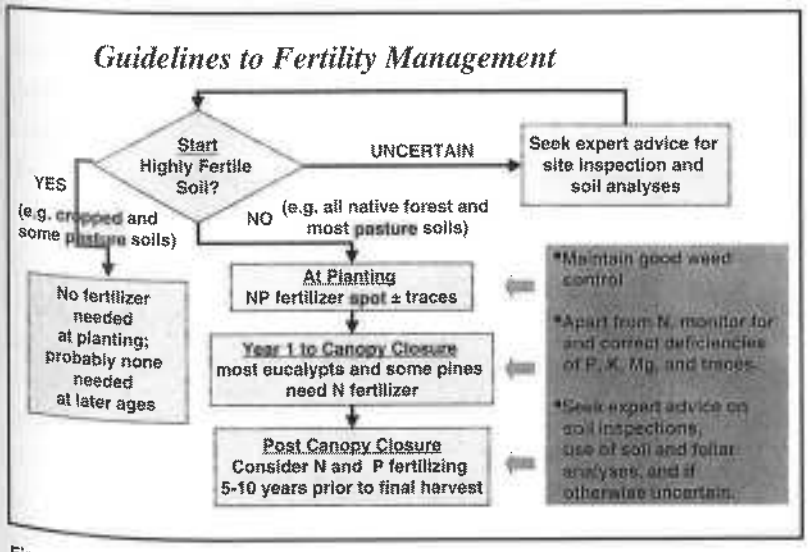


Figure 7
Guidelines for fertility management.

- *Eucalyptus globulus* and *E. nitens* seedlings had similar responses to the concentration of inorganic P in a dilute calcium chloride extract that simulated soil solution; growth was maximised at concentrations above 0.5 µM (Fig. 6).
- Current knowledge of soil fertility management has been summarised in guidelines that are available to the public (Fig. 7).
- Fertilisation of an *E. nitens* plantation two years after planting boosted leaf area of the crop, which was still 45% higher in the fertilised compared to the control treatment at age six years.
- A site selection system used by Bunnings Treefarms for dry environments has been described; good knowledge is required of soil water storage capacity and impediments to rooting.
- Alternative strategies for eucalypt slash management were identified.

Goals

- Complete current evaluations of soil solution N and P as indicators of N and P supply in typical eucalypt plantations during the establishment phase.
- Establish experimental sites for research on post-canopy-closure nutrient management and on slash management.

Project 2

Management of tropical soils

Leader
Assoc Prof Paul Saffigna

Staff
Dr Ian Phillips
Dr Bofu Yu
Prof Calvin Rose
Dr Xu Zhihong
Mr John Simpson,
Mr David Osborne
Mr Ken Bubb
Dr Sue Berners-Price
Ms Nina Prasalova
Dr Senake Perera
Dr Guixin Pu
Mr Tim Blumfield
Ms Danielle Wiseman
Ms Nicole Mathers
Mr Trevor Leaman

Background

Concerns have been expressed about a decline in the reserves of soil organic matter in exotic pine and native hoop pine plantations in subtropical Australia due to inappropriate silvicultural practices, but little research has been undertaken on the dynamics of soil organic matter in these plantations. Productivity of hoop pine plantations is governed to a large extent by the supply of N (and water) from the soil. Nitrogen transformation processes (for example denitrification) which lead to losses of N will be subject to particular investigation. The core hydrology research program of QFRI has undertaken catchment studies and other soil physical process studies over a long period of time. Processes of particular concern included soil erosion on steep slopes for hoop pine and leaching in sandy soils under exotic pine.

The aims of this project are:

- to evaluate the impacts of soil and stand management on both quantity and quality of soil organic matter in subtropical pine plantations of south-east Queensland;
- to develop effective soil organic matter management regimes for sustaining the productivity of subtropical pine plantations;
- to evaluate the impacts of silvicultural practices on N pools and dynamics in hoop pine plantations of south-east Queensland;
- to quantify the effects of both silvicultural practices and environmental conditions on soil N availability and on plantation N demands;
- to quantify the effects of harvesting, site preparation practices and seasonal conditions on soil physical processes in subtropical pine plantations;
- to quantify the relationships between surface condition, site hydrology, soil physical characteristics and leaching processes during the inter-rotation period of the pine plantations.

Outcomes

- Innovative methodology for characterising soil organic matter quality in hoop pine and exotic pine plantations has been tested.
- Retention of hoop pine slash residues increased denitrification and immobilisation of ^{15}N-labelled nitrate in one-year-old hoop pine plantations in summer (Fig. 8).
- Leaching of ^{15}N-labelled nitrate occurred to depths beyond 50 cm within two weeks under average summer rainfall conditions in one-year-old hoop pine plantations.
- The suitability of existing data from long-term catchment studies is being assessed for incorporation into a predictive runoff model of soil loss from sub-tropical pine plantation catchments.
- Preliminary evaluation has been conducted to explore the application of physically based erosion models, such as GUEST, to data collected from QFRI-managed soil erosion trials on steep lands planted to hoop pine near Imbil.

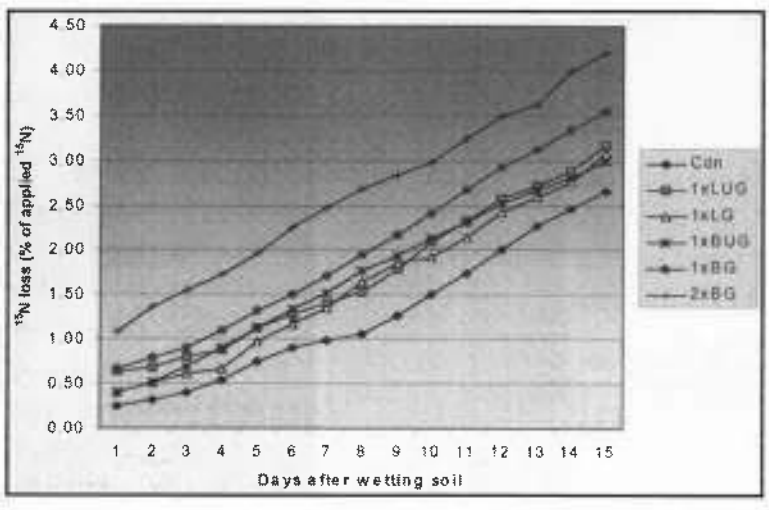


Figure 8
Cumulative daily ^{15}N gas emissions are a measure of denitrification under one-year-old Hoop pine at Amamoor, near Gympie. The treatments are different amounts of residues (L-leaves, B-branches, G-ground, UG-unground, 1x-20 t/ha, 2x-40 t/ha) and a control (no residue). The materials were incorporated into the top 10 cm of soil. The soil was wetted to field capacity and high rainfall simulated by adding further water during the experiment. Note the increase in gas emission (denitrification) with increase in amount of material and after grinding

Goals

- Conduct field experiments to quantify denitrification, immobilisation and leaching of ^{15}N-labelled experiments under different slash (residue) management regimes during winter and summer months in hoop pine plantations.
- Assess the suitability of existing data from long-term catchment studies for incorporation into a predictive model of soil loss from subtropical pine plantation catchments.
- Further develop methodology for characterising soil organic matter quality in hoop pine and exotic pine plantations.
- Estimate the infiltration parameters using the rainfall-runoff model SRM for the site for selected storm events. This model has been successfully applied to a number of ACIAR sites in Australia and south-east Asia. Such rainfall-runoff models would be useful for long-term runoff prediction and design of best management practices.

Project 3

Silvicultural systems

Leader
Chris Beadle

Staff
Mr Paul Adams
Mrs Linda Ballard
Mr Chris Barnes
Dr Philip Brown
Ms Maria Cherry
Mr Keith Churchill
Prof Robert Clark
Mr Dugald Close
Dr Neil Davidson
Ms Amabel Fulton
Ms Sandra Hetherington
Dr Greg Holz
Dr Sarah Jennings
Mr Kelsey Joyce
Prof Peter Kanowski
Mr Sven Ladiges
Dr S Mahendrarajah
Ms Linda Maddern
Ms Jane Medhurst
Prof Robert Menary
Dr Neville Mendham
Mr Peter Naughton
Dr Libby Pinkard
Mr Digby Race
Ms Jackie Schirmer
Dr Chris Shedley
Dr Philip Smethurst
Mr Tim Tabart
Mr Doug Walch
Mr Grant Westphalen
Mr Dale Worledge

Background

The successful establishment and growth of any tree crop relies on the production of seedlings which combine high potential for survival with vigorous growth. This is of particular interest where seedlings must be transferred from the nursery to the relatively harsh environments often used in industrial forestry. The practice of weed management and use of herbicides in forestry has come under increasing pressure from the wider community. A practical response is to minimise herbicide use by suppressing only the primary weeds which affect crop establishment and growth or through the use of non-competing species as cover crops. The production of high value wood products requires longer rotations and additional resource inputs than for pulpwood to ensure that product quality and high growth rates are maintained. Spacing, pruning and thinning systems which are suitable for converting industrial pulpwood plantations to clearwood regimes and for farm forestry will be developed. A small but increasing number of farmers view trees as an integral part of their agricultural output. Promoting the establishment of trees as a commercial crop in the rural landscape will be done by highlighting the benefits and costs of trees on farms from both biological and economic perspectives.

The aims of this project are :

- to provide guidelines for the preparation and management of seedling stock during plantation establishment;
- to develop weed management systems which minimise the use of herbicides, including the use of non-competing species as cover crops;
- to develop pruning, thinning and spacing systems which are suitable for converting industrial pulpwood plantations to clearwood regimes and for farm forestry;
- to assess the benefits and costs of trees on farms, and the real or perceived barriers to the adoption of commercial forestry on part or all of the farm enterprise, and develop an enhanced understanding of the factors which determine regional timber supply.

Outcomes

- A modelling approach was used to examine the importance of physiological responses to pruning in minimising growth losses, and the implications for management. Fifty per cent pruning had no impact on growth because biomass production of the portion of the crown removed was low. Also, at the time of canopy closure trees had a higher leaf area index (LAI, m^2 leaf area/m^2 ground area) than was required for total light interception, and 50%-

pruning had little impact on light interception. Increases in rates of photosynthesis and changes in leaf area / foliage distribution rapidly returned production to the level of unpruned trees. Changes in leaf area / foliage distribution were particularly important following this treatment.

- Whole tree water use in plantation *E. nitens* Deane and Maiden (ex Maiden) and potentially competing A. *dealbata* Link. weeds was estimated by the heat pulse velocity technique. It was shown that the degree of *A. dealbata* infestation was associated with absolute plot water use (Fig. 9).
- It was shown that there was a strong linear relationship between sapwood area and stem diameter and that thinning did not influence this relationship. Thinning increased the leaf area / sapwood area at breast height.
- Weed interference caused a significant and prolonged growth reduction of *E. globulus* after planting. At age 17 months, trees growing in the presence of *Holcus lanatus* (fog grass) had height and diameter up to 70% shorter and up to 80% smaller, respectively, than trees in weed-free plots.
- Tomato (which responds strongly to Cu application) as a test plant was able to successfully distinguish between a soil which led to stem distortion and a soil which led to healthy tree growth of *E. nitens* in the field.
- Irrigation led to lower basic density, longer average fibre length in *E. nitens* and lower coarseness of fibre in *E. globulus*. Irrigation also led to improved strength properties when tested for cold caustic soak (CCS) pulping characteristics.

Goals

- Develop physiological indicators for describing early establishment of eucalypt seedlings in cold environments.
- Measure the competitive impact of weed competition for below-ground resources in eucalypt plantations.
- Determine the effects of thinning on the distribution and activity of canopy processes.
- Provide a physiological basis for fertiliser-induced micronutrient deficiencies.
- Review timber supply modelling approaches.
- Determine if altered microclimate at the edge of clear-felled areas in wet sclerophyll forest results in changes in the composition of the vegetation in this zone.

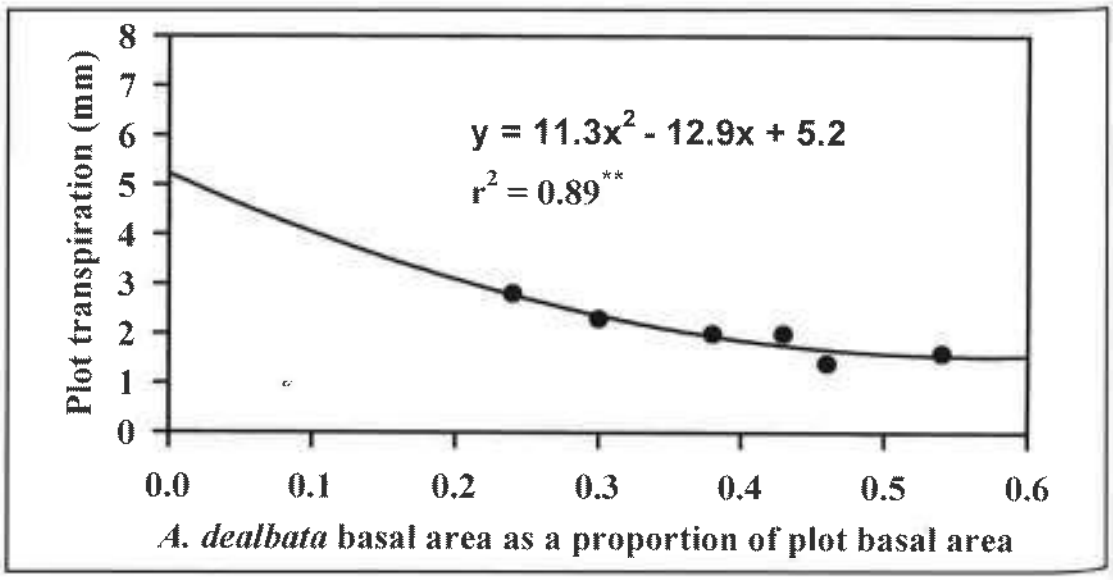


Figure 9
The relationship between plot transpiration and the proportion of *A. dealbata* infestation in a plantation of *E. nitens*.
A decrease in infestation was associated with increasing absolute plot water use.

Project 4

Leader
Dr Peter Sands

Staff
Dr Michael Battaglia
Dr Roger Braddock
Dr David Doley
Mr Mark Hunt
Mr Eric Keady
Dr Rod Keenan
Dr Mark Lewty
Mr Daryl Mummery
Mr Mark Nester
Dr Libby Pinkard
Mr Rob Prydon
Ms Carolyn Raymond
Mr Paul Ryan

Modelling plantation systems

Background

A review of forest growth models according to their intended use highlighted reasons why few process-based models have been applied in forest management, and provided guidelines for the desired structure of models for specific management applications.

The aim of this project is:

- to produce process-based models which enable the productivity and wood quality of plantations to be predicted; which address specific management questions; which have a transparent structure; and for which input data can be readily and cheaply obtained by forest managers.

Outcomes

Work has focused on the extension, application and implementation of PROMOD, the simple model for predicting site productivity of eucalypt plantations described in last year's Annual Report. Additional work has focused on developing methods to obtain the input variables for PROMOD of appropriate levels of accuracy and resolution

- PROMOD was parameterised for *Eucalyptus nitens* and *Pinus radiata* for sites within Tasmania. For independent validation, a data set for *P. radiata* was used and PROMOD predicted peak mean annual increment (MAI) of *P. radiata* with an r^2 of about 0.72.
- The original PROMOD was modified to work under Western Australian conditions of deep and saline soils. This greatly improved the performance of PROMOD for these soils. The results were used to develop criteria used by a CRC partner for assessing site suitability.
- PROMOD was used to explore the response to amount and frequency of irrigation for *E. globulus* grown in semi-arid conditions (Fig. 10):
  - productivity is determined by the frequency of application and how water is allocated to individual applications as well as by total annual irrigation;
  - for each level of total irrigation tested there was a well defined optimum irrigation quantity at which profitability was maximised;
  - a detailed cash-flow analysis of a 25-year rotation saw log production with pulp wood thinnings based on an 8% interest rate showed that trees could compete economically with some agricultural crops.
- A comprehensive analysis of the sensitivity of PROMOD to changes in the structure of the model and to its physiological parameters:
  - showed that further structural simplification of PROMOD leads to a loss of generality;
  - identified a small group of parameters, mainly

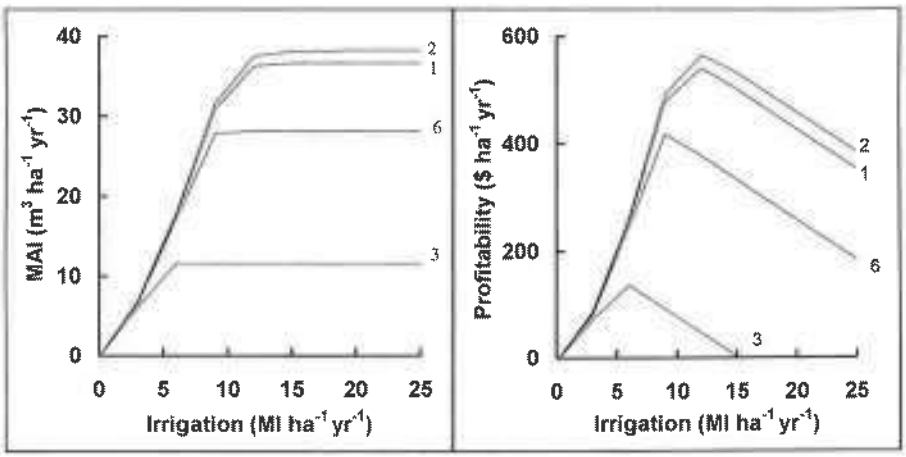


Figure 10
A. Predicted peak Mean Annual Increment (MAI) as a function of total irrigation and the number of times water is applied during November-April at a typical semi-arid site in the Murray-Darling Basin.

B. Predicted profitability as a function of total irrigation and the number of times water is applied during November-April at a typical semi-arid site in the Murray-Darling Basin.

defining photosynthetic production and water use efficiency, which must be determined accurately for new species;

- suggests traits which could be targeted in a breeding program.

- A hybrid of PROMOD and an empirical forest growth model combined the generality and simplicity of the process-based model with the robustness and accuracy of the traditional forest growth model.

- The effect of the quality of site input data on the accuracy of PROMOD productivity estimates was assessed:

  - coarse inputs give poor (r^2=0.11, n=7) growth predictions at the regional scale (10 x 20 km);

  - addition of detailed soils information gives reasonable prediction (r^2=0.69);

  - further addition of soil water distribution based on landscape models gives r^2=0.96.

- A simple mechanistic model to predict closed canopy leaf area index (LAI) of young plantations was developed from the assumption that LAI was an optimal balance between photosynthetic production and respiration.

Goals

- Validate PROMOD for *E. globulus*, *E. nitens* and *P. radiata* against data from outside Tasmania.

- Further develop the user-friendly implementation of PROMOD: include prediction for *E. nitens* and *P. radiata*, and provision for various management options.

- Develop simple empirical relationships for key wood-properties in terms of climatic and silvicultural factors.

- Generate productivity maps for Tasmania for *E. globulus*, *E. nitens* and *P. radiata*, taking soil characteristics into account.

- Develop a process-based model for the dynamics of stand development and demonstrate its application to problems of canopy management.

Resource Protection Program

Manager
Dr Rob Floyd

Introduction

The Resource Protection Program aims to develop a comprehensive understanding of the biology, ecology and impact of a number of key pests (insect and vertebrate) and diseases of eucalypt plantations in temperate Australia, and to develop management techniques and products. Consistent with the principles of sustainable forest management, the knowledge and techniques will be used to minimise the effects of pests and diseases on the quantity and quality of forest products.

The program aims to produce integrated pest management (IPM) strategies for a number of key pests such as the Tasmanian leaf beetles (*Chrysophtharta bimaculata* and *C. agricola*), autumn gum moth (*Mnesampela privata*), Tasmanian pademelon (*Thylogale billardierii*), brushtail possum (*Trichosurus vulpecula*) and Bennett's wallaby (*Macropus rufogriseus*). In addition, the biology, ecology and control of a number of other pest species, including some fungal pathogens, will be studied but will not be sufficiently developed to formulate IPM strategies in the life of this CRC. In some regions, research will focus on establishing the identity and distribution of pest and disease species, as these details are not yet known. Finally, efficient and effective monitoring protocols are being developed for some of these pest and disease species to determine when and whether control actions are necessary.

Project 1

Biology, ecology and economic impact of insect pests

Leaders
Dr Geoff Allen
Dr Rob Floyd

Staff
Mr Dick Bashford
Ms Natasha Beveridge
Mr Stephen Candy
Ms Michelle Court
Dr David de Little
Mr John Dowse
Dr Jane Elek

Background

This project aims to provide a strong foundation of basic research on the biology and ecology of the major insect species across various geographic regions so that IPM strategies can be developed. Particular emphasis in the project is centred upon *Mnesampela privata* (autumn gum moth) across all regions of southern Australia and the leaf beetles *Chrysophtharta agricola* and *C. bimaculata* in Tasmania. Other insect species currently under study include *Acacicola orphana* (fireblight beetle) and *Heteronychus arator* (African black beetle). Areas of research include phenology, host-plant interactions, natural enemies, mating systems, monitoring protocols and impacts on tree growth.

Outcomes

- The critical leaf toughness for neonate larval establishment of *C. bimaculata* across *E. nitens, E. delegatensis* and *E. regnans* has been identified.
- Major factors controlling the phenology of *M. privata* have been determined which identify why populations in elevated areas of Tasmania are active during summer whilst those in lowland areas of Tasmania and mainland Australia are typically active during autumn and winter.
- Studies on the development of the pupal stage of *M. privata* at high temperatures have shown that pre-emergent adult moths can remain dormant for up to two months at temperatures as high as 30°C. This enables adults to delay their emergence in regions with warmer climates until the milder autumn conditions.
- Fieldwork on the geographical distribution of *Acacicola orphana* has been completed, with the insect being located predominantly on *A. dealbata* throughout Tasmania and *A. mearnsii* in Victoria.
- A new insect exclusion trial in three- and four-year-old *E. nitens* plantations was established. Implants of capsules containing a systemic insecticide, acephate, were used to protect selected *E. nitens* and *E. regnans* plantation trees from insect browsing, with mixed results. The capsules appeared to be more effective at protecting older than younger trees.
- A model of impact of leaf area loss on DBH and tree height increment has been developed from the analysis of the effects of artificial defoliation on *E. nitens*.

Staff continued
Dr Humphrey Elliott
Dr Grant Farrell
Mr Bradley Howlett
Dr Marina Hurley
Mr Zoltan Lukacs
Dr John Madden
Ms Linda Maddern
Mr John Matthiessen
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Ms Carolyn Ringrose
Ms Tara Simmul
Dr Martin Steinbauer
Mr Rex Sutherland

Goals

- Refine browsing impact model for *C. bimaculata* on *E. nitens* to include predictions of mortality as a function of leaf toughness, leaf size and age.
- Quantify the growth impact of *C. agricola* and *M. privata* on *E. nitens* and *E. globulus*.
- Establish insect exclusion trials in Gippsland to measure the impact of various insect species on *E. globulus* growth.
- Study the biology, phenology and distribution of *C. agricola*.
- Investigate larval feeding and oviposition of *M. privata* in relation to host species and provenance variation.
- Examine potential triggers involved in the initiation and termination of pupal diapause in *M. privata*.
- Establish developmental temperature thresholds for *A. orphana*.
- Examine the relationship between intraspecific variation in *A. dealbata* and larval survival in *A. orphana*.

Project 2

Insect control techniques and IPM

Leaders
Dr Rob Floyd
Dr Geoff Allen

Staff
Mr Dick Bashford
Ms Natasha Beveridge
Mr Stephen Candy
Ms Michelle Court
Dr David de Little
Mr John Dowse
Dr Jane Elek
Dr Humphrey Elliott
Dr Grant Farrell
Mr Tim Hingston
Dr Marina Hurley
Dr John Madden
Mr John Matthiessen
Dr Richard Milner
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Ms Carolyn Ringrose
Dr Martin Steinbauer
Mr Rex Sutherland

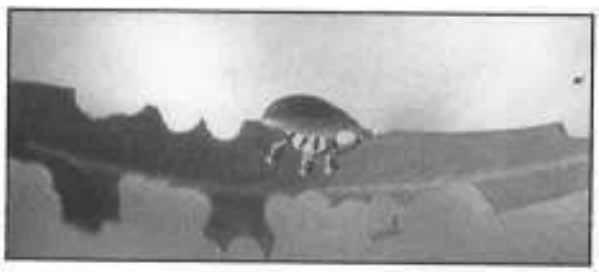
Background

Forest managers are constantly looking for non-chemical options for insect control that are both effective and economically viable. Individual non-chemical control approaches are generally not as efficacious as chemical insecticides and must be used in conjunction with other options in an IPM strategy to achieve adequate control. However, there are very few non-chemical options currently available to managers of eucalypt plantations in temperate Australia. This project will develop a number of control options, including the better use of chemical insecticides, for incorporation into IPM strategies.

Outcomes

- Light traps as early warning systems of potential outbreaks of *M. privata* were investigated by examining past CRC and Tasmanian DPIF records for correlations between outbreaks and light trap catches.
- The optimal sample size for numbers of monitored plots:trees:shoots was reassessed for *C. bimaculata*. Since greatest variation was found between plots, a new monitoring system providing a four-fold improvement in precision for the same cost was developed.
- Preliminary studies aimed at developing efficient and effective surveillance systems in *E. globulus* plantations in Western Australia have been completed. Final statistical analysis is being performed.
- The biological insecticide, Novodor, (active ingredient: *Bacillus thuringiensis* var. *tenebrionis*, Btt) was found to be more efficacious against *C. bimaculata* larvae feeding on *E. regnans* than on *E. nitens* foliage. After spraying with Novodor at 6 litres ha-1, the amount of *E. nitens* foliage eaten by surviving *C. bimaculata* larvae was found to be reduced by two-thirds relative to unsprayed foliage.
- Successful pilot trials augmenting populations of the predatory ladybirds *Cleobora mellyi* and *Harmonia conformis* by mass releasing overwintering adults were carried out to aid control of *C. bimaculata*.

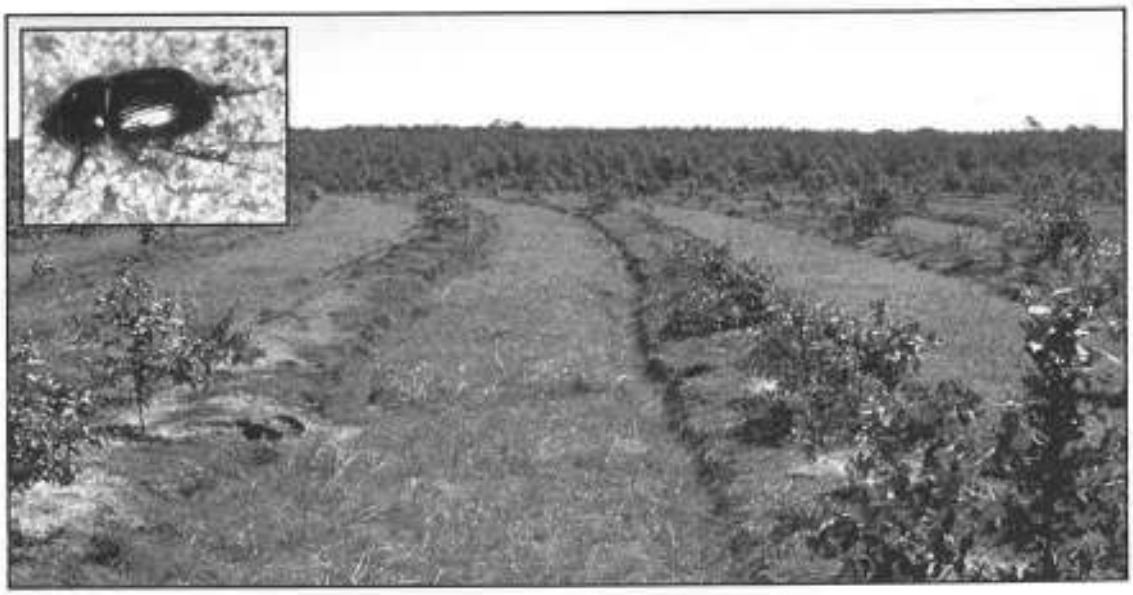
Eucalyptus leaf beetle, *Chrysophtharta bimaculata*.



- Assessment of chrysomelid populations on eucalypts planted adjacent to each other showed that beetles systematically favoured *E. regnans* and *E. delegatensis* species over *E. nitens*. Plots of these 'trap trees' are being established in plantations of industrial partners to act as early warning systems to detect *C. bimaculata* populations.
- High levels of infection (>80%) and subsequent mortality of *C. bimaculata* life stages were achieved under field conditions following ultra low volume spray applications of strains of both *Beauveria* and *Metarhizium* spores formulated in peanut oil.
- A range of strains of *Metarhizium* has been screened in the laboratory for efficacy against early instar *M. privata* larvae. Several strains have been identified that are quite effective at low temperatures.

Goals

- Further refine the chrysomelid monitoring system to include binocular monitoring and use of trap trees as early warning systems for potentially damaging populations.
- Develop a monitoring system to include light trapping for an early warning system for potentially damaging populations of *M. privata*.
- Further develop a sampling protocol for pest and disease surveillance of young *E. globulus* plantations.
- Improve the field performance of the Btt-based insecticide and develop a protocol for its use for controlling chrysomelid populations in eucalypt plantations.
- Assess the importance of natural enemies in controlling chrysomelid populations (*C. bimaculata* and *C. agricola*).
- Develop methods for collecting, holding and manipulating spring beetle so that similar laboratory studies to those commenced on African black beetle in 1997/98 can be performed.
- Conduct studies on the insecticide treatment of seedling *E. globulus* to protect them against damage by African black beetle. The effect of environmental factors, particularly temperature, will be investigated to ensure that management strategies are robust under conditions of heightened insect activity. Aspects of the insect/plant interactions, including the timing of attack of seedlings, will also be investigated.



Gaps in new eucalypt plantation caused by African black beetle killing seedlings.

(Insert) Adult African black beetle, a major establishment pest of eucalypts in south-western Australia.

Project 3

Leader
Dr Clare McArthur

Staff
Mr James Bulinski
Ms Nadia Marsh
Ms Julianne O'Reilly
Mr Stephen Paterson

Resistance of planting stock to vertebrate browsers

Background

A key method for reducing browser damage to eucalypts is through the production of more resistant trees. This should be achievable by the genetic and phenotypic manipulation of those trees. One aim of this project is to investigate both the genetic basis of resistance of eucalypts, and the effects of environment on this resistance. A second aim is to determine whether resistance can be modelled as a function of leaf chemistry, mainly using NIR (near infrared spectroscopy). These aims rely on determining the relative damage to and preferences for various plant types by browsing herbivores. A third aim is to determine the relationship between browsing damage and growth rate. The information will be used to identify resistant genotypes, to develop a rapid method for estimating susceptibility as detected by leaf chemistry, and to predict susceptibility of seedlings as a function of their environment. These three aspects can be incorporated into an overall strategy for predicting and reducing browser damage of eucalypts at plantation establishment.

Outcomes

- In feeding trials, captive (wild-caught) rabbits damaged plantation seedlings more than they ate them, because they often bit the stem off near the base. Rabbits damaged *P. radiata* and *E. globulus* seedlings similarly, and more than *E. nitens* seedlings. No preference (difference in consumption) was detected between leaves of *E. globulus* and *E. nitens*, but stems of *E. globulus* and *P. radiata* were preferred to *E. nitens* stems.
- Damage to *E. nitens* seedlings from different seedlots in the field was, at least partly, a function of seedling size; resulting from different germination and growth potential of different seedlots at time of planting. Impact of damage was lower in larger seedlings.
- Preliminary models were developed, relating NIR characteristics of foliage from genetically-identified *E. globulus*, *E. gunnii* and F_1 hybrids to variation in field susceptibility (r^2=0.88) and captive brushtail possum short-term intakes (r^2=0.84). These models only describe the limited data set from which they were derived.
- An 'acceptable' level of browsing damage to *E. nitens* seedlings in plantations was defined (browsing score less than 0.88 on a scale of 0-5; see Major Development), below which no statistically significant effect on growth rate was detected.

Goals

- Establish the effects of different nursery (environmental) conditions on palatability of eucalypt seedlings to browsers.
- Undertake a preliminary analysis of the genetic basis of palatability of eucalypt seedlings with bioassays.

Clare McArthur with a captive possum used in feeding trials, University of Tasmania, Hobart.

Project 4

Leader
Dr Clare McArthur

Staff
Mr Ian Blanden
Mr James Bulinski
Dr David de Little
Mr Paul Dredge
Mr Miles Lawler
Ms Kirsten le Mar
Ms Nadia Marsh
Mr Stuart Millen
Mr Stephen Paterson
Dr Mick Statham

Strategies to reduce vertebrate browsing damage

Background

This project addresses the problem of reducing browsing damage to seedlings, using characteristics of the environment (whole plantation and its surrounding habitat) as its framework. These environmental characteristics should have a significant influence on the browsers: how many browsers are present, and how they use plantations and other habitats as refuges and feeding areas. Aims are:

- to understand the interaction between browsers and the environment, and the consequences on damage levels to seedlings;
- to investigate the impact of introduced cover crops on browsing of seedlings;
- to develop methods for monitoring damage and predicting risk;
- to design appropriate options to reduce browsing damage through various planting strategies.

Outcomes

- Five months after planting, 84% of seedlings were damaged by browsing on an unpoisoned site, but only 58% were damaged on a poisoned site. Estimated pademelon densities were 97% lower on the poisoned site (0.2 compared with 7.0 animals per hectare), Bennett's wallabies densities were 75% lower (0.3 compared with 1.2 animals per hectare), but possum densities were only 43% lower (0.4 compared with 0.7 animals per hectare), suggesting that possums contributed to much of the damage.
- Observations of severe damage by scarab beetles (*Heteronyx* sp.) over summer indicated the need for frequent, early monitoring in forestry operations to differentiate insect and mammal damage to seedlings.
- Intakes of three native plant species that grow on plantations were compared with *E. nitens* seedlings, using captive pademelons and brushtail possums. Pademelons preferred *Goodenia ovata* to *E. nitens*, tended to eat more foliage of *Cassinia aculeata* than *E. nitens*, but ate almost no *Gahnia grandis*. Possums preferred *E. nitens* to *G. ovata* and *G. grandis*, and tended to eat more *E. nitens* than *C. aculeata*. Possums ate four times the amount of *E. nitens* per individual than pademelons under similar dietary conditions.
- Captive pademelons spent 98% of their feeding time eating cover crop species and only 2% eating *E. nitens* seedlings. No preference for individual cover crop species was detected, using a comparison of 'cropping plus processing' time.
- A very preliminary analysis of radio-tracking data indicated that Bennett's wallabies move greater distances at night than during the day. Dawn and dusk are particularly active times, but they remain within a 2 km radius of the cleared coupe. Pademelons use native forest extensively. They also use grasslands and established plantations. Some go onto the cleared coupe overnight, but others spend all night in the native forest. Possums appear highly variable in their behaviour.
- A relationship between percentage of seedlings damaged and the mean browsing score on a site was described, which can be used to develop effective monitoring systems.
- A descriptive model of severity of damage was developed as a function of possum scat counts (+ve), grass cover (+ve), and fern (mainly bracken) cover (-ve) on plantations (r^2=0.71). Macropod (wallaby and pademelon) scat counts were not useful descriptors.
- A preliminary predictive model of severity of damage was described, using variables that can be obtained before planting (r^2=0.49). The two most important predictive variables were (i) area:perimeter ratio of plantations, and (ii) perimeter

next to cover habitat, followed by characteristics of the cover habitat.

Goals

- Refine two systems for monitoring browsing damage, for use in (i) research, and (ii) operations.
- Determine impact of 1080 poisoning on target and non-target species, including distances travelled from bait line, immediate effects on population sizes, and subsequent increases (or otherwise) in use of a plantation.
- Examine the relationship between vegetation (type and amount growing within 1m² of seedlings) and damage to seedlings by browsers in plantations.
- Compare relative numbers of possums, pademelons and Bennett's wallabies on a eucalypt plantation and surrounding habitat types during their main period of activity (night).

Kirsten le Mar radio tracking herbivores at night at Surrey Hills, NET, northern Tasmania.

Project 5

Leader
Dr Caroline Mohammed

Staff
Ms Karen Barry
Mr Andrew Milgate

Strategies to minimise loss due to fungal attack

Background

The objective of this project is to develop a knowledge base that will allow the development of management tools, to limit the future impact of stem decay fungi and the leaf pathogen *Mycosphaerella*.

Initial studies for better predicting stem decay in plantations focus on the formation, persistence and effectiveness of preformed and responsive barriers in restricting the spread of decay in both regrowth and plantation eucalypts.

In the first year, the priorities for research have been developed. A two-week visit from Dr Ray Pearce from the University of Birmingham, UK in October 1997 greatly assisted in this process. Dr Pearce has been investigating host-pathogen interactions in trees since 1978 and is a world leader in the area of endogenous antimicrobial defences of the sapwood (xylem) tissues and the association of changes in tissue water content, distribution of ions, and the accumulation of phytoalexin-like compounds with the host-pathogen interface. Study of the end-state reaction zone has been the focus of the first year.

The *Mycosphaerella* project has a strong link with geneticists within the Genetic Improvement Program. This study aims at developing a bioassay to screen for resistance to the pathogen, a tool for disease resistance breeding whether by classical or molecular techniques. This has three components: a taxonomical investigation of *Mycosphaerella* species on Tasmanian eucalypt plantations, the production of inoculum suitable for a bioassay and an investigation of inoculation techniques for the bioassay.

Outcomes

- Gravimetric studies of moisture content have indicated that the reaction zone tissue (zones of wood showing evidence of response to exposure to fungal decay) of *E. nitens* has a lower moisture content than adjacent sapwood. This is an extremely interesting result as it contradicts results from other angiosperm reaction zones.
- Analysis has been carried out by proton-induced X-ray emission analysis (PIXE), to determine if there are any mineral elements accumulating in the reaction zone (which would play a role in the osmotic redistribution of water). No disparity across the reaction zone tissue compared to the healthy sapwood was found for a number of mineral elements, including calcium and potassium.
- Methanol extractives from healthy sapwood, reaction zone and decayed tissue have been compared by TLC and HPLC. Comparison of chromatograms indicates that there are many compounds particular to the reaction zone. Analysis of extracts by colorimetry indicates that there is between 3-20 times greater total phenol content in the reaction zone.
- TLC bioassays indicate that substances in the reaction zone extracts at Rf 76 (named fraction F) are inhibitory to fungal growth.
- Study of reaction zone samples by electron spin resonance spectroscopy (ESR) has been carried out to determine if any of the reaction zone polyphenols may be long-lived free radicals. Long-lived free radicals have not been detected.
- A log-store experiment has been initiated to determine the durability of the reaction zone.
- Our knowledge of the taxonomy of *Mycosphaerella* species in Tasmania has increased. Twenty-eight plantation sites were sampled with five *Mycosphaerella* species successfully isolated from 21 sites. At the beginning of the project it was generally thought that there were only two species of importance in the Tasmanian eucalypt plantations, *M. cryptica* and *M. nubilosa*, but results show that there are at least an additional three species found in the plantations. These species are *M. molleriana*, *M. tasmaniensis* and one species whose identity is yet to be confirmed.
- Conidial inoculum from *Mycosphaerella* isolates has been produced.
- Preliminary bioassays have been attempted with *E. globulus*, to test for resistance to *Mycosphaerella*.

Goals

- Gain a better understanding of antimicrobial defence mechanisms in eucalypts and effectiveness in restricting decay.
- Identify factors which are associated with high levels of stem decay in plantations.
- Determine taxonomy and infection biology of *Mycosphaerella*.
- Develop an early screening method to test the resistance of eucalypts to *Mycosphaerella*.

From left, Caroline Mohammed and Karen Barry with stem sections used for research into wood decay, CSIRO FFP, Hobart, Tasmania.

Education and Technology Transfer

Manager
Dr Neil Davidson

Staff
Ms Jane Burrell
Ms Peta Carolan
Prof Robert Clark
Dr David Doley
Prof Robert Henry
Prof Robert Hill
Dr Ryde James
Prof Robert Menary
Prof Jim Reid
Assoc Prof Paul Saffigna
Mr Greg Unwin
Prof Robert White
Dr Robert Wiltshire

Introduction

The Education and Technology Transfer Program coordinates:

- intake of postgraduate students across the three research programs and five university partners in the CRC;
- involvement of CRC staff in education and training;
- transfer of technology from research programs to the industrial partners in the CRC and to small end users of forest technology, particularly farmer groups;
- activities to raise awareness within various sectors of the public of the CRC's research in sustainable forestry;
- development of a CRC ethos.

The principal objectives are:

- to develop a national centre of excellence for post-graduate training with emphasis on training graduates relevant to the industry sector. This includes involving staff from partner organisations in teaching and supervision of university students;
- to publish CRC research to enhance Australia's reputation as a world leader in plantation forestry;
- to rapidly transfer the technology arising from research conducted at the Centre to the industrial partners and other end users;
- to raise community awareness of the CRC's activities and the value to Australia of a sustainably managed forest industry.

Outcomes

Education

- The Centre has 48 PhD, MSc and honours students currently enrolled; eight were attracted from industry, 11 are on scholarships with industry support (APA-I, FFIC, LWRDC), and 10 are on competitive national scholarships (APA, AIDAB). Only nine are supported solely by CRC PhD scholarships (Table 2).
- Two students won awards for their research excellence; Mr Paul Adams won the Maxwell Ralph Jacobs Award for research in forest nutrition ($1200) and Ms Karen Barry won a British Council Scholarship to visit the University of Birmingham to further her research on biochemical and NMR-imaging investigation of antimicrobial defence in young *E. nitens* ($5000).
- Supervision of postgraduate and honours students is widely distributed amongst CRC partner institutions with 24 of the 41 supervisors of honours, MSc and PhD projects being non-university staff (Table 3).
- Seven non-university staff contributed to university courses in fields allied to their research: Dr R Misra (soil physics), Dr N Davidson (physiological plant ecology), Dr M Battaglia (quantitative ecology), Dr P Smethurst (soil and nutrition), Dr B Potts (genetics), Dr C McArthur (vertebrate zoology), Dr Z Xu (soil science). Dr N Davidson coordinates a four-year undergraduate course, 'Forest Ecology', designed for students with an interest in forestry. Dr N Davidson, Dr C McArthur, Dr M Battaglia and Dr C Beadle have also supervised third year students enrolled in a unit entitled 'Plant Science Research' in which students conduct research on a topic in forest ecology.
- Five postdoctoral fellows worked with the Centre in 1997/98: Dr Dorothy Steane in molecular genetics (UTas); Dr Karen Thamarus in molecular genetics (CSIRO Canberra); Dr Martin Steinbauer in entomology (CSIRO Entomology); Dr Mervyn Shepherd in molecular biology (SCU); and Dr Heidi Dungey in forest genetics (QFRI).
- There were three visiting scientists: Prof Tom Whitham (Northern Arizona University, USA) worked in the Genetic Improvement Program on the genetic impacts on dependent pest

CRC Research Students 1997/98

First Name	Last Name	Degree	Funding	Start	Institution	Scientific Supervisors	Topic
Paul	ADAMS	PhD	LWRDC	1996	UT	Dr Mendham, Dr Beadle, Dr Smethurst	Sources of competition from weeds in plantations
Karen	BARRY	PhD	APA-I	1997	UT	Dr C Mohammed	Defence mechanisms against decay in *E. nitens*
Tim	BLUMFIELD	Hons		1998	GU	Dr P Saffigna, Dr Z Xu, Mr I Philips	Residue managment techniques in hoop pine plantations, SE Qld
James	BULINSKI	PhD	CRC	1994	UT	Dr C McArthur	Effect of plantation design on feeding behaviour of wallaby
Peter	BUNDOCK	PhD	APA	1995	UT	Dr R Vaillancourt	Genetic control of cloning ability in *E. globulus*
Steve	CANDY	PhD	FT employee	1993	UT	Dr J Madden, Dr H Elliott	Mathematical models to support IPM of leaf beetles
Paul	CHAMBERS	PhD	APA-I	1995	UT	Dr N Borralho	Quantitative genetics and the economic flow-ons from genetic gains
Dugald	CLOSE	PhD	APA	1997	UT	Dr PBrown, Dr C Beadle, Dr G Holz	Environmental constraints on early growth of seedlings in eucalypt plantations
Dianne	CONNELL	Hons		1998	UT	Dr N Davidson, Dr M Battaglia	Effect of intensity and duration of waterlogging on plantation growth
Greg	DUTKOWSKI	PhD	Tree Geneticist (CRC)	1996	UT	Dr N Borralho, Dr A Gilmour	Improvement of mixed models for prediction of breeding values in forestry and their application
Andrew	HINGSTON	PhD	APA	1998	UT	Dr Brad Potts, Dr Peter McQuillan	Pollination Ecology of *E. globulus* and *E. nitens*
Bradley	HOWLETT	PhD	FFIC	1993	UT	Dr J Madden, Dr A Clarke, Dr P McQuillan	Host location by *Chrysophtharta bimaculata*
Mark	HUNT	PhD	CRC	1994	UT	Dr N Davidson, Dr C Beadle	Competition between understorey species and plantation eucalypts
Peter	KUBE	PhD	FT employee	1996	UT	Dr N Borralho, Ms C Raymond	Breeding objectives for the production of sawtogs from plantation grown *E. nitens* and *E. globulus*
Sven	LADIGES	PhD	CRC	1996	UT	Prof R Menary, Dr C Beadle	Micronutrient deficiencies in eucalypts induced by excess application of N & P
Keith	LAMB	MSc		1997	UT	Prof P Kanowski	Modelling environmental characterisitcs for steep country plantations
Rachel	LAWRENCE	Hons		1998	UT	Dr B Potts, Dr T Witham	Genetic effects on pest loads on eucalypts
Trevor	LEAMAN	PhD	APA	1998	GU	Dr P Saffigna, Dr Z Xu, Mr M Dieters, Mr M Hunt	WUE, S^{13} in plantation forest in SE Qld
Kirsten	LE MAR	PhD	APA	1996	UT	Dr C McArthur, Dr D de Little, Dr M Statham	Comparison of eucalypt plantations use by three herbivorous marsupial species
Gustavo	LOPEZ	MSc	AIDAB	1998	UT	Dr B Potts	The importance of non-additive genetic effects in *Eucalyptus globulus*
Zoltan	LUKACS	PhD	APA	1994	UT	Dr A Clarke, Dr J Madden, Dr R Floyd	Biology of the autumn gum moth
Nicole	MATHERS	PhD	APA-I	1998	GU	Dr P Saffigna, Dr Z Xu, Ms S Berners-Price	C&N dynamics of forest soils using C^{13}, N^{15} & dynamics
Michelle	McGRANAHAN	PhD	APA	1996	UT	Dr N Borralho	Genetic control of propagation ability in *Pinus radiata* and strategies for their use in breeding programs
Jane	MEDHURST	PhD	FFIC	1996	UT	Dr C Beadle, Dr N Davidson	Thinning of *Eucalyptus nitens* stands
Daniel	MENDHAM	PhD	APA-I	1995	UT	Dr P Smethurst, Prof R Menary, Dr G Holz	Process based predictions of nutrient limitations to plants
Andrew	MILGATE	PhD	APA-I	1997	UT	Dr C Mohammed, Dr R Vaillancourt	The genetic basis of resistance to *Mycosphaerella* in *Eucalyptus globulus*
Alexandra	MITCHELL	PhD	CRC	1995	UT	Dr B Potts, Dr R Vaillancourt	Reproductive biology and breeding systems for *E. globulus*
Alicia	MOLLON	Hons		1998	UT	Dr N Davidson, Dr M Battaglia	Strategies of water use amongst eucalypts
Martin	MORONI	PhD	APA-I	1995	UT	Dr P Smethurst, Prof R Menary	Nitrogen mineralisation
Mark	NEYLAND	MSc	FT employee	1998	UT	Dr N Davidson, Dr C Beadle, Dr J Hickey	Alternative silvicultural systems for regenerating native forest
Ross	PEACOCK	PhD	State Forests of NSW	1994	UT	Dr N Davidson, Dr M Brown, Prof R Hill	Regeneration after cable logging
Nina	PRASALOVA	PhD		1997	GU	Dr P Saffigna, Dr Xu	Water use efficiency of hoop pine
David	PROCTOR	Hons		1997	UT	Dr C McArthur	Interactions between cover crops and marsupial browsers
Digby	RACE	PhD	CRC employee	1998	ANU	Dr P Kanowski	Economic aspects of farm forestry development in regional Australia
Jackie	SCHIRMER	Hons		1998	ANU	Prof P Kanowski	Socio-economics of farm forestry in N.E. Tas
Leon	SCOTT	PhD	CRC	1998	SCU	Dr M Shepherd, Prof R Henry	Molecular genetics of hoop pine
Yetty	SETIAWATTI	PhD	AIDAB	1997	UQ	Prof D Doley, Dr M Dieters	Reproductive biology of hoop pine
Tara	SIMMUL	PhD	APA-I	1996	UT	Dr A Clarke	Biology of the fire blight beetle
Rhonda	STOKOE	PhD	CRC	1998	SCU	Dr M Shepherd, Prof R Henry	Molecular analysis of *Eucalyptus cloeziana*
Paulina	TEIXEIRA	PhD	CRC	1993	UT	Dr R Misra	Soil structure and erosion in eucalypt plantations
Peter	VOLKER	PhD	Serve-Ag employee	1992	UT	Dr B Potts, Dr N Borralho	Estimation of genetic parameters for eucalypt hybrids
Doug	WALCH	MSc		1997	ANU	Prof P Kanowski	Benefits of different designs of shelter belts in farm forestry
Tim	WARDLAW	PhD	FCT employee	1994	UT	Dr C Mohammed, Dr G Kile	*Armillaria* butt and root rot of eucalypts
Xianming	WEI	PhD	AIDAB	1994	UT	Dr N Borralho	Efficiency of selection in eucalypts
Grant	WESTPHALEN	PhD	CRC	1996	UT	Dr M Brown, Dr N Davidson	Indicator species for sustainability in native forest systems
Dean	WILLIAMS	PhD	CRC	1996	UT	Prof J Reid, Dr B Potts	Reproductive biology of *Eucalyptus nitens*
Steve	WILSON	PhD	APA-I (TFRC)	1993	UT	Prof R Clarke, Mr P Volker	Early growth and survival of eucalypt seedlings
Danielle	WISEMAN	Hons		1998	GU	Dr P Saffigna, Dr Z Xu, Mr I Philips	Stand nutrient dynamics of hoop pine plantations

Table 3 Summary of student enrolments in the CRC

Number of Students			Funding	
Full/PartTime:	Full Time	40	CRC (PhD/MSc Scholarship)	9
	Part Time	8	APA with CRC top up	7
			APRA - Industry	8
Degree	Hons	7	FFIC	2
	MSc	3	AIDAB	3
	PhD	38	Employed in forest industry	8
			LWRDC	1
CRC Programs	Genetic Improvement	15	Self-supporting	3
	Sustainable Management	23		
	Resource Protection	10		

Supervisors

Dr M Battaglia CSIRO FFP	2	Dr G Holz NET	2	Dr M Statham DPIF	3
Dr C Beadle CSIRO FFP	6	Prof P Kanowski ANU	4	Dr R Vaillancourt Plant Sci UT	3
Dr N Borralho CRC	6	Dr G Kile CSIRO FFP	1	Mr P Volker ANM	1
Dr P Brown Ag Sci UT	1	Dr J Madden Ag Sci UT	3	Prof T Whitham N. Arizona Univ	1
Dr M Brown Forestry Tas	2	Dr C McArthur CRC	3	Dr M Shepherd CRC	2
Prof R Clark Ag Sci UT	1	Dr P McQuillan Geography UT	2	Prof R Henry SCU	2
Dr A Clarke UQ	3	Dr R Misra CRC	1	Dr D Doley UQ	1
Dr N Davidson CRC	7	Dr C Mohammed Ag Sci UT	3	Dr M Dieters QFRI	2
Dr D de Little NET	1	Prof R Menary Ag Sci UT	3	Dr P Saffigna GU	5
Dr H Elliott Forestry Tas	1	Dr N Mendham Ag Sci UT/CSIRO	1	Dr Z Xu QFRI	5
Dr R Floyd CSIRO Ento	1	Dr B Potts CRC	6	Dr S Berners-Price GU	1
Mr J Hickey Forestry Tas	1	Ms C Raymond CSIRO FFP	1	Mr M Hunt QFRI	1
Dr A Gilmour NSW Ag	1	Prof J Reid Plant Sci UT	1	Dr I Philips GU	2
Prof R Hill Plant Sci UT	1	Dr P Smethurst CSIRO FFP	3		

communities (January to June 1998), Dr Peter Minchin (University of Melbourne) worked in the Genetic Improvement Program applying quantitative methods to problems in forest ecology (April to July 1998), Dr Ray Pearce (Birmingham University, UK) worked with Caroline Mohammed in the Resource Protection Program on fungal decay organisms in eucalypts (July to August 1997).

Dr Peter Minchin (front), CRC Visiting Scientist, University of Tasmania, Hobart with Dr Brad Potts (at rear)

Technology transfer

- In the last year the program ran 25 seminars, 14 workshops, seven short courses and field days and produced 20 technical publications (Tables 4 and 5).
- The program produced 74 research papers in refereed journals, 39 unrefereed articles and nine theses.

Major events designed to meet sectoral needs:

- Two books were produced this year: 'Sampling plantation eucalypts for wood and fibre properties' addresses concerns on how to assess trees for wood properties; and 'Vegetation of Tasmania', an undergraduate text on Tasmanian plant ecology. A Technical Report Series was established for the Centre this year and nine have been produced so far. Topics ranged from 'Pollinators of *E. globulus*' to 'Slash management in temperate eucalypt plantations'.
- Two symposia were held, one on 'Genetics and Breeding of *Eucalyptus globulus*', in Hobart (November 1997), the other entitled 'Blue Gums for the Future', in Perth WA (December 1997). These symposia provided a summary of current knowledge in *E. globulus* genetics for CRC industrial partners and other end users. Each attracted national interest and 40 to 50 delegates.
- A workshop on 'Application of the site productivity model PROMOD' was held at Ridgley in June 1998. PROMOD has been well received by industry and is now widely used.
- Farm Forestry Fact Sheets were produced on six subjects; Matching species to sites, Site preparation, Planting, Weed control, Fertilisers, Control of browsing animals. These were produced for Private Forests Tasmania for distribution to farmers.
- Three open days (21, 22 and 29 August) on 'Introduction to radio-tracking research on marsupial herbivores in eucalypt plantations', held at Ridgley and Surrey Hills, were run for North Eucalypt Technologies staff, the public, and ANU forestry students, and attracted a total of 90 participants. This research is responding to substantial community and industry concern about the magnitude of browsing damage and its control.

Public awareness

- The project 'Women in Forest Science' was launched by the Acting Chancellor of the University of Tasmania, Ms Kim Boyer, at the University Centre. The launch was to an invited audience of approximately 50 against a backdrop of a photographic display of women foresters and their work. The aim of the project is to present positive role models of women in forestry to school children to change traditional perceptions. The project is funded through a grant of $26,400 from the Science and Technology Awareness Program.
- Displays depicting the work of women foresters were presented at the Landcare Conference (November 1997) and Agfest (May 1998).

- Drafts were developed for 24 teaching kits on forestry for schools, years 6-9 (10- to 15-year-olds), which demonstrate the importance to Australia of technological advancement in the forestry sector, and depict new research arising from the CRC.
- National Treefest sponsorship ($6400) was obtained to conduct a series of six farm forestry workshops on farms in Tasmania. The workshops will be conducted in collaboration with Greening Australia and Private Forests Tasmania.
- In the last year there have been nine articles in newspapers and industry news sheets, and four items in the electronic media relating to the Centre (see Public Relations).
- The World Wide Web site for the CRC is being upgraded and will be managed with assistance from Ann Single of QFRI.
- Because of problems experienced within the national ANZAAS organisation, the 1998 ANZAAS Conference on 'Sustainability of Southern Ecosystems' proposed for Tasmania was cancelled.

Goals

- Run a series of six farm forestry workshops in August 1998.
- Run a meeting of all CRC staff at Burnie, Tasmania in October 1998.
- Run a symposium on 'Molecular Genetics of Eucalypts' in Hobart in February 1999.
- Run an international conference on 'Advances in research on carbon and nutrient cycling in production forests' on the Gold Coast in August 2000.
- Complete the upgrade of the CRC-SPF web site.
- Complete booklet, web site and trial school kits for 'Women in Forest Science' project.
- Complete and trial 24 school worksheets on forestry for grades 6-9.

Visiting Scientist, Prof Tom Whitham and research assistant Randy Swaty from the Dept of Biological Sciences, Northern Arizona University, worked on the genetic impacts of dependent pest communities, University of Tasmania.

Table 4 Technology Transfer activities conducted in 1997/98

Date	*Function*	*Topic*	*Reach*	*Pgm.*	*Time (days)*
July 1997	Workshop	Farm Forestry in Australia: Landholders decision to adopt	30	SM	1
July 1997	Meetings (monthly)	Wild Animal Management Group	100	RP	10
July 1997	Beyond the Black Stump	Research outcomes (Michael Battaglia)	100	SM	
Aug. 1997	Hot off the Seedbed	Research outcomes (Nuno Borralho)	150	GI	
Aug. 1997	Open day (Ridgley)	Radio tracking marsupial herbivores in eucalypt plantations	90	RP	3
Sept. 1997	Open day (Hamilton)	Insect mediated rural tree decline	30	RP	1
Oct. 1997	Research Working Group	RWG on soils at Ridgley also visited CRC research sites in Florentine	37	SM	2
Oct. 1997	Workshop (WA)	Forest entomology research priority setting	20	RP	2
Nov. 1997	Symposium (Hobart)	Genetics and breeding of *E. globulus*	50	GI	2
Nov. 1997	Display	Landcare conference (CRC was Bronze sponsor)	250	ETT	3
Nov. 1997	Book	Sampling plantation eucalypts for wood and fibre properties	500	GI	
Nov. 1998	Workshop	Brainstorming session for school kits	12	ETT	1
Dec. 1997	Symposium (Perth)	Blue Gums for the Future	40	GI	1
Dec. 1997	'Overstorey'	Staff news	200	ETT	
Dec. 1997	Workshop (Hobart)	Communication workshop	40	ETT	1
Dec. 1997	Workshop (Gympie)	Communication workshop	15	ETT	1
Dec. 1997	Hot off the Seedbed	Research outcomes (Dean Williams, Brad Potts)	150	GI	
Dec. 1997	Workshop (WA)	Forest entomology needs and development of a regional approach	40	RP	1
Dec. 1997	Seminar (CRC Hobart)	Summary outcomes from the IUFRO Conference in Brazil	30	GI/SM	1
Jan. 1998	Seminar (NET Ridgley)	Summary outcomes from the IUFRO Conference in Brazil	15	GI/SM	1

Date	*Function*	*Topic*	*Reach*	*Pgm.*	*Time (days)*
Feb. 1999	Book	Vegetation of Tasmania	1000	ETT	
Feb. 1998	Hot off the Seedbed	Research outcomes (Dean Williams, Brad Potts)	150	GI	
Feb. 1998	Beyond the Black Stump	Research outcomes Libby Pinkard	100	SM	
Feb. 1998	Workshop	Data management (Emlyn Williams)	5	SM	1
March 1998	Hot off the Seedbed	Research outcomes (Dean Williams, Brad Potts)	150	GI	
March 1998	Beyond the Black Stump	Research outcomes (Peter Sands)	100	SM	
March 1998	Workshop (ANM)	Report on FWPRDC fungal pathogen project for Tasmanian industry partners	14	RP	1
April 1998	Farm Forestry Fact Sheet	1. Matching species to sites 2. Site preparation 3. Planting 4. Weed Control 5. Fertilisers 6. Controlling browsing by mammals	500 500 500 500 500 500	SM SM SM SM SM RP and SM	
April 1997	Beyond the Black Stump	Research outcomes (Peter Sands)	100	SM	
April 1998	Seminars (Forestry Tas)	Talks on entomology to students	18	RP	1
April 1998	Workshop (Manjimup)	Results from surveillance methods development project	30	RP	1
April 1998	Workshop	Fitting ASREML to our forestry problems (Arthur Gilmour)	10	GI	1
May 1998	Launch	Women in Forest Science	50	ETT	1
May 1998	Open day	Discovery day at University of Tasmania	180	ETT	1
May 1998	Display	Agfest (a rural expo) Women in Forest Science	200	ETT	4
May 1998	Hot off the Seedbed	Research outcomes (René Vaillancourt)	150	GI	
June 1998	Technical Report Series	Nine technical reports produced in this series	50	all	
June 1998	Workshop (Ridgley)	Slash management	38	SM	1
June 1998	Workshop (Hobart)	Application of the site productivity model PROMOD	41	SM	1

Table 5. Technology Transfer Activities proposed for 1998/99

Date	*Function*	*Proposed activity*	*Reach*	*Pgm.*	*Time (days)*
July 1998	Workshop (Gympie)	Application of the site productivity model PROMOD	15	SM	1
July 1998	Workshop	Farm forestry in Australia; understanding landholders'decision to adopt	30	SM	1
Aug. 1998	Workshops	Present six farm forestry workshops	220	ETT	6
Oct. 1998	Annual Meeting	Meeting of all CRC staff to develop cross-program and cross-institutional links	180	ETT	3
Feb. 1999	International Symposium	Molecular genetics of eucalypts	100	GI	2
May 1999	Display	CRC display at Agfest	200	ETT	4
Feb. 2000	International Conference	Breeding hybrid trees for the future	100	GI	6
Aug. 2000	International Conference	Advances in research on carbon and nutrient cycling in production forests	400	SM	4

Back row: Trevor Leaman, Tim Blumfield, Russell Haines and Ron King
Front row: Nicole Mathers, Paul Saffigna and Danielle Wiseman in front of their award-winning 'Discovery Day' display at Griffith University, Brisbane, Qld

Utilisation and Application of Research

Strategy for the Technology Transfer Program

Research conducted in the CRC-SPF is managed to achieve a preset list of deliverables which have associated time-lines for achievement. (A deliverable is an outcome of a research program in a form that can be readily adopted and used by industry). The deliverables are set through consultation with the Program Coordinating Committees (PCC) and achievement of deliverables is assessed by the PCCs and reported to the Advisory Panel and the Board. Since the deliverables are considered commercial-in-confidence information they are listed in Appendix 1 which has a restricted distribution.

The principal objective of the Technology Transfer Program is to rapidly transfer the technology to the industrial partners and other end users. This involves the following:-

Involvement of industrial partners in planning research projects and running experiments

Most CRC research is conducted using company trials or trials established on company land. Companies therefore are involved at the outset with the planning and implementation of research projects and have ownership of them. Research plans for these experiments are lodged with the companies, and these include an agreed protocol for the research. The company partners allocate staff time (in-kind contributions) to CRC research projects so effective interaction can occur. The Program Coordinating Committees of the CRC retain an overview of these research projects and can support, reject or modify any research program.

Early transfer of results

The early transfer of results starts with informal interactions (telephone, facsimile, electronic mail and visits to company sites). Formal transfer commences with a faxed summary of the applications of recent research on an A4 page entitled 'Hot off the Seedbed' (Genetic Improvement Program) or 'Beyond the Black Stump' (Sustainable Management Program). Company responses then determine whether to organise a seminar, workshop, short course or field day on the topic. Later stages of transfer are through technical reports, unrefereed papers and refereed journal papers.

The Manager of the STBA national eucalypt breeding program is located with the CRC in Hobart, allowing a close working relationship with Genetic Improvement staff and the rapid transfer of results.

Development of training courses in modern forestry techniques for company staff and other end users of CRC research

- Technical training courses run by the CRC this year included: the *E. globulus* symposium (Hobart and Perth) which summarised CRC research to date on genetics of *E. globulus*; the PROMOD workshop (Hobart and Gympie) which presented the developments in modelling of eucalypt and pine growth in relation to site characteristics; and the Slash Management workshop (Ridgley) which discussed current best practice in slash management.
- Technology transfer also occurs through the training of CRC postgraduates. Recent PhD graduates transfer new technology to their employers. There are five company staff enrolled in PhD and MSc while still employed: Mr Tim Wardlaw (Forest Pathologist, Forestry Tasmania), Mr Steve Candy (Statistician, Forestry Tasmania), Mr Peter Kube (Tree Breeder, Forestry Tasmania), Mr Peter Volker (Manager, ANM), Mr Ross Peacock (Research Scientist, Dept Planning, NSW). Three resigned their positions to conduct research but intend returning to industry: Mr Greg Dutkowski, (Research Manager, Bunnings), Mr Paul Adams (SA Dept Primary Industry), Ms Jane

Medhurst (Forestry Tasmania). Eleven of our students are supported by industry scholarships (APA-I, FFIC, LWRDC) (Table 2).

- The success of our students in obtaining employment in the forest industry was demonstrated this year by the following appointments: Dr Heidi Dungey (Geneticist, QFRI), Mark Hunt (Silvicultural Officer, QFRI), Natalie Papworth (Scientific Collections Officer, Royal Tasmanian Botanical Gardens), Dr Libby Pinkard (Silvicultural Officer, Forestry Tasmania), Daniel Mendham (Research Scientist, CSIRO Forestry, WA); Dr Martin Steinbauer (Postdoctoral fellow, CRC-SPF with CSIRO Entomology, Canberra).

Industrial Uptake

In each program there have been new technologies developed which have been transferred to industrial partners and other end users. The principal end users are listed in Table 6.

Genetic Improvement Program

- The recently developed racial classification for *E. globulus* has been evaluated by the STBA for inclusion in their prediction of breeding values.
- Following workshops and tutorial sessions, the software used extensively by the CRC for variance component estimation and breeding value prediction (ASREML) is being increasingly used by tree breeders.
- Greg Dutkowski is part of the STBA data management committee which is designing the information systems for the STBA.
- RAPD markers identified as useful by the CRC have been used to determine the identity of mis-labelled grafts in the STBA *E. nitens* breeding program.
- Experience of CRC staff has been used to develop designs for realised genetic gain trials for the STBA *E. globulus* and *E. nitens* breeding programs.
- Most industrial partners have implemented the sampling recommendations from Project 5 Wood Quality. There has been a large amount of domestic and international interest in wood sampling methods following the release of the wood sampling book.
- Industrial partners are currently testing new controlled pollination procedures developed by the CRC for *E. globulus*.

Sustainable Management Program

- Removal of 40% of green crown in first-lift pruning has been adopted as an appropriate standard by Forestry Tasmania, provided that growth rates are rapid and pruning is timed to coincide with canopy closure. Pruning prescriptions are being refined using models developed by the CRC.
- Fertilising with nitrogen fertiliser between one to three years of age, to coincide with the peak demand for nitrogen during canopy development, has been adopted by North Forest Products, Australian Paper Plantations and Boral Timber Tasmania.
- The soil solution methodology has been adopted by the School of Agricultural Science at the University of Tasmania.
- State-wide productivity maps produced with ProMod were used in the Tasmanian RFA process.
- Bunnings Treefarms is selecting plantation sites using guidelines developed with ProMod.
- North Forests Tamar has used ProMod to screen sites for plantation suitability and is currently using ProMod to screen steep sites on private land.
- North Eucalypt Technologies is using ProMod to assess the efficacy of the Permanent Sample Plot Network.
- Private Forestry Tasmania has requested that ProMod be included in a decision support system being developed as a farm forestry tool, and an interface has been developed to suit this requirement.
- Statistical advice and modelling provided by this

program has been incorporated into publications by CRC participants.

- Expertise within the program has been used to produce technical information sheets for distribution to farmers by Private Forests Tasmania.

Resource Protection Program

- The small scale planting of *E. regnans* as 'trap trees' in plantations of *E. nitens* has been attempted as part of the integrated pest management (IPM) strategy developed for *Eucalyptus* leaf beetle *(Chrysophtharta bimaculata)* for the forestry industries in Tasmania. The use of *E. regnans* in this capacity has been based on casual field observations of greater damage to *E. regnans* versus *E. nitens*. Recently, the application of insect-eucalypt interaction and leaf development theory to research has provided an explanatory model for why this practice is successful. Research has shown that *E. regnans* is more prone to damage by virtue of the greater quantity of soft leaves available to beetles in comparison to *E. nitens*. These research findings have wider relevance to forest insect population dynamics throughout Australia, enabling potential risk scenarios to be highlighted prior to their onset.
- Studies on coreid biogeography have highlighted where different *Amorbus* species are likely to occur and will have relevance to future plantation establishment in other regions.
- Comparison of formulations of *Beauveria* and *Metarhizium* spores in oil applied to *C. bimaculata* eggs and larvae as an ultra-low-volume spray was made under field conditions. Strains of the former genus proved the most effective under the average daily temperature regime of 15°C. However, the potential use of fungi to control target pest populations was limited by the time-lag between spore application and death of infected hosts. Applications to late second instar hosts still resulted in continued feeding until just prior to death. Consequently the reduction of defoliation to sub-economic levels could only be assured by targeting the egg and first instar stages. The window of opportunity to control by this method is too small to provide the essential reliability for economic control and the project has been terminated.

Participants in the symposium on 'Genetics and breeding of *Eucalyptus globulus*' held in Hobart, November 1997

Table 6: List of end users of technology

End user (CRC partners)	Research Program
Australian Newsprint Mills	all programs
Australian National University	all programs
Australian Paper Plantations	all programs
Bunnings Treefarms	all programs
Boral Timber Tasmania	all programs
CSIRO	all programs
Forestry Tasmania	all programs
Australian Forest Growers	all programs
Griffith University	all programs
North Forests Products	all programs
Queensland Forestry Research Institute (PIC Qld)	all programs
Silvagene*	Genetic Improvement
Southern Cross University	all programs
Southern Tree Breeding Association	Genetic Improvement
The University of Queensland	all programs
University of Tasmania	all programs
End user (other end users)	
Private Forests Tasmania*	all programs
Greening Australia*	all programs
Serve-Ag*	all programs
Tasmanian Farmers and Graziers Association*	all programs
Private landholders (farmers and treegrowers)*	all programs

** Small to medium sized enterprise (SME)*

Staffing and Administration

Staffing

As might be expected, there has been substantial change in staff of the CRC as research directions have shifted from those of the CRC for Temperate Hardwood Forestry to those of the CRC for Sustainable Production Forestry.

Research staff who left the CRC were Dr Rabi Misra (root scientist), Dr Allie Muneri (wood scientist), Dr Jean-Noel Ruaud (tissue culture) and technicians Ann LaSala, Jason Lawson, Scott Pepper, Tova Ducker, Linda Ballard, Stuart Millen, Joanne Dingle, Miles Lawler and Stuart Skabo. Several PhD students have finished their PhD and/or moved on to other employment; Bruce Greaves, Daniel Mendham, Mark Hunt, Libby Pinkard, Kristen Williams, Nadia Marsh, Steven Wilson, Xianming Wei, Paulina Teixeira and Susan Lennon. It is always sad to see people go and we wish them well in their new endeavours.

To balance this, we have had a large number of new staff starting with the Centre, right across Australia. Corrine Condie was appointed as Business Manager, Administration, Hobart. The following appointments were made at the University of Tasmania: Dr Geoff Allen (Lecturer, Insect Ecology), Dr Marina Hurley (Lecturer, Entomology), Amabel Fulton (Lecturer, Farm Sociology), and technicians Ruth Osborne and Alex Bradley. CSIRO Entomology and CSIRO Forestry and Forest Products, Canberra appointed Dr Karen Thamarus (Postdoctoral Fellow, Molecular Genetics), Dr Martin Steinbauer (Postdoctoral Fellow, Entomology) and technician Kylie Groom (Molecular Genetics). At Southern Cross University in Lismore, Dr Mervyn Shepherd (Postdoctoral Fellow, Molecular Biology) and Michael Cross (technician) were appointed. At ANU in Canberra Mr Digby Race was employed to conduct research in Farm Forestry while enrolled in a PhD. At QFRI in Gympie, Dr Heidi Dungey commmenced a post doctoral position in Forest Genetics, and Mark Hunt was appointed Senior Scientist in Silviculture.

On 23 March 1998 the Centre received a visit from Dr Geoffrey Vaughan (Chairman of the CRC Review Committee), Ms Kate Jones (representative of the CRC Secretariat) and Dr Peter Nelson (Centre Visitor). This 'Pastoral Visit' was to assess our success in establishing management structures for the new Centre. The visit was very positive and led to a glowing report on our progress (see below).

Administration

The number of meetings held by the Board and other committees during 1997-98, were as follows:

Board of Management	3
Management Committee	10
Program Coordinating Committees	
Genetic Improvement	2
Sustainable Management	2
Resource Protection	2

SPECIFIED PERSONNEL

Title and Name	Contributing Organisation	% of total time in CRC	Role in Centre
Prof James Reid	University of Tasmania	50%	Director
Dr Russell Haines	Primary Industries Corporation (QFRI)	50%	Deputy Director
Dr David de Little	North Forest Products Limited	30%	Chair, Advisory Panel
Dr Nuno Borralho	University of Tasmania	100%	Program Manager, Genetic Improvement
Dr Chris Beadle	CSIRO Forestry and Forest Products	80%	Program Manager, Sustainable Management
Dr Robert Floyd	CSIRO Entomology	50%	Program Manager, Resource Protection
Dr Neil Davidson	University of Tasmania	100%	Program Manager, Education and Technology Transfer

First Year Visit

Introduction

The First Year Visit to the CRC for Sustainable Production Forestry (CRC-SPF) took place on 23 March 1998 at the University of Tasmania.

The Centre was established following a successful application in the Fifth Selection Round. The Centre is a 'new' Centre, building on the excellent record of the First Round CRC for Temperate Hardwood Forestry. The Centre now has research interests well beyond the temperate zone and involves new core participants with interests in both hardwoods and softwoods.

The core participants of the joint venture are:
Universities: University of Tasmania*, Southern Cross University, Griffith University.

Industry: Forestry Tasmania* (State GBE), Primary Industries Corporation Queensland (State GBE), North Forest Products*, Australian Paper Plantations*, Australian Newsprint Mills*, Bunnings Treefarms*.

Government: CSIRO (Divisions of Forestry and Forest Products*, and Entomology).
(* core participants of the original CRC)

There are also three supporting participants (ANU, University of Queensland, and the original core partner, Boral Timber) and three associates (Australian Forest Growers, Southern Tree Breeding Association, and Silvagene).

The visiting Panel was comprised of:
Dr Geoff Vaughan (Chair), Dr Peter Nelson (Centre Visitor) and Ms Kate Jones (CRC Secretariat).

The Centre was represented by:
Mr John Kerin, Board Chair; Prof Jim Reid, Director; Dr Nuno Borralho, Program Manager, Genetic Improvement; Dr Chris Beadle, Program Manager, Sustainable Management; Dr Rob Floyd, Program Manager, Resource Protection; Dr Neil Davidson, Program Manager, Education and Technology Transfer and Ms Corrine Condie, Business Manager.

The Centre has made an excellent start due to both the experience gained in the original Centre and through the leadership shown by the Board and the Director. It was obvious to the Panel that the Centre will meet the expectations of the Fifth Round Selection Panel which were based on a number of perceived strengths of the application, including:

- that the application was submitted by a Centre with an excellent track record;
- the strong networking of the participants;
- that users were heavily involved;
- that very strong education and training programs had been established;
- the direct collaboration with plantation growers involving extensive field work.

The Centre prepared a comprehensive brief in preparation for the visit. The report of the Visitor's annual assessment based on a visit to the Centre on 27 October 1997 was also extremely helpful.

Cooperative Arrangements

The Centre now has a complex structure with the membership shown above. The core, supporting and associate membership comprises:

- 5 universities
- 2 CSIRO divisions
- 2 state enterprises
- 8 industry partners.

These 17 participants are widely spread and create a new challenge for cooperation and collaboration compared to the initial Centre which was mainly Tasmanian based.

However, the Director and Board have put structures in place to meet the challenge and ensure that the cooperation will take place in accordance with CRC objectives. There are excellent relationships between the research partners and the industry partners, and these will underpin cooperation across the Centre as a whole.

The Board has emphasised the need for cooperation across the Centre in four key documents which have been prepared with input from all stakeholders:

- Strategic Plan 1997-2000
- Business Plan 1997/8-1998/9
- Communication Plan 1998
- Education and Technology Transfer Plan 1997-1998.

All of these plans identify strategies to ensure cooperation at all levels and in all areas of activity.

A key feature of the management structure is the role of the Program Coordinating Committees for each research program. The committees are chaired by industry representatives and rotate meetings across states.

Extensive cooperative arrangements also involve local and overseas organisations.

The Centre's brief listed a number of approaches that have been successfully adopted to foster collaboration across CRC sites and to involve staff and students at all levels in cooperative activities that increase collaboration and the integration of activities.

Research and Researchers

The research activity is conducted across three Programs; Genetic Improvement, Sustainable Management, Resource Protection.

The Centre has developed a comprehensive set of research deliverables that have been approved by the Program Coordinating Committees and the Centre Board. The research deliverables are listed in the Strategic Plan, and there is a bi-annual reporting system to monitor progress. A number of research outcomes have already been achieved since the new Centre commenced its wider activities and these were well summarised in the Centre brief prepared for the visit.

The outstanding research teams involve more than 80 research staff from the research providers and industry partners.

Application of Research

The application of research will be in the areas of breeding, silviculture, and pest management. The strong involvement of industry in the Centre allows for rapid technology transfer and a strong focus for the application of research.

Commercial benefits have already resulted from the previous Centre which have been calculated at $10 million over 20 years of plantation growth, leading in the medium to long term to a reduction of wood cost of $40 per tonne each year. These benefits coming from better solutions in breeding programs were a major reason for the increase in the number of participants in the new Centre. This has now led to several other organisations showing an interest in joining the Centre.

The Centre has identified the need for its research to be both relevant and accessible to industry in the several management plans listed above and has identified strategies for this purpose.

The application of research is also catered for through appropriate seminars, workshops, conferences and related extension and training activities.

Education and Training

The emphasis of the education program has been on postgraduate research training with 42 PhD, MSc and honours students currently enrolled, with 10 students on scholarships with industry. Students are co-supervised with industry supervisors whenever possible. The strong industry focus has resulted in recent graduates readily gaining employment.

Scholarships have been established from CRC funds for students at all three core participating universities. Other scholarships have been provided by industry or have been obtained in open competition.

The CRC is involved in undergraduate training with staff updating and restructuring forestry courses at the participating universities. Non-university staff also contribute to teaching.

The Centre also contributes to school science activities by producing school kits, conducting workshops, and encouraging women to take up forestry as a career.

Specialist training has been mentioned previously under application of research.

The Education and Technology Transfer Program is led by an enthusiastic program manager who had put in place an excellent education program in the original Centre. His role, and that of his assistant, is well

defined in the Strategic Plan with expected outcomes that have been further developed in detail in the Centre's Education and Technology Transfer Plan.

The plan lists objectives, strategies and activities to ensure that the Centre offers a broadened and innovative program to meet the needs of all stakeholders and raise community awareness in the CRC and in forest science.

Management and Budget

The Centre, operating as a joint venture, is headed by a strong Board under the leadership of an independent Chair. The Board includes the Director and Deputy Director as members and has further members coming from each core participant organisation. The Chair of the Advisory Panel is also a member of the Board.

The Advisory Panel is chaired by an active researcher from an industry core partner and includes the Chairs of the Program Coordinating Committees along with three external independent expert advisers coming from the academic sector. The Advisory Panel provides scientific and technical advice and evaluation to the Director and Board.

A Management Committee supports the Director in the day-to-day running of the Centre by implementing the policies of the Board. (The Program Coordinating Committees were discussed in an earlier section.)

Full details of the management structure and Board, Panel and Committee memberships were provided in the Centre brief.

The Board determines Centre policy, strategic direction and priorities. It has set guidelines for the very effective management and operation of the Centre. As indicated above the Board has prepared and published a new Strategic Plan and complementary plans for business, communication and education. It is pleasing to see how quickly these were put in place and reflects positively on the maturity, experience and achievements of the original Centre.

An outcome of these plans has been a set of management and budget systems covering:

- triennium program budgeting;
- monthly reporting of financial accounts;
- quarterly reporting of in-kind contributions of partner organisations;
- annual external audit of the full financial accounts;
- annual client satisfaction audits;
- approval, monitoring, and quarterly reporting of research deliverables;
- documentation, monitoring and quarterly reporting on IP;
- quality control and approval of papers for publication;
- approval for commercial activities;
- key account management systems.

The Centre has detailed staffing procedures which recognise the procedures of the respective employment agency. Induction of staff is facilitated by a Staff and Student Handbook.

The Centre has developed a comprehensive public relations program. The major events were listed in the Centre brief and covered research seminars, industry liaison and extension, landcare activities, open days, workshops, community consultation, field days, and an extensive schools program. Newsletters at the Centre and program level are published regularly.

The management and business team is highly committed to ensuring the successful operation of the Centre and is continuing the excellent reputation established in the original Centre.

Conclusion

There is little to say other than to compliment the Centre on its activities to date and on the very sound start it has made as a new Centre involving new research and industry partners.

Any fears that the Centre has taken on too much through extending its geography and its areas of interest are of no concern. The Board and the Director have set strategies and priorities to see that the activities are highly focussed and outcome orientated against preset and agreed 'deliverables'.

The Panel is confident that the Centre will continue the high level of achievement reached to date and will do everything possible to respond to the expectations of the Fifth Round Selection Committee.

Publications

Genetic Improvement

Books and major reviews

Downes GM, Hudson IL, Raymond CA, Dean GH, Michell AJ, Schimleck LR, Evans R and Muneri A (1997). Sampling plantation eucalypts for wood and fibre properties. CSIRO Publishing, Melbourne. 132pp.

Potts BM and Wiltshire RJE (1997). Eucalypt genetics and genecology. In 'Eucalypt Ecology: Individuals to Ecosystems'. (Ed. J. Williams and J. Woinarski), pp. 56-91. (Cambridge University Press: Cambridge.)

Refereed Publications

Araújo JA, Sousa R, Lemos L and Borralho NMG (1997). Estimates of genetic parameters and prediction of breeding values for growth in *Eucalyptus globulus* combining clonal and full-sib progeny information. Silvae Genetica **45**, 223-226.

Chambers PG and Borralho NMG (1997). Importance of survival on short-rotation tree breeding programs. Canadian Journal of Forest Research, **27**, 911-917.

Chambers PGS, Potts BM and Tilyard P (1997). The genetic control of flowering precocity in *Eucalyptus globulus* ssp. *globulus*. Silvae Genetica **46**, 207-214.

Dieters MJ, Nikles DG, Toon PG and Pomroy P (1997). Genetic parameters for F_1 hybrids of *Pinus caribaea* var. *hondurensis* with both *P. oocarpa* and *P. tecunumanii*. Canadian Journal of Forest Research **27**, 1024-1031.

Dungey HS, Potts BM, Carnegie AJ and Ades PK (1997). *Mycosphaerella* leaf disease: Genetic variation in damage to *Eucalyptus nitens*, *E. globulus* and their F_1 hybrid. Canadian Journal of Forest Research, **27**, 750-759.

Greaves BL, Borralho NMG and Raymond CA (1997). Breeding objective for plantation eucalypts grown for production of kraft pulp. Forest Science **43**, 465-472.

Greaves BL, Borralho NMG and Raymond CA (1997). Assumptions underlying the use of economic weights - are they valid in breeding for eucalypt kraft pulp? Forest Genetics **4**, 35-42.

Greaves BL, Borralho NMG, Raymond CA, Evans R and Whiteman P (1997). Age-age correlations in and relationships between basic density and growth in *Eucalyptus nitens*. Silvae Genetica **46**, 264-270.

Hardner CM, Potts BM and Gore PL (1998). The relationship between cross success and spatial proximity of *Eucalyptus globulus* ssp. *globulus* parents. Evolution **52**, 614-618.

Lemos L, Carvalho A, Araújo JA and Borralho NMG (1997). Short Note - Importance of additive genetic and specific combining ability effects for rooting ability of stem cuttings in *Eucalyptus globulus*. Silvae Genetica **46**, 307-308.

MacDonald AC, Borralho NMG and Potts BM (1997). Genetic variation for growth and wood density in *Eucalyptus globulus* ssp. *globulus* in Tasmania. Silvae Genetica **46**, 236-241.

Muneri A (1998). Kraft pulping properties of *Acacia mearnsii* and *Eucalyptus grandis* grown in Zimbabwe. South African Forestry Journal **179**, 13-19.

Muneri A and Balodis V (1997). Determining fibre coarseness of small wood samples for *Acacia mearnsii* and *Eucalyptus grandis* using Kajaani FS200 fibre analyser. Appita **50**, 405-408.

Nesbitt KA, Potts BM, Vaillancourt RE and Reid JB (1997). Fingerprinting and pedigree analysis in *Eucalyptus globulus* using RAPDs. Silvae Genetica **46**, 6-11.

Raymond CA (1997). Flowering biology, genetics and tree breeding. Book chapter in 'Black Wattle and its Utilization: Abridged English Edition' (Eds: AG Brown and Ho Chin Ko). Rural Industries Research and Development Corporation, RIRDC Publication No. 97/72. pp 18-27.

Raymond CA and MacDonald AC (1998). Where to shoot your pilodyn: within tree variation in basic density in plantation *E. globulus* and *E. nitens* in Tasmania. New Forests **15**, 205-221.

Raymond CA, Volker PW and Williams ER (1998). Provenance variation, genotype by environment interactions and age-age correlations for *Eucalyptus regnans* on nine sites in south eastern Australia. Forest Genetics **4**, 235-251.

Searle SD, Owen JV, Williams ER and Raymond CA (1998). Variation in frost tolerance within two provenances of *Acacia mearnsii* De Wild. Australian Forestry **61**, 1-6.

Sorio F and Borralho NMG (1998). The genetics of resistance of *Phoracantha semipunctata* attack in *Eucalyptus globulus* in Spain. Silvae Genetica **46**, 365-369.

Steane DA, Byrne M, Vaillancourt RE and Potts BM (1998). Complex interspecific interactions in *Eucalyptus*: evidence from the chloroplast. Australian Biologist **11**, 39-46.

Steane DA, Byrne M, Vaillancourt RE and Potts BM (1998). Chloroplast DNA polymorphism signals complex interspecific interactions in *Eucalyptus* (Myrtaceae). Australian Systematic Botany **11**, 25-40.

Tyson M, Vaillancourt RE and Reid JB (1998). Determination of clone size and age in a mallee eucalypt using RAPDs. Australian Journal of Botany **46**, 161-172.

Wei X and Borralho NMG (1997). Genetic control of wood basic density and bark thickness and their relationship with growth traits in *Eucalyptus urophylla* in south east China. Silvae Genetica. **46**, 245-249.

Wei X and Borralho NMG (1998). Use of mixed model to account for mortality and selective thinning when estimating genetic parameters. Forest Science. **44**, 246-253.

Wiltshire RJE, Potts BM and Reid JB (1997). The genetic control of reproductive and vegetative phase change in the *Eucalyptus risdonii/E. tenuiramis* complex. Australian Journal of Botany **46**, 45-63.

In Press

Borralho NMG and Dutkowski GW (1998). Comparison of rolling front and discrete generation breeding strategies for trees. Canadian Journal of Forest Research, **28**.

Dutkowski GW and Potts BM (1998). Geographic patterns of genetic variation in *Eucalyptus globulus* ssp. *globulus* and a revised racial classification. Australian Journal of Botany **46**.

Gea L, Mc Connochie R and Borralho NMG (1998). Genetic parameters for growth and wood density traits in *Eucalyptus nitens* in New Zealand. New Zealand Journal of Forestry Science **27**.

Greaves BL, Borralho NMG, and Raymond CA (1998). Early selection for kraft pulp in plantation eucalypts. New Forests.

Prasad NS and Dieters MJ (1998). Genetic control of growth and form in early-age tests of *Casuarina equisetifolia* in Andrah Pradesh, India. Forest Ecology and Management.

Raymond CA, Banham P and MacDonald AC (1998). Within tree variation and genetic control of basic density, fibre length and coarseness in *Eucalyptus regnans* in Tasmania. Appita.

Raymond CA and Muneri A. (1998) Non-destructive sampling of *Eucalyptus globulus* and *E. nitens* for wood properties. 1. Basic density. Wood Science and Technology.

Raymond CA, Muneri A and MacDonald AC (1998). Non-destructive sampling for basic density in *Eucalyptus globulus* and *E. nitens*. Appita.

Schimleck LR, Michell AJ, Raymond CA and Muneri A (1998). Assessment of the pulpwood quality of standing trees using near-infrared spectroscopy. Journal of Near Infrared Spectroscopy.

Shepherd M and Henry R (1998). Monitoring of fluorescence during DNA melting as a method for discrimination and detection of PCR products for varietal identification. Molecular Breeding.

Skabo S, Vaillancourt RE and Potts BM (1998). Fine-scale genetic structure of *Eucalyptus globulus* ssp. *globulus* forest revealed by RAPDs. Australian Journal of Botany, **46**.

Vaillancourt RE, Skabo S, and Gore P (1998). Fingerprinting for quality control in breeding and deployment. Australian Forestry.

Wei X and Borralho NMG (1998). Genetic control of growth traits in *Eucalyptus urophylla* in south east China. Silvae Genetica. **47**.

Unrefereed publications

Araújo JA, Lemos L, Ferreira JG and Borralho NMG (1997). The RAIZ *Eucalyptus globulus* breeding program: a BLUP rolling-front strategy with a mixed clonal and seedling deployment scheme. In 'Silviculture and Improvement of Eucalypts', Vol 1, pp 371-376. Proc. IUFRO Conf., Salvador, Brazil, 24-29 August, 1997, EMBRAPA.

Borralho NMG (1997) Seed orchards or cuttings: which is the best? In 'Silviculture and Improvement of

Eucalypts', Vol 1, pp 330-335. Proc. IUFRO Conf., Salvador, Brazil, 24-29 August, 1997, EMBRAPA.

Chambers PL, Borralho NMG, Banham PW and Cox RE (1997). Impact of wood selection traits on a thermo-mechanical pulping system using *Pinus radiata* to produce newsprint, pp. 155-159. Proceedings of IUFRO '97 Genetics of Radiata Pine, Rotorua, New Zealand, 1-4 December 1997 (FRI Bulletin No. 203).

Dieters MJ and Nikles DG (1998). Predicting the performance of the *Pinus elliottii* var. *elliottii* x *P. caribaea* var. *hondurensis* hybrid in Queensland. In Proc. 6th World Congress on Genetics Applied to Livestock Production, Armidale, NSW Australia, January 11-16, 1998 . Vol. 27. Animal Genetics and Breeding Unit, University of New England, Armidale. pp. 495-498.

Dieters MJ and Nikles DG (1997). The genetic improvement of Caribbean pine (*Pinus caribaea* Morelet) - building on a firm foundation. In Proc. 24th Southern Forest Tree Improvement Conference, Orlando, FL., June 10 - June 12, 1997 . University of Florida, Gainesville, Fl. pp. 20.

Dutkowski GW, Potts BM and Borralho NMG (1997). Revised racial classifiaction of *Eucalyptus globulus* ssp. *globulus* and the importance of including race in analysis of progeny trials. In 'Silviculture and Improvement of Eucalypts', Vol 1, pp 323-329. Proc. IUFRO Conf., Salvador, Brazil, 24-29 August, 1997, EMBRAPA.

Harwood CE, Nikles DG, Pomroy PC and Robson KJ (1997). Genetic improvement of *Eucalyptus pellita* in north Queensland, Australia. In 'Silviculture and Improvement of Eucalypts', Vol 1, pp 219-226. Proc. IUFRO Conf., Salvador, Brazil, 24-29 August, 1997, EMBRAPA.

McGranahan MF, Borralho NMG, Greaves GL and Whiteman PH (1997). Estimates of variances and heritiabilities, and genetic correlations between propagule types, for growth and form in seedlings and cuttings of *Pinus radiata*. Pp 125-128. Proceedings of IUFRO '97 Genetics of Radiata Pine, Rotorua, New Zealand, 1-4 December 1997 (FRI Bulletin No. 203).

Powell M, Borralho NMG, Wormald N and Chow E (1997). What-X - A program to optimise selection and mate allocation in tree breeding. In 'Silviculture and Improvement of Eucalypts', Vol 1, pp 427-432. Proc. IUFRO Conf., Salvador, Brazil, 24-29 August, 1997, EMBRAPA.

Confidential Reports

Vaillancourt RE and Skabo S (1998). Fingerprinting *E. nitens* ramets using RAPD. Confidential report submitted to the Southern Tree Breeding Association (STBA) and to Forestry Tasmania.

Black P, Vaillancourt RE and Potts BM (1998). *Eucalyptus globulus* inter-race diallel 1997. Report No. 9, CRC for Sustainable Production Forestry.

Hingston A and Potts, BM (1998). 'A pictorial catalogue of insects collected from flowers of *Eucalyptus globulus* subsp. *globulus* in eastern Tasmania. Technical Report No. 5, CRC for Sustainable Production Forestry.

Jordan G, Dutkowski GW, Potts BM, MacDonald AC, Tilyard P and Borralho NMG (1998). 'Review of genetic parameters from five NFP base population trials of *E. globulus*' Technical Report No. 6, CRC for Sustainable Production Forestry.

Sustainable Management

Refereed Publications

Battaglia M and Sands PJ (1997). Modelling site productivity of *Eucalyptus globulus* in response to climatic and site factors. Australian Journal of Plant Physiology **24**, 831-850.

Battaglia M and Sands PJ (1998). Process-based forest productivity models and their application in forest management. Forest Ecology and Management **102**, 13-32.

Cromer RN, Balodis B, Cameron D, Garland CP, Rance S and Ryan P (1998). *Eucalyptus grandis* fertilizer trials: growth, wood properties and kraft pulp yield. Appita J. **51**, 45-49.

Misra RK (1997). Maximum axial growth pressures of the lateral roots of pea and eucalypt. Plant Soil **188**, 161-170.

Misra RK, Turnbull CRA, Cromer RN, Gibbons AK and LaSala AV (1998). Below- and above-ground growth of *Eucalyptus nitens* in a young plantation. I. Biomass. Forest Ecol. Manage. **106**, 283-293.

Misra RK, Turnbull CRA, Cromer RN, Gibbons AK, LaSala AV and Ballard LM (1998). Below- and above-ground growth of *Eucalyptus nitens* in a young plantation. I. Nitrogen and phosphorus. Forest Ecol. Manage. **106**, 295-305.

Pinkard EA and Beadle CL (1998). Effects of green pruning on growth and stem shape of *Eucalyptus nitens*. New For. **15**, 107-126.

Pinkard EA, Beadle CL, Davidson NJ and Battaglia M (1998). Photosynthetic responses of *Eucalyptus nitens* (Deane and Maiden) Maiden to green pruning. Trees **12**, 119-129.

Teixeira PC and Misra RK (1997). Erosion and sediment characteristics of cultivated forest soils as affected by the mechanical stability of aggregates. Catena **30**, 119-134.

Turnbull CRA, Beadle CL, McLeod R and Cherry ML (1997). Clearing with excavators and nitrogen fertiliser increases the yield of *Eucalyptus nitens* in plantations established on a native forest site in southern Tasmania. Aust. For. **60**, 109-115.

Wang XJ, Smethurst PJ and Holz GK (1998). Nitrogen fluxes in surface soils of 1-to 2-year-old eucalypt plantations in Tasmania. Aust. J. Soil Res. **36**, 17-29.

Warren CR, Hovenden MJ, Davidson NJ and Beadle CL (1998). Cold hardening reduces photoinhibition of *Eucalyptus nitens* and *E. pauciflora* at frost temperatures. Oecologia **113**, 350-359.

In press

Battaglia M, Cherry ML, Beadle CL, Sands PJ and Hingston A (1998). Leaf area index prediction in eucalypt plantations: accommodating the effects of water stress and temperature. Tree Physiol.

Battaglia M and Sands PJ (1998). Application of sensitivity analysis to a model of *Eucalyptus globulus* plantation productivity. Ecological Modelling.

Hovenden MJ and Warren CR (1998). Photochemistry, energy dissipation and cold-hardening in *Eucalyptus nitens* and *E. pauciflora*. Aust. J. Plant Physiol.

Hunt MA and Beadle CL (1998). Whole-tree transpiration and water-use partitioning between *Eucalyptus nitens* and *Acacia dealbata* weeds in a short-rotation plantation in northeastern Tasmania. Tree Physiol.

Mummery D, Battaglia M, Beadle CL, Turnbull CRA and McLeod R (1998). An application of terrain and environmental modelling in a large-scale forestry experiment. Forest Ecol. and Manage.

Pinkard EA and Beadle CL (1998). Regulation of photosynthesis of *Eucalyptus nitens* (Deane and Maiden) Maiden following green pruning. Trees.

Pinkard EA and Beadle CL (1998). Above-ground biomass partitioning and crown architecture of *Eucalyptus nitens* (Dean and Maiden) Maiden following green pruning. Can. J. For. Res.

Pinkard EA, Battaglia M, Beadle CL and Sands PJ (1998). Impact of physiological responses to green pruning on net biomass production of *Eucalyptus nitens* (Deane and Maiden) Maiden. Tree Physiol.

Smethurst PJ, Line MA and Moroni MT (1998). Soil microbial biomass and activity in two plantation soils after fertilization. Tasforests.

White DA, Beadle CL, Worledge D, Honeysett J and Cherry M (1998). The influence of drought on the relationship between leaf and conducting sapwood area in *Eucalyptus globulus* and *Eucalyptus nitens*. Trees.

Unrefereed Publications

Battaglia M (1998). Matching species to sites. Farm Forestry Technical Information Sheet No 5. Level 2. Private Forests Tasmania.

Beadle CL (1997). Dynamics of leaf and canopy development. In 'Management of soil, water and nutrients in tropical plantation forests' (EKS Nambiar and AG Brown, eds). ACIAR, Canberra. pp 169-212.

Beadle CL (1998). Planting. Farm Forestry Technical Information Sheet No 16. Level 2. Private Forests Tasmania.

Beadle CL, Banham PW, Worledge D, Russell SL, Hetherington SJ, Honeysett J and White DA (1997). Irrigation increases growth and improves fibre quality of *Eucalyptus globulus* and *Eucalyptus nitens*. Proceedings IUFRO Conference on Silviculture and Improvement of Eucalypts Volume 4, p 155.

Boardman R, Cromer RN, Lambert MJ and Webb M (1997). Forest plantations. In 'Plant analysis and interpretation manual' (DJ Reuter and JB Robinson, eds). CSIRO Publishing, Melbourne, Australia.

McArthur C and Beadle CL (1998). Browsing damage to seedlings. Farm Forestry Technical Information Sheet No 18. Level 2. Private Forests Tasmania.

Smethurst PJ (1998). Slash management in temperate eucalypt plantations: a mini-review. CRC Sustainable Production Forestry. Technical Report No. 1.

Smethurst PJ (1998). Fertilisers. Farm Forestry Technical Information Sheet No 17. Level 2. Private Forests Tasmania.

Teixeira PC and Misra RK (1997). Measurement and prediction of nitrogen loss due to erosion of forest soils. Proceedings of the IUFRO Conference on silviculture and improvement of eucalypts, Volume 4 Environmental and social impacts of eucalypt plantations, pp 161-165. Salvador, Brasil. 24-29 August 1997.

Resource Protection

Refereed publications

Candy SG (1997). Growth and yield models for *Eucalyptus nitens* plantations in Tasmania and New Zealand. Tasforests **9**, 35-50.

Candy SG and Gerrand A (1997). Comparison of financial returns from sawlog regimes for *Eucalyptus nitens* plantations in Tasmania. Tasforests **9**, 167-198.

Clarke AR, Zalucki MP, Madden JL, Patel VS and Paterson SC (1997). Local dispersion of the *Eucalyptus* leaf beetle, *Chrysophtharta bimaculata* (Coleoptera: Chrysomelidae), and implications for forest protection. Journal of Applied Ecology **34**, 807-816.

Congdon BC, Lange CL and Clarke AR (1997). Geographical variation and gene flow in the *Eucalyptus* defoliating beetle *Chrysophtharta bimaculata* (Coleoptera: Chrysomelidae). J. Appl. Ecol **34**, 1287-1292.

Crous PW, Wingfield MJ, Mohammed C and Yuan ZQ (1998). New foliar pathogens of *Eucalyptus* from Australia and Indonesia. Mycological Research 102, 527 - 532.

Elek JA (1997). Assessing the impact and exploring options for managing leaf beetles in eucalypt plantations. Tasforests **9**, 139-154.

Li H, Madden JL and Potts BM (1997). Variation in leaf waxes of Tasmanian *Eucalyptus* spp. 1. Subgenus *Symphyomyrtus*. Biochem. System. Ecol. **25**, 631-657.

McArthur C and Turner S (1997). Feeding preferences of captive brushtail possums for eucalypt and acacia foliage. Tasforests **9**,155-162.

Steinbauer MJ (1997). Notes on *Psaltoda moerens* (Germar) (Hemiptera: Cicadidae) in Tasmania. Aust. Ent. **24**, 169-171.

Steinbauer MJ (1997). The incidence and relative abundance of *Amorbus obscuricornis* (Westwood) and *Gelonus tasmanicus* (Le Guillou) (Hemiptera:

Coreidae) in southern Tasmania and their performance on selected *Eucalyptus* species. Aust. J. Zool. **45**, 631-649.

Steinbauer MJ (1998). Seasonal fluctuations in body weight, lipid content and the starvation-longevity of *Amorbus obscuricornis* (Westwood) and *Gelonus tasmanicus* (Le Guillou) (Hemiptera: Coreidae). Aust. J. Entomol. **37**, 90-96.

Steinbauer MJ, Clarke AR and Madden JL (1998). Oviposition preference of a *Eucalyptus* herbivore and the importance of leaf age on interspecific host choice. Ecol. Entomol. **23**, 201-206.

In press

Baker SC, Elek JA and Candy SG (1998). The food consumption and utilization, development time, and mortality of immature leaf beetles, *Chrysophtharta bimaculata* (Coleoptera: Chrysomelidae) on *Eucalyptus nitens* and *E. regnans* foliage. Agricultural and Forest Entomology.

Beveridge N and Elek J (1998) Effects of a bioinsecticide, *Bacillus thuringiensis* var. tenebrionis, on the predator, *Chauliognathus lugubris* (F.) (Coleoptera: Cantharidae). Australian Journal of Entomology.

Bulinski J and McArthur C (1998). An experimental field study of the effects of mammalian herbivore damage on *Eucalyptus nitens* seedlings. Forest Ecology and Management.

Clarke AR (1998). Day-degree estimates for the immature stages of *Chrysophtharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae). Aust. Entomol.

Clarke AR, Paterson SC and Steinbauer MJ (1998). Larval trapping as a means of sampling *Paropsina* (Coleoptera: Chrysomelidae: Chrysomelinae) from *Eucalyptus* forests. Col. Bull.

Clarke AR, Paterson SC and Pennington P (1998). *Gonipterus scutellatus* Gyllenhal (Coleoptera: Curculionidae) oviposition on seven naturally co-occurring *Eucalyptus* species. Forest Ecology and Management **95**.

Clarke AR, Shohet D, Patel VS and Madden JL (1998). Overwintering sites of *Chrysophtharta bimaculata* (Olivier) (Coleoptera: Chrysomelidae) in commercially managed *Eucalyptus obliqua* forests. Aust. J. Entomol. **37**.

Foley WJ, Iason GR and McArthur C (1998). Role of plant secondary metabolites in the nutritional ecology of mammalian herbivores - how far have we come in 25 years? Book Chapter in: Proceedings for the International Herbivore Conference.

Matthiessen JN and Learmonth SE (1998). Seasonally contrasting activity of African black beetle, *Heteronychus arator* (Coleoptera: Scarabaeidae): implications for populations, pest status and management. Bulletin of Entomological Research 88.

Ramsden N and Elek J (1998). The life cycle and development rate of *Chrysophtharta agricola* (Coleoptera: Chrysomelidae) on *Eucalyptus nitens* at two temperature regimes. Australian Journal of Entomology.

Steinbauer MJ and Clarke AR (1998). Field observations of dispersion, mating and development of *Amorbus obscuricornis* (Westwood) (Hemiptera: Coreidae). Australian Journal of Entomology. 37.

Steinbauer MJ, Clarke AR and Paterson SC (1998). The influence of coppiced and non-coppiced eucalypts on the foraging behaviour and development of *Amorbus obscuricornis* (Westwood) (Hemiptera: Coreidae). Bulletin of Entomological Research.

Unrefereed publications

Boland J, Davison E, Dyer R, Floyd R, Lawrence S, Maddern L, Mutzig S, Shedley C and Speijers J (1998). Surveillance and monitoring of *Eucalyptus globulus* plantations in the south west of Western Australia. Phase 1 Development of surveillance method. Curtin Consulting Services, 64 pp.

Bulinski J (1998). Can we predict vertebrate browsing damage in Tasmanian eucalypt plantations? 11th

Australian Vertebrate Pest Conference. Promaco Conventions Pty Ltd (publisher), pp. 255-257.

Elek JA (1998). Assessing the impact of insect defoliation on plantation eucalypts. Proceedings of the International Congress of Forest Insect Pests, August, 1997, Pucon, Chile.

Elek JA, Beveridge N and Ramsden N (1998). To Bt or not to Bt: Is a *Bacillus thuringiensis*-insecticide suitable for IPM to control leaf beetles in eucalypt plantations. Proceedings of the Sixth Applied Entomological Research Conference, September, 1998, Brisbane, Australia.

Floyd RB (1998). Insect pests of temperate eucalypt and acacia plantations in Australia. Proceedings of the Workshop on Insect Threats to Eucalypt and Acacia Plantations. Bogor, 1997.

Floyd RB and Raymond CA (1998). Insect resistance of *Eucalyptus* species in Australia. In Proceedings of the International Workshop of Forest Pest Management. Pucon Chile, 1997.

Floyd RB, Farrow RA, Farrell GS and Court MM (1998). Insect feeding on *Acacia mearnsii* in south-east mainland Australia. Proceedings of the Third International Acacia Workshop, Hanoi, 1997.

McArthur C (1998). Using diet selection as a tool for reducing herbivore browsing damage to seedlings in forestry. 11th Australian Vertebrate Pest Conference. Promaco Conventions Pty Ltd (publisher). ISBN 1 86308 067 8, pp. 259-261.

McArthur C and Beadle C (1998). Browsing damage to seedlings. Farm Forestry Technical Information Sheet No. 18, Level 2. Cooperative Research Centre for Sustainable Production Forestry, Private Forests Tasmania, DPIF, p. 6.

Milner R and Floyd RB (1998). Development of a mycoinsecticide to control autumn gum moth. CSIRO Entomology, Technical Report No 77.

Wang H, Floyd RB, Farrow RA, Gao C, Lin C, Ren H, Farrell GS and Xu T (1998). Insect damage on *Acacia mearnsii* in China. Proceedings of the Third International Acacia Workshop, Hanoi, 1997.

Theses completed

Jackson H (1997). Chloroplast DNA variation in *Eucalyptus globulus*. Honours, University of Tasmania.

Kelly C (1997). An examination of the natural variation and genetic control of relative bark thickness in *Eucalyptus globulus* ssp *globulus*. Honours, University of Tasmania.

Marrison M (1997). Importance of islands as refuges for regeneration of pencil pine, *Athrotoxis cupressoides*. Honours, University of Tasmania.

Marsh N (1998). Browsing of *Eucalyptus* seedlings by marsupial herbivores. PhD, University of Tasmania.

Papworth N (1997). Germination niche for dry scelerophyll eucalypts. Honours, University of Tasmania.

Teixeira P (1998). Erosion and nitrogen loss from forest soils in relation to soil structure. PhD, University of Tasmania.

Wei X (1998). Genetic evaluation of *Eucalyptus urophylla* for pulp produciton in southeast China. PhD, University of Tasmania.

Williams K (1998). Predicting eucalypt distributions in Tasmania. PhD, University of Tasmania.

Wilson S (1998). Water stress to transplanted *Eucalyptus regnans* and *Eucalytus nitens* seedlings. PhD, University of Tasmania.

Communication

Public Presentations

Note: Some public presentations appear in unrefereed publications, where conference proceedings are published.

Genetic Improvement

Milgate AW, Yuan ZQ, Vaillancourt RE, Powell MB and Mohammed C (1997). *Mycosphaerella* species associated with leaf blotch of *Eucalyptus globulus* and *Eucalyptus nitens* in Tasmanian plantations. Proceedings of the 11th Biennial Conference of the Australasian Plant Pathology Society, Perth, WA, 29 Sept. - 2 Oct., 1997.

Mitchell AG, Potts BM and Vaillancourt RE (1997). Allozyme variation in *Eucalyptus globulus* ssp. *globulus*. Poster presented at the Opening Symposium of the Centre for Biodiversity and Evolutionary Biology, 12 July 1997.

Moran, GF (1997). Towards molecular breeding of forest trees for quantitative traits. Invited paper. Genetics Society of Australia Annual Conference, September 1997, Perth.

Potts BM, Vaillancourt RE, Skabo S and Hardner CM (1997). Fine scale genetic structure of *Eucalyptus* forests. Presented at the Opening Symposium of the Centre for Biodiversity and Evolutionary Biology, 12 July 1997.

Raymond CA and Greaves BL (1997). Developing breeding objectives for kraft and cold soda soak (CCS) pulping of eucalypts. CTIA/IUFRO International Wood Quality Workshop on "Timber management toward wood quality and end-product value". Quebec City, Canada. 18-22 August, 1997.

Reid JB (1998). Participant in a symposium entitled Forest Biotechnology - 2020 Vision at Shell International Renewable, East Malling, UK, June 1998

Schimleck LR, Michell AJ and Raymond CA (1997). Assessment of the pulpwood quality of standing trees using near-infrared spectroscopy. 8th International Conference on Near-Infrared Spectroscopy. Essen, Germany, September, 1997.

Steane DA (1997). Complex interspecific interactions in *Eucalyptus:* evidence from chloroplast DNA. Poster presented at Advances in Plant Molecular Systematics, International Meeting of the Systematics Association and the Linnean Society. University of Glasgow, Scotland, UK. 13-15 August 1997.

Steane DA (1997). Complex interspecific interactions in *Eucalyptus:* evidence from chloroplast DNA. Poster presented at Systematics - First Biennial International Conference of the Systematics Association, St. Anne's College, Oxford, England, UK. 19-21 August 1997.

Sustainable Management

Battaglia M and Sands PJ (1998). Application of sensitivity analysis to a model of *Eucalyptus globulus* plantation productivity. Presented at MODSIM 97, International Congress on Modelling and Simulation, 8-11 December, Hobart.

Kile GA, Booth TH, Cromer RN, Marcar N, Myers BJ and Polglase PJ (1998). The role of plantations and farm forests in sustainable land management. In 'Boosting international competitiveness in Australian timber and forestry'. AIC Conference, Sydney. 29-30 April 1998.

Mummery D, Battaglia M, Grant J and Sands PJ (1997). Use of a productivity model to contrast the spatial performance of *Eucalyptus globulus* in Tasmania using low and high resolution landscape and soil inputs. 1997 World Conference on Natural Resource Modelling, 15-18 December, Hobart.

Mummery D, Battaglia M, Beadle CL, Turnbull CRA and McLeod R (1997). An application of terrain and environmental modelling in a large-scale forestry experiment. Presented at MODSIM 97, International Congress on Modelling and Simulation, 8-11 December, Hobart.

Sands PJ, Rawlins W and Battaglia M (1998). Use of a simple plantation productivity model to study the profitability of irrigated *Eucalyptus globulus*. 1997 World Conference on Natural Resource Modelling, 15-18 December, Hobart.

Smethurst PJ (1997). Use of soil solutions to detect inadequate nitrogen supply in *Eucalyptus nitens* plantations. Presentation to workshop 'Research and

management of soils and nutrition in eucalypt plantations'. Research Working Group 3 Meeting. Burnie, Tasmania. 12-17 October 1997.

Smethurst PJ (1998). Predicting fertiliser responses in young Tasmanian eucalypt plantations. Presentation to workshop 'What's new in site management for establishment of pine and eucalypt plantations'?' Mt Gambier, South Australia, 20-21 May 1998.

Resource Protection

Candy SG (1997). Improving sampling efficiency for population monitoring of a forest insect pest using mixed Poisson regression models. Paper presented to Resource Modelling Association World Conference, Hobart, 15-18 December 1997.

Clarke A and Paterson S (1997). *Gonipterus scutellatus* Gyllenhal (Coleoptera: Curculionidae) oviposition on seven naturally co-occurring *Eucalyptus* species. Program and Abstracts of the 28th Annual General Meeting and Scientific Conference of the Australian Entomological Society, Melbourne, p. 38.

Elek JA (1997). Assessing the impact of insect defoliation on plantation eucalypts. Paper presented at the International Congress of Forest Insect Pests, August 1997, Pucon, Chile.

Floyd RB (1997). Insect pests of temperate eucalypt and acacia plantations in Australia. Paper presented at the Workshop on Insect Threats to Eucalypt and Acacia Plantations. Bogor, 1997.

Floyd RB and Raymond CA (1997). Insect resistance of *Eucalyptus* species in Australia. Paper presented at the International Workshop of Forest Pest Management. Pucon Chile, 1997.

Floyd RB, Farrow RA, Farrell GS and Court MM (1997). Insect feeding on *Acacia mearnsii* in south-east mainland Australia. Paper presented at the Third International Acacia Workshop, Hanoi, 1997.

Lukacs Z (1997). The effect of phenotypic plasticity on the seasonal phenology of autumn gum moth, *Mnesampela privata*. Program and Abstracts of the 28th Annual General Meeting and Scientific Conference of the Australian Entomological Society, Melbourne, p. 41.

McArthur C (1997). Feeding behaviour of marsupial browsers of eucalypts. Presented to employees of North Forest Products and other interested members of the forestry industry, at North Forests Burnie, Ridgley Tasmania, 24th June.

McArthur C (1997). Reducing damage to seedlings by mammals. Invited speaker to the Tasmanian Arboretum Inc. at Devonport, 23rd September.

McArthur C (1997). Preferences, damage and cover crops: interactions between mammals and eucalypt plantations. Invited speaker to APPITA at their AGM, Hobart, 4th December.

McArthur C (1998). Possible implications of slash management on eucalypt treefarms on browsing damage in Tasmanian plantations. Presented to the Slash Management Workshop, North Forest Products, Ridgley, 2nd June.

Mohammed C, Savva MH and Hall MF (1997). Reduction of loss from stem decay in *Eucalyptus nitens* plantations grown for saw log and veneer. In Proceedings from the IUFRO Root and Butt Rots Working Party Ninth International Conference. Carcans, France August 31 - September 7, 1997.

Mohammed C, Savva MH and Hall MF (1997). Reduction of loss from stem decay in *Eucalyptus nitens* plantations grown for saw log and veneer. Australasian Plant Pathology Society, 11th Biennial Conference, Perth, September 29 - October 2, 1997 (abstract).

Simmul TL (1997). Biology of the Fireblight Beetle, *Pyrgoides orphana* (Erichson) (Coleoptera: Chrysomelidae) a defoliator of silver wattle. Presented at the National Treefest, May 1997 Simmul TL (1997). Biology of the Fireblight Beetle. Program and Abstracts of the 28th Annual General Meeting and Scientific Conference of the Australian Entomological Society, Melbourne, p. 40.

Public Relations

Presentations

Boyer K (Acting Chancellor, University of Tasmania) (1998). Launch of Women in Forest Science project (University Centre, University of Tasmania), 50 participants (7 May 1998).

Carson, MJ and Haines, RJ Biotechnology systems for increasing timber production from plantation forests. Invited paper presented to the Asia Business Forum Conference on Plantation Forestry, Malaysia, May 1998.

Davidson N (1998). Research conducted by the CRC-SPF (University of Tasmania Discovery Day), 180 participants (May 1998).

Davidson N (1997). 'Sustainable forestry and the environment' (2 lectures to Environmental Studies students, Hobart College), 18 participants, (August 1997).

Davidson N (1997). New technology developed at the CRC-SPF (Hutchins School), 15 participants, (October 1997).

Davidson N (1997). Novel research of the CRC-SPF (Plant Science Open Day, University of Tasmania), 120 participants (November 1997).

Davidson N and Burrell J (1998). Bush art and tree walk (Hobart City Council, School Holiday Program), 12 participants (February 1998).

Davidson N (1998). How the bush survives a bushfire (Kingborough Council School Holiday Program), 10 participants (February 1998).

Davidson N (1998). Seed collection for forest revegetation (Mercy School, Kingston), 30 participants (March 1998).

Davidson N (1998). Effects of fire on the bush (Friends School), 25 participants (April 1998).

Reid J. (1998) Management structure and research of the CRC-SPF, talk to visiting Chinese delegation. (May 1998).

Haines, RJ 1998. Meeting the 2020 challenge in Queensland. Invited paper presented to the Forestry and Paper Forum, Melbourne, May 1998.

Haines RJ 1998. Forest biotechnology, current applications and future possibilities in the genetic improvement of trees. Invited paper presented to the Sixth Pacific Rim Biotechnology Symposium, Hong Kong, June 1998.

Henry RJ, and Harris PJ. Molecular distinction of monocotyledons and dicotyledons. 5th International Congress of Plant Molecular Biology, Singapore 1997.

Steane D (1998). Talk to a scientist (Kingston Primary School), 32 participants (May 1998).

Saffigna P and Mathers N (1998). Nutrient and carbon cycling in forest soils (Griffith University Discovery Day), 100 participants (June 1998).

Shepherd M, Mc Lauchlan A, Homer L, henry RJ. A rapid assay for plant breeding applications based on capillary-PCR combined with real time fluorescent detection. 5th International Congress of Plant Molecular Biology, Singapore 1997

Walker, SM and Haines, RJ 1997. Evaluation of clonal strategies for Acacias. Paper presented at Third International Acacia Workshop, Hanoi, Vietnam, 27-30 October 1997.

Molecular verification of interspecific hybridisation in tropical Pinus Service provided to DPI Forestry by Southern Cross University.

Print

Battaglia M and Sands P (1997) Predicting plantation productivity. Tree Grower, August 1997, p. 30.

Battaglia M and Sands P (1997) Predicting plantation productivity. National Forest Timber, July 1997, p. 17.

Battaglia M and Sands P (1997) Predicting plantation productivity. IFA Newsletter. October 1997, p. 18.

Tasmanian Country 29/5/98 'Women Welcome in Woods'.

The Examiner 9/6/98 'Michelle logs on to career in forestry'.

Unitas 18/5/98 'Bid to attract more women to forest science'.

The Saturday Mercury 16/5/98 'More women tipped for forestry'.

Facets newsletter, June 1998 'Oh I'm a lumberjack ... '

Radio and Television

ABC Radio Morning Show, 4 May 1998. Dorothy Steane and Jonathan Jones interview about the Women in Forest Science project.

ABC News, 7 May 1998. Women in Forest Science launch.

Southern Cross News, 7 May 1998. Women in Forest Science launch.

ABC Radio, 4 May 1998. Women in Forest Science launch.

Grants and Awards

Grant/Award	Awarded for	Duration	Recipients	Amount $
FWPRDC	PhD Scholarship	3 years	Mr D Kain	75 000
ARC small grant	Genetic control of biodiversity	1 year	Dr B Potts Prof T Whitham	8 000
MR Jacobs Award	Research excellence in forest nutrition	1 year	Mr P Adams (PhD student)	1 200
North Eucalypt Technologies	Herbivore use of plantations and surrounding habitat	1 year	Dr C McArthur	10 000
Browsing Animal Research Council	Herbivore use of plantations and surrounding habitat	1 year	Dr C McArthur	5 000
North Forest Products	Herbivore use of plantations and surrounding habitat	1 year	Dr C McArthur	9 191
Browsing Animal Research Council	Browsing damage in plantations	1 year	Dr C McArthur	2 808
North Forest Products, Tamar	Browsing damage in plantations	1 year	Dr C McArthur	900
ANM	Browsing damage in plantations	1 year	Dr C McArthur	2 354
British Council Scholarship	Research excellence in antimicrobial defence in *E. nitens*	1 year	Ms K Barry (PhD student)	5 000

Consultancies

Consultancy with	For	Duration	Recipients	Amount
STBA and Forestry Tasmania	Finger -printing in *E. nitens*		Dr R Vaillancourt	1 200
Private Forests	Collect and analyse data for the Drier Tasmanian Demonstration Area Project		Mr M Savva Dr C Beadle	10 000
Private Forests Tasmania	Farm Forestry Fact Sheets	4 weeks	Dr N Davidson Ms C Condie	10 000
RAIZ and Sopocell Portugal	Analysis of Genetic Control of Rooting Ability	2 weeks	Dr N Borralho	10 434
Forestry Tasmania	Preferences and palatability	1 year	Dr C McArthur	3 000
National Treefest	Series of 6 workshops on Farm Forestry	1 year	Dr N Davidson	6 400

Performance Against Indicators

Cooperative Arrangements

- *Level of participation of contributors in major decisions concerning the research direction of the Centre*

Most CRC research is conducted using company trials, or trials established on company land. Companies therefore are involved at the outset with the planning and implementation of research projects and have ownership of them. Research plans for these experiments are lodged with the companies, and these include an agreed protocol for the research. The company partners allocate staff time (in-kind contributions) to CRC research projects so effective interaction can occur. The Program Coordinating Committees of the CRC retain an overview of these research projects and can support, reject or modify any research program.

- *Level of interchange of personnel among different sites and participating institutions*

There has been an average of nine visits by scientific and management staff between CRC sites each month during 1997/1998 giving an estimated total of 108 visits per year.

- *Proportion of joint publications with other research groups*

In the publication list, 21 of the 122 publications (74 refereed + 39 unrefereed + 9 theses = 122) were written with other research groups.

- *Number and duration of stay of visitors to the Centre from Australia and overseas*

Overseas visits to the CRC SPF were arranged for two 'Visiting Scientists'; Prof Tom Whitham from Northern Arizona University, US (four months at UTas), Dr Ray Pearce from Birmingham University, UK (two weeks at UTas). Dr Peter Minchin from Melbourne University spent four months at UTas. In addition there have been visits from Dr Phillipe Vigneron from France (two days at QFRI), Dr Joao Silva from Denmark (one month at UTas), Dr Arthur Gilmour from NSW Agriculture (one week at UTas), Dr Emlyn Williams from CSIRO Canberra (two days at UTas). The CRC molecular biology group based at CSIRO, Canberra has had about five visits from overseas scientists.

- *The degree of interaction among scientific staff at dispersed locations on core activities of the research program, including:*

- *the economic importance and genetic control of growth, stem characteristics and wood properties at the quantitative and molecular levels*

There is strong interaction between the various research laboratories conducting genetic research. Project A1 'Genetics and reproductive biology of eucalypts' led by Brad Potts at University of Tasmania, has strong links with project A6 led by Mark Dieters at QFRI. Project A1 is conducting work at the University of Tasmania, Bunnings Treefarms (WA) and North Eucalypt Technologies (northern Tasmania). Two symposia were run on Genetics of *Eucalyptus globulus* in 1997/98 (Hobart and Perth) and a symposium on hybrid breeding is being organised for 1999 to provide a focus for this interaction.

Project A5 'Wood quality' led by Carolyn Raymond in Tasmania has strong links with the CRC-HFPS in Melbourne in research on Silviscan, cellulose content analysis and Near Infrared Reflectance Analysis, as well as with project A3 'Molecular approaches to tree breeding' led by Gavin Moran. There are also increasing linkages between the three laboratories working on molecular genetics through Projects A3, A4 and A7, as evidenced by joint publications in this area (e.g. Vaillancourt and Byrne joint publications), joint research projects (A3 and A4; Inheritance of cpDNA using recently discovered chloroplast microsatelite), and a symposium ('Molecular Genetics of Eucalypts' in February 1999), to which all groups will contribute. In addition, the level of interaction between projects is demonstrated by 17 within-Centre cooperative links in this area on non-core activities (see Cooperative Linkages, Table 1). Several projects involve collaboration between the Genetic Improvement

Program (GI projects A1 and A3) and the Sustainable Management Program (SM), and there is increasing linkage between GI, SM and the Resource Protection Program (RP) on the genetics of pest and disease resistance.

- *Effective mating, selection and deployment strategies in tree improvement programs*

Project A2 'Breeding strategies' led by Nuno Borralho has strong links with most industrial partners as well as other research projects on the core research in selection and deployment strategies. This project is intimately linked with the Southern Tree Breeding Association's (STBA) national eucalypt breeding program. It is enhanced by the co-location of the STBA's eucalypt program manager, Peter Gore, on the University of Tasmania campus. In addition there were three within-Centre cooperative links in this area (Table 1) on non-core activities.

- *The dynamics and cycling of organic matter and nitrogen in soils in response to silvicultural treatments*

There has been a history of close interaction between Project B1 'Site productivity', led by Philip Smethurst and Project B2 'Management of tropical soils' led by Paul Saffigna, as they both cover organic matter and nutrient cycling. Dr Holz (NET) initiated and obtained assistance from the CRC for a workshop in June on the potential for more efficient 'slash management' in second rotation plantations. An international conference, 'Advances in research on carbon and nutrient cycling in production forests', which will serve to present research in this area for temperate and tropical ecosystems, is being organised for August 2000.

- *Prediction of productivity in response to environmental factors and management inputs*

Project B4 'Modelling plantation systems' has recently run two workshops at CRC centres to familiarise industrial partners with the operation and application of the growth model PROMOD. In addition there are two within-Centre cooperative links in this area (Table 1) in non-core activities.

- *Investigation of pathogens of forest insect pests*

There is increasing linkage between the Resource Protection, Genetic Improvement and Sustainable Management programs on the genetics of pest and disease resistance. Richard Milner has been working in collaboration with John Madden on entomopathogens of Chrysomelids.

- *studies of the ecology and behaviour of autumn gum moth in temperate Australia*

Rob Floyd in CSIRO Canberra has continued links with Zoltan Lukacs (UTas) through his supervision of Zoltan's PhD research, and through parallel observations on the mainland. Geoff Allen in Tasmania is developing other aspects of autumn gum moth work in collaboration with Rob Floyd and Martin Steinbauer.

There also exist close links amongst workers on other insect pests: Rob Floyd (CSIRO Canberra) with Tarn Simmul (UTas) on fireblight beetle, and Martin Steinbauer (CSIRO Canberra) and Bradley Howlett (Utas) on *Eucalyptus* leaf beetle.

Research and Researchers

Papers in refereed journals.

In 1997/98 the Centre produced 74 publications in refereed journals, 35 unrefereed publications and nine theses.

- *Books and book chapters covering the results of the Centre's research*

There were two books, 'Sampling plantation eucalypts for wood and fibre properties' and 'Vegetation of Tasmania'; and three book chapters, 'Eucalypt genetics and genecology' (Potts and Wiltshire), 'Forest Plantations' (Boardman *et al.*), 'Dynamics of leaf and canopy development' (Beadle), produced this year.

- *Invitations to present keynote addresses and papers at conferences*

Dr Rob Floyd was invited to present a paper entitled 'Insect resistance in *Eucalyptus*' at a IUFRO Conference on 'Management of Forest Insect Pests' in Pucon, Chile. Dr Michael Battaglia and Dr Peter Sands were invited to present a paper at 'Modsim '97', an International Congress on Modelling and Simulation, Hobart. Dr Nuno Borralho is Chairman of the IUFRO Forest genetics program and was invited to chair a session at the IUFRO Conference on Forest Genetics in Brazil. Dr Gavin Moran was invited to present a paper at the same Brazilian IUFRO Conference. Dr Brad Potts was invited to present a paper at the VII INTECOL Symposium 'Ecology of Hybrid Zones' in Florence. Presentations by Dr Russell Haines and colleagues, MJ Carson and SM Walker, included: 'Forest biotechnology, current applications and future possibilities in the genetic improvement of trees' presented to the Sixth Pacific Rim Biotechnology Symposium, Hong Kong, (June 1998); 'Meeting the 2020 challenge in Queensland', presented to the Forestry and Paper Forum, Melbourne (May 1998); and 'Biotechnology systems for increasing timber production from plantation forests', presented to the Asia Business Forum Conference on Plantation Forestry, Malaysia (May 1998).

- *Number and value of competitive grants awarded*

There were three competitive grants awarded to CRC staff in 1997/98 (see Grants and Awards).

- *Honours and awards*

There were four honours degrees awarded in 1997/98; these were to Hamish Jackson, Corrina Kelly, Natalie Papworth and Matthew Marrison (see Publications). Two postgraduate students Mr Paul Adams and Ms Karen Barry received awards for research excellence (see Grants and Awards).

Education and Training

- *Time spent by researchers on research training*

We have 48 postgraduate and honours students affiliated with the CRC. It is recognised that each student takes 5-10% of a researchers' time to supervise. This is equivalent to 2.4 to 4.8 man-years on research training.

- *Number of postgraduate students working in the Centre*

The Centre has 41 postgraduate students and seven honours students (see Table 2).

- *Number of postgraduate students trained in the areas specified*

Genetic Improvement	15
Sustainable Management	23
Resource Protection	10

- *Number of enrolments in special courses*

A special undergraduate course, Forest Ecology has 12 students enrolled and two are enrolled in Forest Ecology honours this year.

- *Quality and number of post-doctoral fellows attracted*

There were five postdoctoral fellows who worked with the Centre in 1997/98: Dr Dorothy Steane in molecular genetics (UTas); Dr Karen Thamarus in molecular genetics (CSIRO Canberra); Dr Martin Steinbauer in entomology (CSIRO Entomology); Dr Mervyn Shepherd in molecular biology (SCU); and Dr Heidi Dungey in forest genetics (QFRI).

- *Rate and percentage of completion of higher degrees*

Five PhD students completed their theses this year; Kristen Williams, Nadia Marsh, Steven Wilson, Paulina Teixeira and Xianming Wei.

- *Acceptance and employment by the forestry community of students on completion of their studies*

The success of our students in obtaining employment in the forest industry was demonstrated this year by the following appointments: Heidi Dungey (Geneticist, CRC-SPF with QFRI Gympie), Mark Hunt (Senior Silvicultural Research Scientist, QFRI), Natalie Papworth (Scientific Collections Officer, Royal Tasmanian Botanical Gardens), Libby Pinkard (Silvicultural Research Scientist, Forestry Tasmania), Daniel Mendham (Research Scientist, CSIRO Forestry and Forest Products, WA); Martin Steinbauer (Postdoctoral Fellow, CRC-SPF with CSIRO Entomology, Canberra).

Application of Research

- *Degree of adoption of research results by industry*

There were 20 items of technology transferred to industry (see Utilisation and Application of Research).

- *Quality and relevance of technical publications targeted to user groups.*

There were nine reports produced in the new CRC Technical Report series. In addition there were nine technical news sheets released ('Hot off the Seed Bed' and 'Beyond the Black Stump'), two books ('Sampling plantation eucalypts for wood and fibre properties' and 'Vegetation of Tasmania,'), six Farm Forestry Fact Sheets, and five articles in partner news sheets.

- *Extent of advice and consultancy services provided to industry and government*

Six consultancies were conducted during 1997/98 (see p. 68, Consultancies). Advice is also provided through participation on national committees. For example, Greg Dutkowski (GI) is on the Technical Committee of the STBA and three subcommittees of the STBA Technical Committee; he is also a member of Research Working Group 1 (RWG1, Forest Genetics); Dr Brad Potts (GI) is a member of RGW1 and is on the subcommittee on Forest Genetic Resources; and Dr Philip Smethurst (SM) was chairman of RWG3, Soils and Nutrition.

- *Number of presentations to companies or user groups*

There were 21 events where presentations were made to companies or other end users (see Table 4, Technology Transfer Activities), many of these were workshops with two days of presentations (e.g. the '*Eucalyptus globulus* genetics and breeding' workshop). There were also 30 presentations to conferences (see Public Presentations) and 12 talks to school groups (see Public Relations).

- *Number and financial contribution of potential users*

The CRC-SPF has twelve industry partners which includes most of the major wood producing companies in Australia. Each of these commits cash and/or in-kind contributions to the CRC (see financial tables). In addition, partners may provide funds to support particular projects (see table on Grants and Awards). Other end users of our technology, e.g. Greening Australia and Private Forests Tasmania, have given in-kind support in running technology transfer exercises to farmer groups.

- *Number of visitors from user groups*

As the partners in the Centre represent our main user group, many of the 108 within-CRC visits (see Performance Indicator 2 under Cooperative Arrangements) are from users of the technology we are developing. For example, in the Genetic Improvement Program in Hobart Wayne Tibbits and Mike Powell from NET, Peter Kube from FT, Peter Volker and Sandra Hetherington from ANM, Chris Shedley from Bunnings Treefarms, and Silvia Pongracic from APP, are regular visitors. Other visitors who are not partners include Frances Sugden from Greening Australia, Arthur Lyons from Private Forests Tasmania, David Hamilton and Darcy Vickers from the Forest Education Foundation. The same rates of visitation occur at other CRC locations.

- *Number of media or trade journal presentations*

There were twelve media and/or trade journal presentations about the CRC this year.

- *Number of seminars, workshops and field days organised to transfer results to industry and the public, including the level of response*

There were 25 seminars, 14 workshops and 7 field days organised to transfer results to industry and the public this year. An estimated 1230 people attended these activities.

Management and Budget

- *Establish procedures to report on progress and achievements*

There have been a series of plans set in place; Strategic Plan, Business Plan, Communication Plan, and a set of deliverables agreed upon to meet industry expectations of progress in research areas. There are also established checks and balances on the quality and quantity of research and its value to industry through Program Coordinating Committees, the Advisory Panel, the Board and the Annual Report.

- *Timely and accurate reporting of progress*

The CRC reports in a timely and accurate manner against the deliverables set for industry and the milestones set by each project and program. These are reported to the Program Coordinating Committees (quarterly report on research deliverables), the Advisory Panel, the Board, and in the Annual Report.

- *Extent of staff turnover*

There was substantial staff turnover this year which coincided with the start of the new Centre. Sixteen staff departed and 15 new appointments were made (see Staffing and Administration).

- *Proportion of projects completing milestones within the planned time and budget*

No milestones are due until June 1998. However, progress is on track to meet the milestones as they become due.

- *Accurate recording and reporting of financial transactions*

The Centre has implemented the following management and budgetary systems: triennium budgeting, monthly reporting of financial accounts (to program managers and project leaders), quarterly reporting of in-kind contributions of partner organisations (to the Board), annual external audit of the financial accounts, and an Annual Report.

Budget

Notes to and forming part of the accounts for 1997/98

Summary of significant accounting policies

All funds under the Cooperative Research Centre's control are administered through the University of Tasmania's Financial Management System (FMS).

The principal accounting policies adopted in preparing the accounts of the unincorporated entity are detailed hereunder.

(a) Basis of accounting and principles of consolidation

The cash accounts have been prepared on the basis of historic costs. Cost in respect to the cash contributions and expenditure is the cash sum exchanged in the financial year determined from transactions recorded on the FMS.

In-kind amounts are the economic values of goods and services declared by each of the joint venture partners and accepted by the entity as being valid.

(b) Interest

Interest is calculated and paid by the University based on the monthly cash balances being held on the FMS on behalf of the entity.

(c) Assets and depreciation

Plant and equipment assets are recorded on the University's asset register in the name of the entity as they are acquired. Their entire cost is expensed in the year of purchase and depreciation is not provided for.

Capital expenditure relates to costs associated with buildings. These costs are also expensed and depreciation is not provided for.

(d) Employee entitlements

Provision has been made for pro-rata entitlements to annual and long service leave.

(e) Partner contributions

Budget estimates of contributions are taken from the original Commonwealth Agreement and actual figures are provided by the partners.

(f) Allocation from Commonwealth Grant

During 1997/98 the CRC received the usual four quarterly grant payments.

PBS
Partners

**INDEPENDENT AUDIT REPORT TO
THE MEMBERS OF THE COOPERATIVE RESEARCH CENTRE FOR SUSTAINABLE PRODUCTION FORESTRY, AND
THE COOPERATIVE RESEARCH CENTRES SECRETARIAT DEPARTMENT OF INDUSTRY, SCIENCE AND TOURISM REPRESENTING THE COMMONWEALTH IN RESPECT OF**

COOPERATIVE RESEARCH CENTRE FOR SUSTAINABLE PRODUCTION FORESTRY

FINANCIAL INFORMATION FOR THE YEAR ENDED 30 JUNE 1998

Scope

We have audited the attached financial information of the Cooperative Research Centre for Sustainable Production Forestry as set out in Tables 1 to 4 of the Annual Report for the year ended 30 June 1998 as required by clause 14(1)(f) of the Commonwealth Agreement. The Parties to the Cooperative Research Centre are responsible for the preparation and presentation of the financial information contained therein, and have determined that the basis of accounting as described in Note 1 is appropriate to meet the needs of the Members of the Cooperative Research Centre and the Commonwealth. We have conducted an independent audit of the financial information in order to express an opinion to the Members of the Cooperative Research Centre and the Commonwealth on its preparation and presentation and to report on the matters identified below in relation to the sources and applications of the Cooperative Research Centre for Sustainable Production Forestry funding. No opinion is expressed as to whether the basis of accounting as described in Note 1 is appropriate to the needs of the Members of the Cooperative Research Centre and the Commonwealth.

The financial information has been prepared for distribution to Members of the Co-operative Research Centre and for the purpose of fulfilling the requirements of the Commonwealth Agreement. We disclaim any assumption of responsibility for any reliance on this report or on the financial information to which it relates to any person other than the Members of the Cooperative Research Centre and the Commonwealth, or for any purpose other than that for which it was prepared.

Our audit has been conducted in accordance with Australian Auditing Standards. Our procedures included examination, on a test basis, of evidence supporting the amounts and other disclosures in the financial information. These procedures have been undertaken to provide reasonable assurance that the Cooperative Research Centre for Sustainable Production Forestry has complied with Clauses 4, 5(1), 5(2), 5(3), 9(1), 9(5) and 12(2) of the Commonwealth Agreement and to form an opinion as to whether in all material respects, the financial information presents fairly the sources and applications of funding in accordance with the basis of accounting described in Note 1. These policies do not require the application of all Accounting Standards and Urgent Issues Group Consensus Views.

While we have not performed any audit procedures upon the estimates for future budget periods and do not express any opinion thereon, we ascertained that they have been formally approved by the Board of Management as required under the Joint Venture Agreement

The audit opinion expressed in this report has been formed on the above basis and reports on compliance with the following matters:

PBS
Partners

1. The multipliers adopted by the Centre to value in-kind contributions other than salary costs have a sound and reasonable basis. The Researcher's Contributions for the year has been provided at least to the value for that year committed in accordance with the Budget and the total value of all contributions for the year under report equalled or exceeded the amount of grant paid during the year, with the following exceptions:

ORGANISATION	AMOUNT COMMITTED $	AMOUNT PROVIDED $
CSIRO Forestry & Forestry Products	2,121,000	2,062,600
CSIRO Entomology	425,000	402,900
Australian Paper Plantations	206,000	201,300
Southern Cross University	309,000	252,600
University of Queensland	72,000	18,600

2. The Researcher has used the grant and the Researcher's contributions for the Activities of the Centre and not for any other purpose.

3. The Researcher's allocations of the budgetary resources between Heads of Expenditure has not been lower or higher than the allocation in the budget by $100,000 or 20% (whichever is the greater amount) without prior approval by the Commonwealth.

4. Capital Items acquired from the Grant and Researcher's Contributions are vested as provided in the Joint Venture Agreement.

5. Intellectual Property in all Contract Material is vested as provided in the Joint Venture Agreement and no Intellectual Property has been assigned or licensed without the prior approval of the Commonwealth.

6. Proper accounting standards and controls have been exercised in respect of the Grant and Researcher's Contributions and income and expenditure in relation to the Activities of the Centre have been recorded separately from other transactions of the Researcher.

Audit Opinion

In our opinion the attached financial information presents fairly, in accordance with the basis of accounting described in Note 1, the sources and applications of the Cooperative Research Centre for Sustainable Production Forestry funding for the year ended 30 June 1998 and has complied with the required clauses of the Commonwealth Agreement.

PBS Partners
Chartered Accountants

Steven A Hernyk
Partner

Hobart
14/9 1998

IN-KIND CONTRIBUTIONS FROM PARTNERS ($000's)

TABLE 1

PARTNER	EXPENDITURE Cumulative 1997/98 Actual	TOTAL TO DATE Actual	TOTAL TO DATE Agr'mt	PROJECTED EXPENDITURE 1998/99 Budget	1998/99 Agr'mt	1999/00 Budget	1999/00 Agr'mt	2000/01 Budget	2000/01 Agr'mt	2001/02 Budget	2001/02 Agr'mt	2002/03 Budget	2002/03 Agr'mt	2003/04 Budget	2003/04 Agr'mt	GRAND TOTAL TOTAL 7 Years	GRAND TOTAL Agreement 7 years	GRAND TOTAL Difference 7 years
CSIRO FORESTRY and FOREST PRODUCTS																		
SALARIES	652.6	652.6	673.0	668.9	651.0	685.5	618.0	702.6	618.0	720.2	618.0	738.2	618.0	756.6	618.0	4,924.5	4,414.0	510.5
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	1,410.0	1,410.0	1,448.0	1,439.9	1,407.0	1,470.9	1,345.0	1,502.6	1,345.0	1,535.2	1,345.0	1,568.6	1,345.0	1,602.8	1,345.0	10,530.0	9,580.0	950.0
TOTAL	2,062.6	2,062.6	2,121.0	2,108.7	2,058.0	2,156.4	1,963.0	2,205.2	1,963.0	2,255.4	1,963.0	2,306.8	1,963.0	2,359.4	1,963.0	15,454.5	13,994.0	1,460.5
CSIRO ENTOMOLOGY																		
SALARIES	163.2	163.2	152.0	157.1	152.0	160.3	152.0	165.1	152.0	158.7	152.0	158.7	152.0	158.7	152.0	1,121.8	1,064.0	57.8
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	239.7	239.7	273.0	267.9	273.0	291.8	273.0	299.8	273.0	293.5	273.0	293.5	273.0	293.5	273.0	1,979.7	1,911.0	68.7
TOTAL	402.8	402.9	425.0	425.0	425.0	452.1	425.0	464.9	425.0	452.2	425.0	452.2	425.0	452.2	425.0	3,101.5	2,975.0	126.5
UNIVERSITY OF TASMANIA																		
SALARIES	385.4	385.4	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	386.7	2,705.6	2,706.9	-1.3
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	703.1	703.1	701.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	763.0	5,281.1	5,279.0	2.1
TOTAL	1,088.5	1,088.5	1,087.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	7,986.7	7,985.9	0.8
AUSTRALIAN NEWSPRINT MILLS																		
SALARIES	34.0	34.0	25.0	33.0	28.0	33.0	28.0	33.0	28.0	33.0	28.0	33.0	28.0	33.0	28.0	232.0	193.0	39.0
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	186.0	186.0	171.0	166.0	161.0	166.0	161.0	169.0	161.0	169.0	161.0	167.0	161.0	167.0	161.0	1,190.0	1,137.0	53.0
TOTAL	220.0	220.0	196.0	199.0	189.0	199.0	189.0	202.0	189.0	202.0	189.0	200.0	189.0	200.0	189.0	1,422.0	1,330.0	92.0
NORTH FOREST PRODUCTS																		
SALARIES	263.0	263.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	863.0	700.0	163.0
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	369.0	369.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	216.0	1,665.0	1,512.0	153.0
TOTAL	632.0	632.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	316.0	2,528.0	2,212.0	316.0
FORESTRY TASMANIA																		
SALARIES	137.0	137.0	93.0	136.1	102.0	136.1	112.0	136.1	124.0	136.1	136.0	136.1	149.0	136.1	164.0	953.6	880.0	73.6
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	179.1	179.1	115.0	178.0	126.0	178.0	139.0	178.0	152.0	178.0	168.0	178.0	185.0	178.0	203.0	1,247.1	1,088.0	159.1
TOTAL	316.1	316.1	208.0	314.1	228.0	314.1	251.0	314.1	276.0	314.1	304.0	314.1	334.0	314.1	367.0	2,200.7	1,968.0	232.7
AUSTRALIAN PAPER PLANTATIONS																		
SALARIES	65.8	65.8	85.0	85.0	85.0	87.6	85.0	90.2	85.0	92.9	85.0	95.7	85.0	98.5	85.0	615.7	595.0	20.7
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	135.5	135.5	121.0	121.0	121.0	124.6	121.0	128.4	121.0	132.2	121.0	136.2	121.0	140.3	121.0	918.2	847.0	71.2
TOTAL	201.3	201.3	206.0	206.0	206.0	212.2	206.0	218.6	206.0	225.1	206.0	231.9	206.0	238.8	206.0	1,533.9	1,442.0	91.9
BUNNINGS TREEFARMS																		
SALARIES	65.9	65.9	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	395.9	385.0	10.9
CAPITAL	0.0	0.0														0.0	0.0	
OTHER	107.3	107.3	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	115.0	797.3	805.0	-7.7
TOTAL	173.2	173.2	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	170.0	1,193.2	1,190.0	3.2
PRIMARY INDUSTRIES CORPN (QFRI)																		
SALARIES	449.8	449.8	322.0	402.1	322.0	402.1	322.0	402.1	322.0	402.1	322.0	402.1	322.0	402.1	322.0	2,862.4	2,254.0	608.4
CAPITAL	28.4	28.4		24.0												52.4	0.0	
OTHER	526.0	526.0	380.0	329.7	380.0	329.7	380.0	329.7	380.0	329.7	380.0	329.7	380.0	329.7	380.0	2,504.2	2,660.0	-155.8
TOTAL	1,004.2	1,004.2	702.0	755.8	702.0	731.8	702.0	731.8	702.0	731.8	702.0	731.8	702.0	731.8	702.0	5,419.0	4,914.0	452.6

SOUTHERN CROSS UNIVERSITY																		
	SALARIES	62.9	62.9	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	422.9	420.0	2.9
	CAPITAL	0.0	0.0													0.0	0.0	
	OTHER	189.7	189.7	249.0	249.0	249.0	249.0	249.0	249.0	249.0	249.0	249.0	249.0	249.0	249.0	1,683.7	1,743.0	-59.3
	TOTAL	252.6	252.6	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0	309.0	2,106.6	2,163.0	-56.4
GRIFFITH UNIVERSITY																		
	SALARIES	163.7	163.7	126.5	161.1	126.5	161.1	126.5	161.1	126.5	161.1	126.5	161.1	126.5	161.1	126.5	1,130.3	885.5	244.8
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	150.6	150.6	116.4	148.3	116.4	148.3	116.4	148.3	116.4	148.3	116.4	148.3	116.4	148.3	116.4	1,040.4	814.8	225.6
	TOTAL	314.3	314.3	242.9	309.4	242.9	309.4	242.9	309.4	242.9	309.4	242.9	309.4	242.9	309.4	242.9	2,170.7	1,700.3	470.4
BORAL TIMBER TASMANIA																		
	SALARIES	6.4	6.4	5.0	6.4	5.0	6.4	5.0	6.4	5.0	6.4	5.0	6.4	5.0	6.4	5.0	44.8	35.0	9.8
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	34.8	34.8	35.0	33.6	35.0	33.6	35.0	33.6	35.0	33.6	35.0	33.6	35.0	33.6	35.0	236.4	245.0	-8.6
	TOTAL	41.2	41.2	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	281.2	280.0	1.2
THE AUSTRALIAN NATIONAL UNIVERSITY																		
	SALARIES	59.2	59.2	63.8	59.2	63.8	59.2	63.8	59.2	63.8	59.2	63.8	59.2	63.8	59.2	63.8	414.4	446.6	-32.2
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	177.7	177.7	112.0	177.7	112.0	177.7	112.0	177.7	112.0	177.7	112.0	177.7	112.0	177.7	112.0	1,243.9	784.0	459.9
	TOTAL	236.9	236.9	175.8	236.9	175.8	236.9	175.8	236.9	175.8	236.9	175.8	236.9	175.8	236.9	175.8	1,658.3	1,230.6	427.7
THE UNIVERSITY OF QUEENSLAND																		
	SALARIES	8.6	8.6	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	156.6	175.0	-16.4
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	10.0	10.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	292.0	329.0	-37.0
	TOTAL	18.6	18.6	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	450.6	504.0	-53.4
AUSTRALIAN FOREST GROWERS																		
	SALARIES	1.1	1.1	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.5	0.0	0.5	0.0	4.1	0.0	4.1
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	0.3	0.3	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0	3.3	7.0	-3.7
	TOTAL	1.4	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.4	7.0	0.4
SOUTHERN TREE BREEDING ASS'N																		
	SALARIES	6.0	6.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	42.0	0.0	42.0
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER		0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	5.0	0.0	35.0	-35.0
	TOTAL	6.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	6.0	5.0	42.0	35.0	7.0
SILVAGENE																		
	SALARIES		0.0	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
	CAPITAL	0.0	0.0														0.0	0.0	
	OTHER	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	35.0	0.0
	TOTAL	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0	35.0	0.0
TOTAL IN-KIND CONTRIBUTIONS																		
	SALARIES	2,524.6	2,524.6	2,172.0	2,342.0	2,162.0	2,364.5	2,139.0	2,389.0	2,151.0	2,402.9	2,163.0	2,423.7	2,176.0	2,444.9	2,191.0	16,891.6	15,154.0	1,737.6
	CAPITAL	28.4	28.4		24.0	0.0		0.0				0.0	0.0	0.0		0.0	52.4	0.0	52.4
	OTHER	4,423.8	4,423.8	4,110.4	4,257.6	4,132.4	4,316.1	4,083.4	4,362.6	4,096.4	4,392.7	4,112.4	4,428.1	4,129.4	4,466.4	4,147.4	30,647.3	28,811.8	1,835.5
GRAND TOTAL IN-KIND		6,976.8	6,976.8	6,282.4	6,623.6	6,294.4	6,680.6	6,222.4	6,751.6	6,247.4	6,795.6	6,275.4	6,851.8	6,305.4	6,911.3	6,338.4	47,591.3	43,965.8	3,625.5

CASH CONTRIBUTIONS ($000's)

ATTACHMENT C TABLE 2

PARTNERS	ACTUAL 1997/98 Actual	CUMULATIVE Total to date Actual	CUMULATIVE Total to date Agr'mt	PROJECTED 1998/99 Budget	1998/99 Agr'mt	1999/00 Budget	1999/00 Agr'mt	2000/01 Budget	2000/01 Agr'mt	2001/02 Budget	2001/02 Agr'mt	2002/03 Budget	2002/03 Agr'mt	2003/04 Budget	2003/04 Agr'mt	GRAND TOTAL Total 7 yrs	GRAND TOTAL Agr'mt 7 yrs	GRAND TOTAL Diff 7 yrs
CSIRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
University of Tasmania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry Tasmania	22.5	22.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	112.5	105.0	7.5
North Forest Products	65.1	65.1	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	365.1	350.0	15.1
Australian Paper Plantations	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	245.0	245.0	0.0
Australian Newsprint Mills	22.4	22.4	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	142.4	140.0	2.4
Bunnings Treefarms	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	245.0	245.0	0.0
Primary Industries Corporation	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	175.0	175.0	0.0
Southern Cross University	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	700.0	700.0	0.0
Griffith University	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	175.0	175.0	0.0
Boral Timber Tasmania	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
Australian National University	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
The University of Queensland	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
Australian Forest Growers	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.0	7.0	0.0
STBA	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
Silvagene	0.0	0.0	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0	0.0	0.0
TOTAL CASH FROM PARTICIPANTS	331.0	331.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	306.0	2,167.0	2,142.0	25.0
OTHER CASH																		
Interest	20.4	20.4	0.0	30.0	0.0	30.0	0.0	30.0	0.0	30.0	0.0	30.0	0.0	30.0	0.0	200.4	0.0	200.4
Non-participants	7.8	7.8	0.0													7.8	0.0	7.8
Other external funds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRC Grant	1,718.1	1,718.1	1,680.0	2,277.0	2,300.0	2,299.8	2,300.0	2,322.0	2,300.0	2,345.2	2,300.0	2,368.6	2,300.0	2,392.3	2,300.0	15,723.0	15,480.0	243.0
TOTAL CRC CASH CONTRIBUTION	2,077.3	2,077.3	1,986.0	2,613.0	2,606.0	2,635.8	2,606.0	2,658.0	2,606.0	2,681.2	2,606.0	2,704.6	2,606.0	2,728.3	2,606.0	18,098.2	17,622.0	476.2
Cash carried over from previous year	741.0		549	1,002.6	0.0	806.6	-6.0	650.9	-3.0	496.2	-2.0	419.8	-2.0	362.9	-3.0			
Less unspent balance	1,002.6			806.6	-6.0	650.9	-3.0	496.2	-2.0	419.8	-2.0	362.9	-3.0	835.1	0.0			
TOTAL CASH EXPENDITURE	1,815.7	1,815.7	2,535.0	2,809.0	2,612.0	2,791.5	2,603.0	2,812.7	2,605.0	2,757.6	2606	2761.5	2,607.0	2,256.1	2,603.0	18,004.1	18,171.0	-166.9
ALLOCATION OF CASH EXPENDITURE BETWEEN HEADS OF EXPENDITURE																		
SALARIES	1,288.9	1,288.9	1,740.0	1,922.6	1,697.0	1,913.2	1,698.0	1,926.4	1,700.0	1,866.3	1701	1860.2	1,702.0	1,449.8	1,703.0	12,227.4	11,941.0	286.4
CAPITAL		0.0	0.0															
OTHER	526.8	526.8	795.0	886.4	915.0	878.3	905.0	886.3	905.0	891.3	905	901.3	905.0	806.3	900.0	5,776.7	6,230.0	-453.3

SUMMARY OF RESOURCES APPLIED TO ACTIVITIES OF CENTRE ($000's)

TABLE 3

ALL PROGRAMS

EXPENDITURE

	Actual 1997/98	Cumulative Total to date		1998/99		Projected 1999/00		2000/01		2001/02		2002/03		2003/04		GRAND TOTAL		
	Actual	Actual	Agr'mt	Budget	Agr'mt	Budget	Agr'mt	Budget	Agr'mt	Budget	Agr'mt	Budget	Agr'mt	Budget	Agr'mt	Total	Agr'mt	Diff
GRAND TOTAL (IN-KIND)	6,976.8	6,976.8	6,282.4	6,623.6	6,294.4	6,580.6	6,222.4	6,751.6	6,247.4	6,795.6	6,275.4	6,851.8	6,305.4	6,911.3	6,338.4	47,591.3	43,965.8	3,625.5
GRAND TOTAL (CASH EXPENDITURE)	1,815.7	1,815.7	2,535.0	2,809.0	2,612.0	2,791.5	2,603.0	2,812.7	2,605.0	2,757.6	2,606.0	2,761.5	2,607.0	2,256.1	2,603.0	18,004.1	18,171.0	-166.9
TOTAL RESOURCES APPLIED TO ACTIVITIES OF CENTRE	8,792.5	8,792.5	8,817.4	9,432.6	8,906.4	9,472.1	8,825.4	9,564.3	8,852.4	9,553.2	8,881.4	9,613.3	8,912.4	9,167.4	8,941.4	65,595.4	62,136.8	3,458.6

ALLOCATION OF TOTAL RESOURCES APPLIED TO ACTIVITIES OF CENTRE BETWEEN HEADS OF EXPENDITURE

TOTAL SALARIES (CASH AND IN-KIND)	3,813.5	3,813.5	3,912.0	4,264.6	3,859.0	4,277.7	3,837.0	4,315.4	3,851.0	4,269.2	3,864.0	4,283.9	3,878.0	3,894.7	3,894.0	29,119.0	27,095.0	2,024.0
TOTAL CAPITAL (CASH AND IN-KIND)	28.4	28.4	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.4	0.0	52.4
TOTAL OTHER (CASH AND IN-KIND)	4,950.6	4,950.6	4,905.4	5,144.0	5,047.4	5,194.4	4,988.4	5,248.9	5,001.4	5,284.0	5,017.4	5,329.4	5,034.4	5,272.7	5,047.4	36,424.0	35,041.8	1,382.2

ALLOCATION OF RESOURCES BETWEEN CATEGORIES OF ACTIVITIES TABLE 4

PROGRAM	RESOURCE USAGE			
	Cash $000's	In-kind $000's	Contributed Staff	Cash Funded Staff (CRC)
Research	1,411.9	6,209.3	21.8	15.2
Education	85.2	348.8	1.3	0.5
Commercialisation/ Tech Transfer				
Administration	318.6	418.7	1.6	0.2
Other (transferred ; non CRC activities)				
TOTAL	1,815.7	6,976.8	24.7	15.9

RESEARCH STAFF RESOURCES (1997/98)

ATTACHMENT B

Organisation		Main activity	Total % time	% spent on Research Program GI	SM	RP	Total on Research	% spent on Education	% Spent on Commercialisation Program	% spent on CRC Administration
Australian Newsprint Mills										
HETHERINGTON, S		R	20	5	5	10	20			
VOLKER, P		R	10	5			5			5
GRANT, J		R	2		2		2			
WILLEMS, A		A	5							5
Total			37	10	7	10	27			10
Australian Paper Plantations										
PONGRACIC, S		R	43	15	20	8	43			
CAMERON, J		R	5	1.7	1.7	1.7	5			
Total			48	16.7	21.7	9.7	48			
Bunnings Treefarms										
SHEDLEY, C		R	25		25		25			
PILBEAM, D		R	20	20			20			
MADDERN, L		R	20		20		20			
BREIDAHL, R		R	5							5
VITLICH, M/MCARTHUR, G		A	2				0			2
LEE, R		A	1				0			1
Total			73	20	45	0	65	0		8
North Forest Products										
HOLZ, G		R	76		55		55			21
BARNES, C		R	50		50		50			
TIBBITS, W		R	39	39			39			
DE LITTLE, D		R	27			21	21			6
POWELL, M		R	19	19			19			
RASMUSSEN, G		R	9	9			9			
JAMIESON, A		A	14							14
Total			213	67	105	21	193			20
Forestry Tasmania										
ELEK, J		R	40			40	40			
CANDY, S		R	40			40	40			
MARSH, N		R	40			40	40			
KUBE, P		R	20	20			20			
PINKARD, L		R	20		20		20			
ELLIOTT, H		R	10			10	10			
NIELSEN, B		R	5		5		5			
DRIELSMA, H		R	3				0			3
Total			178	20	25	130	175			3
CSIRO Forestry & Forest Products										
RAYMOND, C		R	100	50	50		100			
BATTAGLIA,M		R	100		90		90			
MUMMERY, D		R	90		90		90			
SANDS, P		R	80		80		80			
BEADLE, C		R	80		80		80			
SMETHURST, P		R	72		72		72			
CROMER, R		R	50		50		50			
MORAN,G		R	30	30			30			
MCCORMACK, B		R	10		10		10			
MOHAMMED, C		R	10			10	10			
WILLIAMS, E		R	10	10			10			
WALLIS, A		R	5	5			5			
EVANS, R		R	5	5			5			
Total			632	100	522	10	632			

EVANS, R		R	5	5			5			
Total			632	100	522	10	632			

CSIRO Entomology

DOWSE, J		R	30			30	30			
FLOYD,R		R	25			25	25			
MILNER, R		R	20			20	20			
MATTHIESEN, R		R	20			20	20			
LAWRENCE, J		R	10			10	10			
EDWARDS, E		R	10			10	10			
Total			85	0	0	85	85			

University of Tasmania

REID, J		R	50	10			10	10		30
VAILLANCOURT, R		R	45	45			45			
WILTSHIRE, R		R	30				0	30		
BROWN, P		R	30		30		30			
BORRALHO, N		R	25	25			25			
POTTS,B		R	25	25			25			
ALLEN,G		R	25			25	25			
HURLEY,M		R	25			25	25			
MENARY, R		R	20	10			10	10		
CLARK, R		R	20		10		10	10		
LINE, M		R	20		20		20			
JENNINGS, S		R	15		15		15			
MOHAMMED,C		R	15			15	15			
HILL, R		R	10				0	10		
HALLEGRAF,G		R	10							10
JOHNSON,C		R	10				0	10		
HOVENDEN,M		R	5	5			5			
CANTY,A		A	1				0			1
Total			381	120	75	65	260	80		41

Primary Industries Corporation

SIMPSON, JA		R	50		50		50			
DIETERS, M		R	40	40			40			
BUBB, K		R	40		40		40			
KEENAN, R		R	40		40		40			
NIKLES, G		R	35	35			35			
WALKER, S		R	20	20			20			
HARDING, K		R	20	20			20			
NESTER, M		R	20	20			20			
HUNT, M		R	25		25		25			
HOUSE, A		R	30		30		30			
LEWTY,M		R	15		7.5		7.5			7.5
RYAN, P		R	10		10		10			
XU, Z		R	50		50		50			
OSBORNE, D		R	50		50		50			
KEADY, E		R	5		5		5			
PRYDON, R		R	5		5		5			
HAINES, R		A	50	20			20			30
Total			505	155	312.5		467.5			37.5

Southern Cross University

HENRY, R		R	30	20			20	10		
CODRINGTON, T		R	20	20			20			
Total			50	40	0		40	10	0	0

Griffith University

SAFFIGNA,P		R	60		40		40	10		10
PERARA,S		R	20		10		10			10
BERNERS-PRICE,S		R	15		5		5			10
YU,B		R	15		15		15			
RICKSON,R		R	15		15		15			
PHILLIPS,I		R	10		10		10			
BRADDOCK,R		R	15		15		15			
HUGHES,J		R	5	5			5			
KING,R		A	12				0			12
Total			157	5	110		115			42

RESEARCH STAFF RESOURCES

Attachment B cont../3

Boral Timber Tasmania										
NAUGHTON,P		R	10		10		10			
Total			10	0	10		10			
Australian National University										
KANOWSKI, P		R	30	10	20		30			
RACE, D		R	25				0	25		
MAHENDRARAJAH, S		R	10		10		10			
JAMES, R		R	10				0	10		
Total			75	10	30		40	35	0	0
The University of Queensland										
DOLEY, D		R	10		10		10			
Total			10	0	10		10			
STBA										
GORE, P		R	10	10			10			
Total			10	10	0		10			
Australian Forest Growers										
Various		A	0.5				0			0.5
Total			0.5	0	0		0			0.5
CRC funded										
MUNERI, A	Uni Tas	R	100	100			100			
RUAUD, J-N	CSIRO	R	100	100			100			
DUTKOWSKI,G	Uni Tas	R	100	100			100			
SHEPHERD, M	SCU	R	100	100			100			
DUNGEY, H	QFRI	R	100	100			100			
THAMARUS, K	CSIRO	R	100	100			100			
DAVIDSON, N	Uni Tas	R	100		50		50	50		
MISRA, R	Uni Tas	R	100		100		100			
PU, G	Griffith Uni	R	100		100		100			
McARTHUR, C	Uni Tas	R	100			100	100			
STEINBAUER, M	CSIRO	R	100			100	100			
STEANE, D	Uni Tas	R	80	80			80			
POTTS, B	Uni Tas	R	75	75			75			
BORRALHO, N	Uni Tas	R	75	75			75			
ALLEN, G	Uni Tas	R	50			50	50			
HURLEY, M	Uni Tas	R	50			50	50			
SMETHURST, P(until 3/98)	CSIRO	R	72		72		72			
RACE, D	ANU	R	25		25		25			
FULTON, A	UniTas	R	25		25		25			
REID,J	UniTas	R	20				0			20
JORDAN,G	UniTas	R	16	16			16			
Total			1588	846	372	300	1518	50	0	20

SUMMARY OF CONTRIBUTIONS IN PERSON YEARS

	Total person years	Person years spent on Research program				Person years spent on Education Program	Person years spent on Commercialisation Program	Person years spent on CRC Administration
		Gen	*SSM*	*Prot*	Total on Research			
Total Contributed	24.6	5.7	12.7	3.3	21.8	1.3		1.6
Total funded by CRC	15.9	8.5	3.7	3.0	15.2	0.5		0.2
Grand total	40.5	14.2	16.5	6.3	37.0	1.8		1.8
Proportion of total professional (%) staff resources in each activity	100.0	35.0	40.6	15.6	91.2	4.3		4.5

staff resources in each activity

SUPPORT STAFF

Attachment B cont. ../4

Contributed	
Organisation	Number of staff (person years)
CSIRO(FFP & ENTO)	6.1
North Forest Products	2.6
Primary Industries Corporation	2.2
Forestry Tasmania	2.0
Bunnings Treefarms	1.1
University of Tasmania	0.7
Australian Paper Plantations	0.5
SCU	0.5
Australian Forest Growers	0.5
ANM	0.0
Boral Timber	0.0
Griffith University	0.0
Australian National University	0.0
Silvagene	0.0
STBA	0.0
The University of Queensland	0.0
Total	16.2

CRC Funded (by employing organisation)	
Organisation	Number of staff (person years)
University of Tasmania	10.4
CSIRO (FFP & Ento)	1.5
SCU	0.5
GU	0.5
Total	12.9

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Australian Forest Growers

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
Administration	Research	0.25								0.0
Publicity	Research	0.25								0.0
		Total Salary	1.0	0.5	0.5	0.5	0.5	0.5	0.5	4.0
	Direct On-Costs	*% of total Salary*								
	Productivity benefit)									0.0
	Superanuation)									0.0
	Workers Compensatio	10								0.0
	Leave Loading)									0.0
	Long service Leave)									0.0
	Other)									0.0
		Total On-Costs	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4
		Total Salaries & On-Costs	1.1	0.5	0.5	0.5	0.5	0.5	0.5	4.4
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER									
	Publicity		0.3	0.5	0.5	0.5	0.5	0.5	0.5	3.3
		Total Other	0.3	0.5	0.5	0.5	0.5	0.5	0.5	3.3
	TOTAL IN-KIND CONTRIBUTION		1.4	1.0	1.0	1.0	1.0	1.0	1.0	7.7
ALL PROGRAMS CASH CONTRIBUTIONS			1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.0

The Australian National University

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
P Kanowski	Research	30								
S Mahendrarajah	Research	10								
D Race	Research	25								
R James	Research	10								
		Total Salary	48.5	48.5	48.5	48.5	48.5	48.5	48.5	339.5
	Direct On-Costs	*% of total Salary*								
	Payroll tax									
	Superanuation									
	Workers Compensatio									
	Leave Loading									
	Long Service Leave									
		Total On-Costs	10.7	10.7	10.7	10.7	10.7	10.7	10.7	74.9
		Total Salaries & On-Costs	59.2	59.2	59.2	59.2	59.2	59.2	59.2	414.4
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Head Office Support									
	Other									
		Total Other	177.7	177.7	177.7	177.7	177.7	177.7	177.7	1,243.9
		TOTAL IN-KIND CONTRIBUTION	236.9	236.9	236.9	236.9	236.9	236.9	236.9	1,658.3
ALL PROGRAMS CASH CONTRIBUTIONS										0.0

Australian Newsprint Mills

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

SALARIES		*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
S Hetherington	Forest Research Sci	20								
P Volker	Silvicultural Super	10								
R Pyke	Technician	2								
A Willems	Manager, Forests	5								
J Grant	Soil Scientist	2								
		Total Salary	26.0	25.0	25.0	25.0	25.0	25.0	25.0	176.0
	Direct On-Costs	*% of total Salary*								
	Other-Total	31.9	8.3	8.0	8.0	8.0	8.0	8.0	8.0	56.1
		Total On-Costs	8.3	8.0	8.0	8.0	8.0	8.0	8.0	56.1
		Total Salaries & On-Costs	34.3	33.0	33.0	33.0	33.0	33.0	33.0	232.1
CAPITAL										
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER		*% of Total Salaries & On -Costs*								
Office Support			10.0							
Land rent			148.5							
Trial maintenance			15.0							
Experiments			8.5							
Other(Vehicles)			4.0							
		Total Other	186.0	166.0	166.0	169.0	169.0	167.0	167.0	1,190.0
		TOTAL IN-KIND CONTRIBUTION	220.3	199.0	199.0	202.0	202.0	200.0	200.0	1,422.1
ALL PROGRAMS CASH CONTRIBUTIONS			22.4	20.0	20.0	20.0	20.0	20.0	20.0	142.4

Australian Paper Plantations

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
S Pongracic	Scientist	43								
R Appleton	Technician	25								
M Krygsman	Technician	30								
J Cameron	Board	5.1								
		Total Salary	55.6	65.0	67.0	69.0	71.0	73.2	75.4	476.2
	Direct On-Costs	*% of total Salary*								
	Other-Total		10.1	20.0	20.6	21.2	21.9	22.5	23.2	139.5
		Total On-Costs	10.1	20.0	20.6	21.2	21.9	22.5	23.2	139.5
		Total Salaries & On-Costs	65.7	85.0	87.6	90.2	92.9	95.7	98.6	615.7
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Overheads		38.6	34.5	35.5	36.6	37.7	38.8	40.0	261.7
	Operating		96.9	86.5	89.1	91.8	94.5	97.4	100.3	656.5
		Total Other	135.5	121.0	124.6	128.4	132.2	136.2	140.3	918.2
		TOTAL IN-KIND CONTRIBUTION	201.2	206.0	212.2	218.6	225.1	231.9	238.9	1,533.9
ALL PROGRAMS CASH CONTRIBUTIONS			35.0	35.0	35.0	35.0	35.0	35.0	35.0	245.0

Boral Timber Tasmania

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
Designation									
P Naughton	10								0.0
Research	*Total Salary*	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0
Direct On-Costs	*% of total Salary*								
Payroll Tax	7								
Superannuation	5.5								
Workers Compensation	5								
Leave Loading	8								
Long service leave	2								
	Total On-Costs	1.4	1.4	1.4	1.4	1.4	1.4	1.4	9.8
	Total Salaries & On-Costs	**6.4**	**6.4**	**6.4**	**6.4**	**6.4**	**6.4**	**6.4**	**44.8**
CAPITAL									
									0.0
	Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	*% of Total Salaries & On -Costs*								
Head office overheads		0.8	0.8	0.8	0.8	0.8	0.8	0.8	5.6
Office support		1.9	1.9	1.9	1.9	1.9	1.9	1.9	13.3
Operational		1.9	1.9	1.9	1.9	1.9	1.9	1.9	13.3
Amortised vehicle costs		0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.1
Land rent		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7
Trial maintenance		0.5	0.5	0.5	0.5	0.5	0.5	0.5	3.5
Experiments		1.3	1.3	1.3	1.3	1.3	1.3	1.3	9.1
Other		28.0	26.8	26.8	26.8	26.8	26.8	26.8	188.8
	Total Other	34.8	33.6	33.6	33.6	33.6	33.6	33.6	236.4
	TOTAL IN-KIND CONTRIBUTION	41.2	40.0	40.0	40.0	40.0	40.0	40.0	281.2
ALL PROGRAMS CASH CONTRIBUTIONS									

Bunnings Treefarms

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	% time	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
M Vitlich	Board	2								
R Lee	Research	1								
R Breidahl	Research	5								
D Pilbeam	Research	20								
C Shedley	Research	25								
L Maddern	Research	20								
D Walch	Technical	40								
M Booth	Technical	20								
V Sims	Technical	20								
Y Jansen	Technical	20								
Nusery staff	Technical	5								
		Total Salary	54.4							
	Direct On-Costs	*% of total Salary*								
	Payroll tax	0.06	3.3							
	Superanuation	0.06	3.3							
	Workers Compensation	0.06	3.3							
	Leave Loading	0.0146	0.8							
	Long Service Leave	0.0167	0.9							
		Total On-Costs	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total Salaries & On-Costs	65.9	55.0	55.0	55.0	55.0	55.0	55.0	395.9
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Administration	47.52	31.3							
	Office Support	2.56	1.7							
	Corporate Overheads	9.11	6.0							
	Operational	52.87	34.8							
	Amortised capital costs	12.63	8.3							
	Land rent	3.16	2.1							
	Trial Maintenance	10.11	6.7							
	Consumables & Freight	1.67	1.1							
	Library	1.26	0.8							
	Computer Support	3.35	2.2							
	Meetings & visits	16.69	11.0							
	WA Genetics workshop	1.82	1.2							
		Total Other	107.2	115.0	115.0	115.0	115.0	115.0	115.0	797.2
		TOTAL IN-KIND CONTRIBUTION	173.1	170.0	170.0	170.0	170.0	170.0	170.0	1,193.1
ALL PROGRAMS CASH CONTRIBUTIONS			35.0	35.0	35.0	35.0	35.0	35.0	35.0	245.0

CSIRO - Entomology

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
R Floyd	R	25%								
G Farrell	R	30%								
R Milner	R	20%								
J Matthiesen	R	20%								
J Dowse	R	30%								
R Sutherland	R	30%								
M Court	R	30%								
M Steinbauer	R	100%								
PhD Student	R	100%								
J Lawrence	R	10%								
E Edwards	R	10%								
		Total Salary	130.5	125.7	128.0	132.1	127.0	127.0	127.0	897.3
	Direct On-Costs	*% of total Salary*								
	Superannuation	19.9	26.0	25.0	25.5	26.3	25.3	25.3	25.3	178.6
	Comcare	1.1	1.4	1.4	1.4	1.5	1.4	1.4	1.4	9.9
	Leave Loading	1.5	2.0	1.9	1.9	2.0	1.9	1.9	1.9	13.5
	Long Service Leave	2.5	3.3	3.1	3.2	3.3	3.2	3.2	3.2	22.4
	Other	0								
		Total On-Costs	32.6	31.4	32.0	33.0	31.8	31.8	31.8	224.3
		Total Salaries & On-Costs	163.1	157.1	160.0	165.1	158.8	158.8	158.8	1,121.6
	CAPITAL									
		Total Capital								
	OTHER	*% of Total Salaries & On -Costs*								
	Divnl other support	156	190.8	210.3	228.2	234.5	229.9	229.9	229.9	1,553.5
	Corporate support	32	48.9	57.6	63.6	65.3	63.7	63.7	63.7	426.5
		Total Other	239.7	267.9	291.8	299.8	293.6	293.6	293.6	1,980.0
	TOTAL IN-KIND CONTRIBUTION		402.8	425.0	451.8	464.9	452.4	452.4	452.4	3,101.6
	ALL PROGRAMS CASH CONTRIBUTIONS									

CSIRO - Forestry & Forest Products

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	% time	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
Moran,G	R	30%								
Raymond,C	R	100%								
Battaglia,M	R	90%								
Beadle,C	R	80%								
McCormack,S	R	10%								
Mummery,D	R	90%								
Sands, P	R	80%								
Cromer, R	R	50%								
Mohammed,C	R	10%								
Williams,E	R	10%								
Wallis,A	R	5%								
Evans,R	R	5%								
Hand, R (31/8/97)	T	100%								
Baillie,C(3 mths)	T	100%								
Murrell,J	T	50%								
Owen,J	T	10%								
Cherry,M	T	100%								
LaSala,A(end 1/98)	T	100%								
Worledge,D	T	30%								
Churchill,K	T	60%								
Smethurst,P(from 3/98)	R	72%								
Kile,G	A	5%								
Nambiar,S	A	5%								
MacGillivray,G	A	25%								
Lockwood,R	A	1%								
Coles,P	A	25%								
Denton,B	T	25%								
Sprent,J	A	50%								
		Total Salary	515.5	528.2	541.5	555.0	568.9	583.1	597.7	3,889.9

Direct On-Costs	*% of total Salary*								
Productivity Benefit	3	15.5	15.8	16.2	16.7	17.1	17.5	17.9	116.7
Superannuation	18.5	95.4	97.7	100.2	102.7	105.2	107.9	110.6	719.6
Workers Compensation	1.1	5.7	5.8	6.0	6.1	6.3	6.4	6.6	42.8
Leave Loading	1.5	7.7	7.9	8.1	8.3	8.5	8.7	9.0	58.3
Long Service Leave	2.5	12.9	13.2	13.5	13.9	14.2	14.6	14.9	97.2
Other	0								
	Total On-Costs	137.1	140.5	144.0	147.6	151.3	155.1	159.0	1,034.7
	Total Salaries & On-Costs	652.6	668.7	685.5	702.6	720.2	738.2	756.7	4,924.6

CAPITAL									
	Total Capital								

OTHER	*% of Total Salaries & On-Costs*								
Divnl other support	153.4	1,001.1	1,025.8	1,051.6	1,077.8	1,104.8	1,132.4	1,160.8	7,554.4
Corporate support	32	208.8	214.0	219.4	224.9	230.5	236.2	242.1	1,575.9
Imputed Rent		200.0	200.0	200.0	200.0	200.0	200.0	200.0	1,400.0
	Total Other	1,410.0	1,439.8	1,471.0	1,502.7	1,535.3	1,568.7	1,602.9	10,530.3
	TOTAL IN-KIND CONTRIBUTION	2,062.6	2,108.5	2,156.5	2,205.3	2,255.5	2,306.9	2,359.6	15,454.9

ALL PROGRAMS CASH CONTRIBUTIONS								

Forestry Tasmania

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

SALARIES		*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
H Elliott	Research/Admin	10								
J Elek	Research	40								
P Kube	Research	20								
S Candy	Research	40								
R Bashford	Technician	10								
C Ringrose	Technician	50								
N Ramsden	Technician	50								
N Beveridge	Technician	50								
N Marsh	Research	40								
A Jenni	Technician	40								
H Drielsma	Research/Admin	3								
L Pinkard	Research	20								
B Neilsen	Research	5								
		Total Salary	109.4	108.7	108.7	108.7	108.7	108.7	108.7	761.6
Direct On-Costs		*% of total Salary*								
Superannuation			13.0	12.9	12.9	12.9	12.9	12.9	12.9	90.4
Workers Compensation			3.9	3.9	3.9	3.9	3.9	3.9	3.9	27.3
Long Service Leave			2.7	2.7	2.7	2.7	2.7	2.7	2.7	18.9
Payroll Tax			7.9	7.9	7.9	7.9	7.9	7.9	7.9	55.3
		Total On-Costs	27.5	27.4	27.4	27.4	27.4	27.4	27.4	191.9
		Total Salaries & On-Costs	**136.9**	**136.1**	**136.1**	**136.1**	**136.1**	**136.1**	**136.1**	**953.5**
CAPITAL										
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER		*% of Total Salaries & On -Costs*								
Head office o'heads			57.0	56.7	56.7	56.7	56.7	56.7	56.7	397.2
Office support			30.5	30.3	30.3	30.3	30.3	30.3	30.3	212.3
Corporate Support			24.9	24.8	24.8	24.8	24.8	24.8	24.8	173.7
Operational			66.7	66.2	66.2	66.2	66.2	66.2	66.2	463.9
		Total Other	179.1	178.0	178.0	178.0	178.0	178.0	178.0	1,247.1
		TOTAL IN-KIND CONTRIBUTION	316.0	314.1	314.1	314.1	314.1	314.1	314.1	2,200.6
ALL PROGRAMS CASH CONTRIBUTIONS			22.5	15.0	15.0	15.0	15.0	15.0	15.0	112.5

Griffith University

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
P Saffigna	Research	50								
S Berners-Price	Research	5								
S Perera	Research	10								
I Phillips	Research	10								
B Yu	Research	15								
R Rickson	Research	15								
J Hughes	Research	5								
R Braddock	Research	15								
R King	Board Member									
		Total Salary	113.5	113.5	113.5	113.5	113.5	113.5	113.5	794.5
	Direct On-Costs	*% of total Salary*								
	Payroll tax	5	5.7	5.7	5.7	5.7	5.7	5.7	5.7	39.7
	Superanuation	17	19.3	19.3	19.3	19.3	19.3	19.3	19.3	135.1
	Workers Compensatio	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	6.4
	Leave Loading	1.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.3
	Enterprise Bargaining	2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	15.9
	HECS student costs		20.5	18.0	18.0	18.0	18.0	18.0	18.0	128.5
		Total On-Costs	50.1	47.6	47.6	47.6	47.6	47.6	47.6	335.9
		Total Salaries & On-Costs	163.6	161.1	161.1	161.1	161.1	161.1	161.1	1,130.4
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Academic services	20	32.7	32.2	32.2	32.2	32.2	32.2	32.2	226.1
	General University Services	41	67.1	66.1	66.1	66.1	66.1	66.1	66.1	463.4
	Deptl Other support	8	13.1	12.9	12.9	12.9	12.9	12.9	12.9	90.4
	Other Lab Space	23	37.6	37.1	37.1	37.1	37.1	37.1	37.1	260.0
		Total Other	150.5	148.2	148.2	148.2	148.2	148.2	148.2	1,039.9
		TOTAL IN-KIND CONTRIBUTION	314.2	309.4	309.4	309.4	309.4	309.4	309.4	2,170.3
ALL PROGRAMS CASH CONTRIBUTIONS			25.0	25.0	25.0	25.0	25.0	25.0	25.0	175.0

North Forest Products

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
D deLittle	Scientist									0.0
G Holz	Scientist									0.0
G Rasmussen	Scientist									0.0
W Tibbits	Scientist									0.0
M Powell	Scientist									
A Jamieson	Manager									
C Bames	Scientist									
Casuals/Others	Technicians									
		Total Salary	198.0							198.0
	Direct On-Costs	*% of total Salary*								
	Other-Total	33	65.3							65.3
		Total On-Costs	65.3	0.0	0.0	0.0	0.0	0.0	0.0	65.3
		Total Salaries & On-Costs	**263.3**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**863.3**
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Office Support		7.0							
	Land rent		87.0							
	Trial maintenance		8.0							
	Other(Vehicles)		267.0							
		Total Other	369.0	216.0	216.0	216.0	216.0	216.0	216.0	1,665.0
	TOTAL IN-KIND CONTRIBUTION		632.3	316.0	316.0	316.0	316.0	316.0	316.0	2,528.3
ALL PROGRAMS CASH CONTRIBUTIONS			65.1	50.0	50.0	50.0	50.0	50.0	50.0	365.1

QFRI - Primary Industries Corporation

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	% time	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
M Dieters	Research	40								
D Nikles	Research	35								
S Walker	Research	20								
K Harding	Research	15								
M Nester	Research	15								
K Bubb	Research	40								
M Hunt	Research	25								
A House	Research	5								
B Keenan	Research	25								
M Lewty	Research	15								
P Ryan	Research	10								
J Simpson	Research	50								
Z Xy	Research	50								
D Osborne	Research	50								
E Keady	Research	5								
B Prydon	Research	5								
B Haines	Research/Administration	50								
P Toon	Technician	40								
P Pomeroy	Technician	20								
J Huth	Technician	10								
M Podberseck	Technician	10								
C Radddatz	Technician	40								
M Johnsen	Technician	15								
P Frayne	Technician	25								
P Collins	Chemist	15								
L Cox	Technician	20								
L Stephens	Technician	10								
B Mumbray	Administration	10								
M Robinson	Administration	10								
T Wemmerslager	Administration	10								
	Total Salary		332.7	297.3	297.3	297.3	297.3	297.3	297.3	2,116.5
	Direct On-Costs	*% of total Salary*								
	Payroll Tax	5.7	19.0	16.9	16.9	16.9	16.9	16.9	16.9	120.6
	Superannuation	13.5	44.9	40.1	40.1	40.1	40.1	40.1	40.1	285.7
	Long Service Leave	1.8	6.0	5.4	5.4	5.4	5.4	5.4	5.4	38.1
	Leave Loading	8.3	27.6	24.7	24.7	24.7	24.7	24.7	24.7	175.7
	Enterprise Bargaining	4	13.3	11.9	11.9	11.9	11.9	11.9	11.9	84.7
	Salary banding	1.7	5.7	5.1	5.1	5.1	5.1	5.1	5.1	36.0
	Workers comp yrly premium x 10%		0.7	0.7	0.7	0.7	0.7	0.7	0.7	4.9
	Total On-Costs		117.1	104.8	104.8	104.8	104.8	104.8	104.8	745.7
	Total Salaries & On-Costs		449.8	402.1	402.1	402.1	402.1	402.1	402.1	2,862.2
	CAPITAL									
	Lab Modifications		3.0							3.0
	Gas Chromatograph/Mass Spectrometer x 20%s		25.4							25.4
	Replace flow injection analyser			24.0						24.0
	Total Capital		28.4	24.0	0.0	0.0	0.0	0.0	0.0	52.4
	OTHER	*% of Total Salaries & On -Costs*								
	QFRI Administrative Overheads	5	22.5	20.1	20.1	20.1	20.1	20.1	20.1	143.1
	Dept administrative support	10	45.0	40.2	40.2	40.2	40.2	40.2	40.2	286.2
	Office space	10	45.0	40.2	40.2	40.2	40.2	40.2	40.2	286.2
	Laboratory/Glasshouse rent	10	45.0	40.2	40.2	40.2	40.2	40.2	40.2	286.2
	Travel & Accommodation			30.0	30.0	30.0	30.0	30.0	30.0	180.0
	Field Trials		303.2	100.0	100.0	100.0	100.0	100.0	100.0	903.2
	Chemical analysis		26.4	20.0	20.0	20.0	20.0	20.0	20.0	146.4
	Depreciation		39.0	39.0	39.0	39.0	39.0	39.0	39.0	273.0
	Total Other		526.0	329.7	329.7	329.7	329.7	329.7	329.7	2,504.4
	TOTAL IN-KIND CONTRIBUTION		1,004.3	755.8	731.8	731.8	731.8	731.8	731.8	5,418.9
ALL PROGRAMS CASH CONTRIBUTIONS			25.0	25.0	25.0	25.0	25.0	25.0	25.0	175.0

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

SILVAGENE

Itemised List of Cash and In-Kind Contributions (in $'000's)

Name	**SALARIES** *Designation*	*% time CRC*	97/98 Actual	98/99 Budget	99/2000 Budget	2000/01 Budget	2001/02 Budget	2002/03 Budget	2003/04 Budget	TOTAL
										0.0
		Total Salary	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Direct On-Costs	*% of total Salary*								
		Total On-Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total Salaries & On-Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER									
		Total Other	5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0
	TOTAL IN-KIND CONTRIBUTION		5.0	5.0	5.0	5.0	5.0	5.0	5.0	35.0
ALL PROGRAMS CASH CONTRIBUTIONS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Southern Cross University

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
R Henry	Research	30								
T Codrington	Research	20								
P Carolan	Administration	10								
P Baverstock	Research	5								
V Watt	Administration	10								
D Mcintyre	Administration	10								
		Total Salary	47.1							
	Direct On-Costs	*% of total Salary*								
	Payroll Tax	7.7	3.6							
	Superannuation	16.6	7.8							
	Workers compensation	1.5	0.7							
	Long Service Leave	3	1.4							
	Leave Loading	1.3	0.6							
	Tess	3	1.4							
	Other- Maternity Leave	0.4	0.2							
		Total On-Costs	15.8							
	Total Salaries & On-Costs		**62.9**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**60.0**	**422.9**
	CAPITAL									
	Total Capital		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Academic Servs/bldgs	8.7	5.5							
	Academic Activities- other	27.7	17.4							
	Libraries	15.4	9.7							
	Other academic support services	15.5	9.7							
	Student support services	12	7.5							
	Public services	1	0.1							
	Buildings & grounds	16.8	10.6							
	Admin & general	37.6	23.6							
	Independent operations	20.4	12.8							
	Other(Research)		89.2							
	Other(Admin)		3.0							
	Total Other		189.2	249.0	249.0	249.0	249.0	249.0	249.0	1,683.2
	TOTAL IN-KIND CONTRIBUTION		252.0	309.0	309.0	309.0	309.0	309.0	309.0	2,106.0
ALL PROGRAMS CASH CONTRIBUTIONS			100.0	100.0	100.0	100.0	100.0	100.0	100.0	700.0

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Southern Tree Breeding Association

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
P Gore	Prog mgr	10								0.0
		Total Salary	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Direct On-Costs	*% of total Salary*								
		Total On-Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Salaries & On-Costs		6.0	6.0	6.0	6.0	6.0	6.0	6.0	42.0
	CAPITAL									
		Total Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER									
		Total Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL IN-KIND CONTRIBUTION		6.0	6.0	6.0	6.0	6.0	6.0	6.0	42.0
ALL PROGRAMS CASH CONTRIBUTIONS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The University of Queensland

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

	SALARIES	*% time*	97/98	98/99	99/2000	2000/01	2001/02	2002/03	2003/04	TOTAL
Name	*Designation*	*CRC*	Actual	Budget	Budget	Budget	Budget	Budget	Budget	
D Doley	Research	20								0.0
		Total Salary								0.0
	Direct On-Costs	*% of total Salary*								
	Payroll tax)	21%								
	Superanuation)									
	Workers Compensatio)									
	Leave Loading)									
	Long Service Leave)									
		Total On-Costs								
	Total Salaries & On-Costs		8.6	25.0	25.0	25.0	25.0	25.0	25.0	158.6
	CAPITAL									
	Total Capital		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	*% of Total Salaries & On -Costs*								
	Lab space & facilities		8.0							
	Consumables		2.0							
	Total Other		10.0	47.0	47.0	47.0	47.0	47.0	47.0	292.0
	TOTAL IN-KIND CONTRIBUTION		18.6	72.0	72.0	72.0	72.0	72.0	72.0	450.6
ALL PROGRAMS CASH CONTRIBUTIONS										0.0

University of Tasmania

CRC FOR SUSTAINABLE PRODUCTION FORESTRY 1997/98 Financial tables

Itemised List of Cash and In-Kind Contributions (in $'000's)

SALARIES

Name	*Designation*	*% time CRC*	97/98 Actual	98/99 Budget	99/2000 Budget	2000/01 Budget	2001/02 Budget	2002/03 Budget	2003/04 Budget	TOTAL
J Reid	Research	50								
R Vaillaincourt	Research	45								
G Allen	Research	25								
M Hurley	Research	25								
R Clark	Research	20								
R Menary	Research	20								
R Hill	Research	10								
G Hallengraf	Research	10								
M Line	Research	20								
P Brown	Research	30								
R Wiltshire	Research	30								
M Hovenden	Research	5								
S Jennings	Research	15								
C Mohammed	Research	15								
CR Johnson	Research	10								
S Hunter	Technical	5								
A Smolenski	Technical	18								
I Cummings	Technical	30								
L Johnson	Technical	1								
B Rumbold	Technical	1								
C Ashworth	Technical	1								
G Johnson	Technical	20								
G Haig	Technical	20								
A Canty	Research	1								
B Potts	Research	25								
N Borralho	Research	25								
	Total Salary		259.1	260	260	260	260	260	260	1819.1
Direct On-Costs		*% of total Salary*								
Payroll Tax		7	18.1	18.2	18.2	18.2	18.2	18.2	18.2	127.3
Superannuation		17	44.0	44.2	44.2	44.2	44.2	44.2	44.2	309.2
Workers Compensation		1	2.6	2.6	2.6	2.6	2.6	2.6	2.6	18.2
Leave Loading-Academics		1.3	3.2	3.4	3.4	3.4	3.4	3.4	3.4	23.6
Long Service Leave		3.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3	58.2
Outside Study Academics			20.0	20.0	20.0	20.0	20.0	20.0	20.0	140.0
HECS student costs			30.0	30.0	30.0	30.0	30.0	30.0	30.0	210.0
Other										0.0
	Total On-Costs		126.3	126.7	126.7	126.7	126.7	126.7	126.7	886.6
	Total Salaries & On-Costs		385.4	386.7	386.7	386.7	386.7	386.7	386.7	2,705.7
CAPITAL										
	Total Capital		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER		*% of Total Salaries & On -Costs*								
Academic Services		25.0	96.3	96.7	96.7	96.7	96.7	96.7	96.7	676.4
General Uni Services		41.0	158.0	158.5	158.5	158.5	158.5	158.5	158.5	1,109.3
Departmental office support		10.0	38.5	38.7	38.7	38.7	38.7	38.7	38.7	270.6
Laboratory rent		32.0	123.3	123.7	123.7	123.7	123.7	123.7	123.7	865.8
Office Space		8.0	30.8	30.9	30.9	30.9	30.9	30.9	30.9	216.4
CSI.			84.4	84.4	84.4	84.4	84.4	84.4	84.4	590.8
Centre Agency (10% grant)			171.8	230.0	230.0	230.0	230.0	230.0	230.0	1,651.8
	Total Other		703.2	763.0	763.0	763.0	763.0	763.0	763.0	5,281.1
TOTAL IN-KIND CONTRIBUTION			1,088.6	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	1,149.7	7,986.8
ALL PROGRAMS CASH CONTRIBUTIONS										

Cooperative Research Centre for Sustainable Production Forestry

Summary of External Funds Received 1997/98
(for specific projects that are not part of the Activities of the Centre)

Opening Balance at 1/7/97	93,506
Add Income	154,519
Less Expenses	
Salaries	67,382
Consumables	46,413
Equipment	3,522
TOTAL EXPENSES	117,317
Closing Balance at 30/6/98	130,708

ALL PROGRAMS CASH CONTRIBUTIONS

COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY

GPO Box 252-12, Hobart, Tasmania 7001, Australia
Tel (03) 6226 7947 (Internat) +61 3 6226 7947
Fax (03) 6226 7942 (Internat) +61 3 6226 7942

Internet http://www.tased.edu.au/tasonline/crcfores/