COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY

Annual Report 04/05

CRC AUSTRALIA

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

Mission Statement

The role of the Cooperative Research Centre for Sustainable Production Forestry (CRC-SPF) 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-SPF 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 stakeholders capture the benefits of Centre research through effective technology transfer.

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ANNUAL REPORT 2004/05

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AUSTRALIAN FOREST GROWERS

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

FOREST ENTERPRISES AUSTRALIA PTY LTD

FORESTRY TASMANIA

GUNNS LIMITED

NORSKE SKOG PAPER MILLS (AUSTRALIA) LIMITED

PRIVATE FORESTS TASMANIA

SEEDENERGY PTY LTD

SOUTHERN CROSS UNIVERSITY

SOUTHERN TREE BREEDING ASSOCIATION INCORPORATED

THE AUSTRALIAN NATIONAL UNIVERSITY

TIMBERCORP LIMITED

UNIVERSITY OF TASMANIA

WACAP TREEFARMS PTY LTD

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DIRECTOR'S REPORT

The CRC for Sustainable Production Forestry wound up on 30 June 2005 after eight productive years of research in support of the Australian forest industries. In this final year we have focussed upon taking further value from a range of long-term experiments and also upon technology transfer to help our industry partners improve their own business performance.

In implementing this year's communication and technology transfer program, CRC-SPF staff were responsible for a total of 300 individual items, including scientific journal articles, seminars, reports, conference proceedings, book chapters, industry newsflashes, media reports, and field days. The CRC also hosted major workshops addressing the way forward in alternatives to 1080 poisoning to control mammal browsing; in eucalypt genetics research and eucalypt breeding strategies; and in breeding and silvicultural techniques for value-added end products from plantations.

The primary role of the CRC has been to conduct high-quality research of value to the industry, but we were also charged with securing the future of forest science by educating the next generation of researchers. The Education Program has been recognised as a particular strength of CRC-SPF. In total 48 postgraduate students were enrolled in 2004/5. Eleven postgraduate students successfully completed their degrees and a further nine postgraduate students submitted theses for examination.

Through the incentives of top-up scholarships and our ability to offer direct links with industry and a greater likelihood of subsequent employment, we have consistently attracted high-calibre students. In 2004, four of the 13 University of Tasmania graduates recognised by the Dean of Graduate Research Commendation Award for Outstanding Doctoral Theses were from the CRC-SPF; this is a tribute both to the students themselves and to the scientists who supervised their research programs.

A successful CRC is a community activity with all parties - research providers, industry users and students – all contributing and benefiting from their involvement. For example, senior scientists within CSIRO have observed that being a partner with the CRC-SPF has impacted upon their own culture by introducing young PhD students into their traditionally non-teaching research environment. The CRC-SPF has made great efforts to involve our industry partners in research and student mentoring, rather than just representing our "customer base". Each of our Program Co-ordinating Committees has been chaired by someone from industry, and their efforts are appreciated, but a particularly important message for the future is that technology transfer is an active process requiring effort from all involved. To take full advantage from their investment, companies do need to make staff time available and this has not always been the case.

The CRC-SPF has perhaps been fortunate in being in the right place at the right time. During the terms of this CRC and its predecessor, CRC-THF, there was a massive expansion in hardwood plantation establishment encouraged by the 2020 Vision policy developed in partnership between the Commonwealth, state and territory governments and forest industries. This created an expanding market for our science, with increasingly favourable economies of scale.

All three CRC-SPF research program areas have contributed to the success of this expanded national investment, not only through specific research outputs, but through a wider appreciation of the possibilities for using science and technology to underpin business activity. In the mid-1990s it is fair to say that many forest managers did not really believe that the consequences of their actions could be modelled and predicted. Through the development of process-based models such as CABALA, CRC-SPF scientists have changed this view. With current knowledge it is possible to break down the total variation in the plantation system into predictable components that might account for up to 70 per cent of total variation in growth potential; and this knowledge can be used to reduce the many risks associated with managing these new investments.

The most successful part of the CRC research program as judged by a cost:benefit analysis has been the sustained effort in genetics, breeding and seed production of blue-gums and shining gum. This science has been used by breeders servicing the industry needs as the area planted with these species has expanded from about 50,000 ha in 1990 to 625,000 ha in 2004.

One of the greatest challenges for Australian eucalypt growers in competing with the rest of the world is that they have had to contend with all the co-evolved insect pests, diseases, and vertebrate browsers present in native forests. Protecting the plantation resource from these impacts in environmentally and socially acceptable ways has been an important focus of CRC-SPF research.

I am proud of the achievements of my colleagues during the course of CRC-SPF, and confident that we have repaid the Australian taxpayer and our industry partners for the financial and in-kind support that made the program possible. From 1 July 2005 most partners in CRC-SPF, together with a number of new research providers and industry partners, will be embarking upon another seven-year term of cooperative research. The objectives of the new CRC for Forestry will be substantially different, but it is the track record of CRC-SPF staff that attracted the industry support critical to the success of this new bid. I would like to thank them all, and in particular my research program managers: Drs Chris Beadle, Caroline Mohammed and Associate Professor Brad Potts.

Finally I would like to acknowledge the behind-the-scenes activity of our Board of Directors in ensuring that the business of the CRC was conducted according to plan and in the interests of all partners. The goodwill and support at both political and industry level that made year eight possible did not "just happen", it required much planning and lobbying. It was particularly useful to be able to draw upon the experience and support of our Chairman Mr John Kerin. Thank you John, from us all at CRC-SPF.

Professor Rod Griffin
Director.

MANAGEMENT

The Board

The Board of Management of the CRC comprises an independent Chair, a representative of each core member organisation, the Director and Deputy Director of the CRC and the Chair of the Advisory Panel. The Board determines policy and strategic direction, and sets guidelines for the effective operation and management of the CRC.

The Board held three meetings during the year 2004/05.

The management structure and links are shown in Figure 1. Operation of the CRC is facilitated through three committees:

Advisory Panel

The Advisory Panel has the role of providing scientific advice to the Board. The panel includes Dr David de Little (Chair), three external scientific experts – Dr Peter Ades (University of Melbourne), Professor Roger Sands (University of Canterbury, New Zealand), Dr Tim New (La Trobe University), and the Chair of each Program Coordinating Committee.

Management Committee

The Management Committee assists the Director in the day-to-day running of the CRC by implementing the policies set by the Board.

The Management Committee met seven times during the year 2004/05.
The committee comprises:
Professor Rod Griffin (Director)
Professor Robert Henry (Deputy Director)
Mrs Jo Neilson (Business Manager)
Mrs Shelley Caswell (Administrative Officer)

Program Managers:
Associate Professor Brad Potts (Genetic Improvement)
Dr Chris Beadle (Sustainable Management)
Dr Caroline Mohammed (Resource Protection)
Dr Neil Davidson (Education)
Dr Philip Smethurst (Technology Transfer)

CRC Board


Mr John Kerin
Chairman


Prof Rod Griffin
Director


Dr David de Little
Chair, Advisory Panel


Prof Robert Henry
Deputy Director


Mr Ian Ravenwood
Plantation Division Manager
North West
Gunns Ltd


Prof Andrew Glenn
Pro-Vice-Chancellor
(Research)
University of Tasmania


Dr Hans Driehuis
General Manager
(Forest Management)
Forestry Tasmania


Mr Tim Browning
General Manager - Forestry
Timbercorp Ltd


Prof Peter Baverstock
Dean
Graduate Research College
Southern Cross University


Dr Clive Carlyle
Centre Director, CSIRO
Forestry and Forest Products


Mr Arnol Willems
Performance Manager-Fibre
Norske Skog Paper Mills
(Australia) Limited


Mr Richard Breidahl
General Manager
Plantation Operations
WACAP Treefarms Pty Ltd

MANAGEMENT

Program Coordinating Committees

The Program Coordinating Committees meet at least twice each year to review and preview research with regard to its scientific and technological merit and to set and review research program outcomes. The committees are chaired by an industry partner representative, and consist of the Program Manager and at least three industry partner representatives. Project leaders within the program are included as non-voting members.

Genetic Improvement Program
Dr Peter Volker (Chair)
Professor Rod Griffin (Director)
Associate Professor Brad Potts (Program Manager)
Ms Helen O'Sullivan (Timbercorp)
Mr Chris Berry (Norske Skog)
Mr Simon Hunter (WACAP)
Mr Kelsey Joyce (Gunns Limited)
Dr Tony McRae (Southern Tree Breeding Association)

Sustainable Management Program
Ms Sandra Hetherington (Chair)
Professor Rod Griffin (Director)
Dr Chris Beadle (Program Manager)
Mr Chris Barnes (Gunns Limited)
Dr Paul Adams (Forestry Tasmania)
Mr Mark Bamess (WACAP)
Dr James Bulinski (Timbercorp)
Dr Neil Davidson (Program Manager, Education Technology Transfer)

Resource Protection Program
Dr David de Little (Chair)
Professor Rod Griffin (Director)
Dr Caroline Mohammed (Program Manager)
Mr Chris Barnes (Gunns Limited)
Mr Chris Berry (Norske Skog)
Dr James Bulinski (Timbercorp)
Dr Tim Wardlaw (Forestry Tasmania)
Dr Neil Davidson (Program Manager Education Technology Transfer)
Dr Geoff Allen (Project Leader, C1 and C2)
Dr Julianne O'Reilly-Wapstra (Project Leader, C3 and C4)

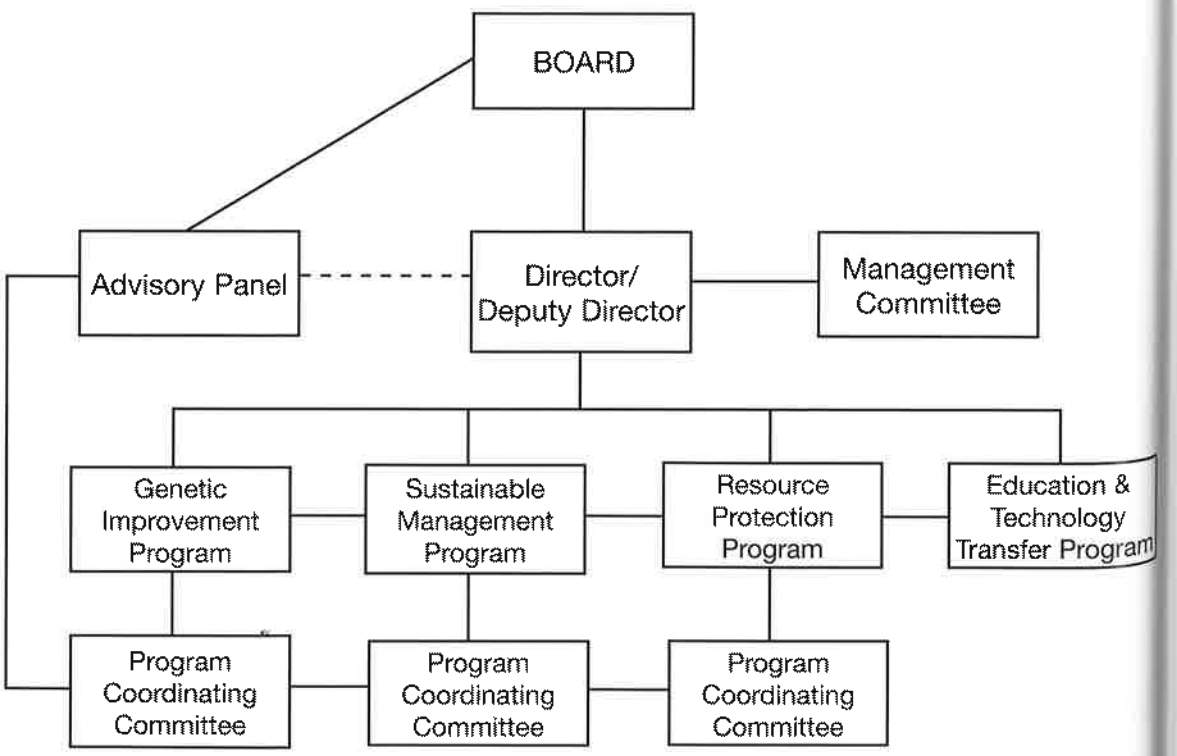


Figure 1. Management Structure

MAJOR DEVELOPMENTS

Genetic relationships in a breeding population of *Eucalyptus globulus*

Tree breeding is an important tool for increasing productivity and profit from Australian plantations. With support from an Australian Research Council Australian Postgraduate Award Industry (ARC APAI) scholarship and the Southern Tree Breeding Association (STBA), PhD student Tim Jones used state-of-the-art molecular markers (microsatellites) to determine the genetic composition of open-pollinated seed from a natural stand, and examined the genetic diversity within the first generation of the STBA national *Eucalyptus globulus* breeding program. The base generation of this breeding program comprises trials established from open-pollinated seed collected from native stands in Australia.

The study reports the first direct measurements of the extent of bi-parental inbreeding in a native eucalypt forest. Bi-parental inbreeding occurs when the male and female are related. Open-pollinated families exhibit inbreeding depression and selfing was known to contribute to this, but the importance of bi-parental inbreeding was unclear. Tim Jones found that the bi-parental form of inbreeding was more prevalent than expected and accounted for about one third of the total inbreeding depression expected from open-pollinated families. To estimate this in a natural eucalypt forest it was necessary, firstly, to fingerprint 168 male trees in close proximity to the female trees; secondly, to estimate which trees were related to the female; and then to use paternity analysis to work out which trees were the males. The paternity analysis of 549 seedlings from nine females showed that a large number of males contributed to each open-pollinated family. Twenty-one males on average were represented in an average family size of 61. This result is good news for breeders predicting breeding values and for capturing genetic diversity. However, it was shown that trees even in close proximity to each other in a dense native forest may vary markedly in their level of outcrossing and this may bias breeding value predictions. This study showed the power of molecular fingerprinting to recover pedigree relationships. Integrating such information into genetic evaluation models offers potential to improve breeding value predictions and genetic parameter estimation.

The genetic diversity among 149 selections in the first generation of the STBA *E. globulus* breeding population was then compared to the levels of genetic diversity in native trees sampled from throughout the geographic range of *E. globulus* previously obtained from a microsatellite study led by Dr Dorothy Steane. The genetic diversity and heterozygosity in the breeding population was at least as high as that found in native populations. Following the first generation of selection, the breeding population captured a significant amount of the genetic diversity from the natural distribution of the species, with most selections fitting closely with their native race of origin. This study provides the foundation for monitoring changes in genetic diversity in the breeding and deployment populations of *E. globulus* used in Australia, and for quality control.

State-of-the-art DNA fragment analysis was a major component of the project. Here, Tim Jones is examining DNA fingerprints using the Beckman Coulter CEQ 8000 Genetic Analyses System.

MAJOR DEVELOPMENTS

"Landsat" images can be used to monitor woody-vegetation change

An initial assessment in 1992 of rural tree decline in the Midlands of Tasmania showed that approximately 50,000 ha were affected. Observation suggests that tree decline has since accelerated in areas already affected and that previously unaffected areas are showing signs of thinning in woody vegetation. A major task in a Natural Heritage Trust funded project was to quantify these changes. To accomplish this, a sequence of eight satellite images was obtained for the period 1989 to 2004.

Images were calibrated to correct for differences in solar azimuth and elevation, variable reflectance of a target as a function of illumination geometry and viewing angle, and terrain-based shading and illumination effects. An index sensitive to woody-vegetation density, and masks for cloud and non-woody vegetation, were created. Scaled temporal response-profiles over the time period were calculated using orthogonal polynomials.

The two principal outputs are a multi-date index file that can be used to plot change over time for any 25 metre pixel or collection of pixels and a vegetation trend f that contains summaries of the temporal patterns vegetation change suitable for display as a single ima or map (see Figure 2). The map was made by assigni the positive and negative linear slopes to red and bl respectively, and assigning the mean brightness green.

If the temporal response is smooth, then the trend ban (mean, linear, quadratic) will provide an adequa summary of change. Clearing will result in a sudd change in brightness; grazing will cause a more gradu change over a longer period. Vegetation changes a based solely on the spectral values of the index used an allow comparison of the location, timing and directio of canopy reflectance changes. The index provides onl a surrogate for actual canopy and understorey conditio and density changes over time. Ideally, samples of eac vegetation type should be described and delineated i the field, an exercise in this project that complement this work with satellite imagery.

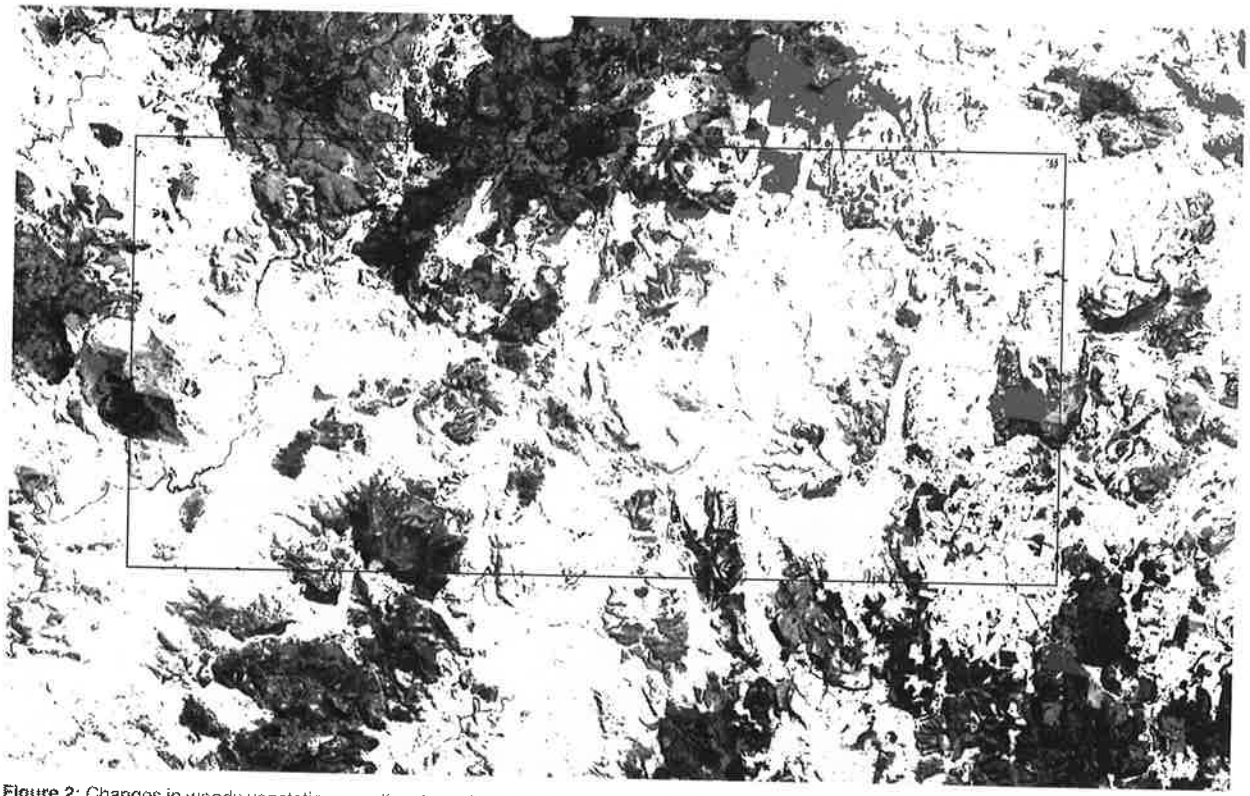
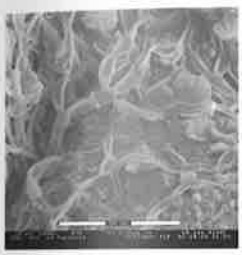


Figure 2: Changes in woody vegetation over time in a 62 x 38.5 km area of the Midlands of Tasmania. Black and green indicate stable dense (low mean brightness index) and less dense (high mean brightness index) vegetation, respectively; red is vegetation decline (dense to thin vegetation, positive linear brightness trend); blue is vegetation recovery (thin to dense vegetation, negative linear brightness trend), orange and cyan indicate decline and recovery of thinner vegetation, respectively; purple is cloud cover (not assessed); beige is masked out as non-woody vegetation.

MAJOR DEVELOPMENTS

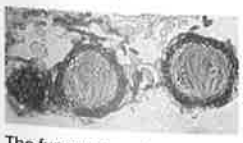
Resistance of juvenile eucalypt leaves to *Mycosphaerella* leaf disease

Fungal spores germinate and enter leaves via stomata



Infection covers leaf surface.

Unrestricted necrosis causes defoliation, shoot blight, branch death and stem defects.



The fungus reproduces. Spores are carried by the wind to other trees and the cycle starts again.

Mycosphaerella leaf disease (MLD) is a major cause of leaf necrosis; blight; premature senescence in leaves and shoots; and tree death in temperate eucalypt plantations worldwide.

Financial losses may result from: the need to entirely re-establish a plantation; reduced growth of an existing plantation; extended rotational time of an existing plantation; or, decreased stem quality at the time of harvesting a plantation due to branch trace defects.

Structural characteristics of the leaf (such as fewer stomata, thicker cuticle and enhanced waxy coatings) can reduce the likelihood of infection. Upon infection, defensive responses occur in adjacent undamaged cells and tissues to isolate the pathogens. These cells become saturated with lignin, suberin and flavanoids to form a continuous barrier to restrict pathogen spread.

PhD student Anna Smith has been studying resistance to *Mycosphaerella* leaf disease at an inter- and intra-specific level. Anna's study found that:

1. *E. globulus* is more susceptible to MLD than *E. nitens* in Australia.

2. Provenances of *E. nitens* from northern New South Wales are more resistant than those from southern New South Wales.

3. Intra-specific differences in resistance can be detected within families of *E. globulus*.

After contrasting resistant and susceptible genotypes at each of these levels, Anna proposed two resistance mechanisms:

Type 1: Resistance to initial infection

- Increased wax coverage of stomata was found in resistant *E. globulus*.

- Fungi are more likely to grow over wax-covered stomata, which have fewer entry points into the leaf. The hydrophobic nature of the wax reduces the amount of free water (free water is needed for spore germination).

Type 2: Restriction of pathogen after infection

A higher specific leaf weight in resistant genotypes of *E. globulus* is linked with a higher cell density of mesophyll.

In *E. nitens*, higher cell densities were recorded in resistant genotypes due to:

- Additional layers and/or tightly packed palisade mesophyll

- Reduced leaf thickness

- Reduced proportion of spongy mesophyll

- Reduced airspace within the spongy mesophyll layer

Increased initial cell density allows for high rates of cell division to occur once infection occurs. This results in a rapidly formed and stronger barrier-zone in resistant genotypes compared with susceptible genotypes. Rapid and effective barrier-zones are essential for compartmentalising and containing pathogen spread to shoots and branches.

As chemical control options are not viable for MLD, breeding for resistance appears to be the most suitable means for the long-term control of MLD. Specific leaf weight is suggested as an easily assessable screening trait for enhanced *Mycosphaerella* resistance.

COOPERATIVE LINKAGES

The CRC SPF has strong international linkages between the:

Genetic Improvement Program and scientists in the United States of America, New Zealand, Chile, Argentina, Portugal, China, France, Denmark and Malaysia;

Sustainable Management Program and scientists in the United States of America, Germany, China, Sweden, Portugal, France, New Zealand and South Africa;

Resource Protection Program and scientists in the United States of America, Canada, United Kingdom, New Zealand, Chile, Brazil, Sweden, Germany, Japan, Malaysia and Indonesia.

Major national links exist with a number of Australian universities, State authorities and forestry companies. Within centre links exist between all projects and programs.

Genetic Improvement Program

International links	CRC staff	Collaborator	Research
Project A1: *Genetics and reproductive biology of eucalypts*	A/Prof B Potts	Prof T Whitham (UNA, USA)	Genetic impacts on biodiversity
	A/Prof B Potts Dr G Dutkowski	Dr J Costa e Silva and Prof MH Almeida, (Universidade Técnica de Lisboa, Portugal) Dr N Borralho (RAIZ, Portugal)	Optimising genetic evaluation methods to develop breeding and deployment strategies in *Eucalyptus globulus*
	A/Prof B Potts Dr René Vaillancourt	Dr N Borralho (RAIZ, Portugal)	Unravelling the relationship between growth and wood properties in temperate eucalypts (ARC funded)
Project A2: Breeding Strategies	Dr G Dutkowski	Dr J Costa e Silva (Denmark)	Spatial analysis
	Dr G Dutkowski	Dr T Ericsson (Sweden) and Dr N Borralho (Portugal)	Across site analysis
	Dr G Dutkowski	Dr N Borralho (Portugal) and Ms R Sanhueza, Mr E Velilla (Chile)	Breeding value prediction
	Dr G Dutkowski A/Prof B Potts	Dr J Costa e Silva (Denmark)	Genotype x environment analysis *E. globulus*
Project A4: Molecular genetics of eucalypts	Dr R Vaillancourt, A/Prof B Potts and Mr J Freeman	Dr C Marques and Dr N Borralho (RAIZ, Portugal)	Assignment of the Portugese landrace of *E. globulus* to native races using microsatellites
	Dr R Vaillancourt, Prof Rod Griffin, Prof J Reid, A/Prof B Potts, Dr D. Steane and Ms F Poke	Dr A Myburg (University of Pretoria, South Africa), Dr D Grattapaglia (Embrapa, Brazil) and Dr C Marques (RAIZ, Portugal)	International eucalypt genome initiative
National links			
Project A1: Genetics and reproductive biology of eucalypts	A/Prof B Potts Dr René Vaillancourt	Ms H O'Sullivan (Timbercorp), Mr S Hunter (WAPRES), I Ravenwood (GL), C Hajek (DPI, Vic), Dr P Volker (FT), M Henson (Forests NSW), Dr T McRae (STBA), M Lavery (Arianda Pty. Ltd)	Assessing the risk of genetic pollution from *Eucalyptus globulus* and *Corymbia* plantations (ARC funded)
Project A2: Breeding Strategies	Dr G Dutkowski	Dr T McRae (STBA), Ms S Hetherington (NS), Mr P Lloyd (Auspine), Mr R Underdown (Forestry SA), Mr H Stewart (Treecorp), Mr G Ellis (GSP), Dr P Volker (FT)	Breeding management
	Dr G Dutkowski	Dr A Gilmour (NSW Agriculture)	Improvements in quantitative genetic models
	Dr G Dutkowski	Dr T McRae (STBA), Dr H Graser, Dr B Tier (AGBU, UNE)	Breeding value prediction software for tree breeding
	Dr B Greaves	Dr G Nolan, Dr T Innes (UTas)	Wood quality evaluation
Project A4: Molecular genetics of eucalypts	Dr D Steane and Dr R Vaillancourt	Australian Genome Research Facility (AGRF)	Sequencing the chloroplast genome of *E. globulus*
Project A5: Wood quality	Dr C Harwood and Ms K Siu	Dr C Raymond and Mr J Ilic (CSIRO FFP)	Non-destructive assessment of wood stiffness
	Ms F Poke	Dr C Raymond (NSW Forestry) and Dr J Wright (CSIRO FFP)	NIR models for lignin
Project A7: Molecular genetic improvement for tropical and sub-tropical production	Dr M Shepherd	Mr B Chen (Fujian Ag. & Forestry University, Fujian , Peoples' Republic of China)	Molecular variation in *Corymbia*
	Dr M Shepherd	Dr G Dale (Saltgrow P/L Aust)	Genetics of vegetative propagation traits in hybrid pines
	Dr M Shepherd	Dr D Lee (QDPI&F Hort. And Forestry Sci.)	Comparative mapping of *Corymbia* and *Eucalyptus*
	Dr M Shepherd	Mr P Connellan; Dr L Stevenson (Natural Products and Pharmacology Unit, SCU)	Genome size analysis of *Corymbia*

Within-centre links			
Project A1: Genetics and reproductive biology of eucalypts	A/Prof B Potts Dr R Vaillancourt Dr D Williams Ms M McGowen	Mr D Pilbeam (STBA) Mr P Gore (*sE*)	Genetic control of self incompatibility (partly STBA funded) and other reproductive traits in *E. globulus*.
	A/Prof B Potts Dr R Vaillancourt Mr P Tilyard Ms M McGowen	Mr D Pilbeam (STBA) Mr P Gore (*sE*)	Inbreeding and inter- and intra-race crossing of *E. globulus*.
	A/Prof B Potts	Mr N McCormick (FT) Dr D Williams	Seed orchard management and optimising seed and seedling quality.
	Dr R Barbour A/Prof B Potts Dr R Vaillancourt	Mr K Joyce (GL) Dr P Volker (FT)	Gene flow between *E. nitens* plantations and native eucalypt forests (ARC funded).
	A/Prof B Potts Mr P Tilyard	Dr C McArthur (RP) Dr J O'Reilly-Wapstra (RP) Mr H Fitzgerald (RP)	Genetic variation in *E. globulus* to marsupial browsing.
	A/Prof B Potts	Dr G Allen (RP) Dr L Rapley (RP)	Genetic basis of susceptibility to insect pests
Project A2: Breeding Strategies	Dr G Dutkowski	Dr T McRae, Mr M Powell Mr D Pilbeam (STBA) and A/Prof B Potts	ASREML software usage
	Dr G Dutkowski	Dr T McRae, Mr D Pilbeam (STBA), Mr K Joyce and Mr I Ravenwood (GL)	Breeding value prediction
	Dr G Dutkowski	Mr P Gore (sE), Mr D Pilbeam, Dr T McRae (STBA), Mr K Joyce and Mr I Ravenwood (GL)	Breeding strategies
	Dr G Dutkowski	Dr T McRae (STBA), Mr D Pilbeam (STBA) and Dr T McRae (STBA)	Genetic analysis of progeny trials
	Mr Y Li, Dr L Apiolaza	Mr D Pilbeam (STBA)	Connectedness evaluation across environments
Project A4: Molecular genetics of eucalypts	Dr R Vaillancourt and Mr J Freeman	Dr M Shepherd (SCU)	Mapping *E. globulus* with AFLPs and microsatellites
	Dr R Vaillancourt and Ms F Poke	Dr C Harwood (CSIRO)	Molecular genetics of lignin
	Dr R Vaillancourt	A/Prof B Potts (A1) and Mr P Gore (*seedEnergy*)	Estimation of contamination levels under mass supplementary pollination in *E. globulus*
	Dr R Vaillancourt, Mr A Milgate, Mr J Freeman and A/Prof B Potts	Dr C Mohammed (C5) and Mr K Joyce (GL)	The genetic basis of *Mycosphaerella* resistance in *E. globulus*
	Dr R Vaillancourt, Mr T Jones, Ms R. Jones and A/Prof B Potts	Mr P Gore (*seedEnergy*) and Mr D Pilbeam (STBA)	Fingerprinting and relationship within the STBA *E. globulus* breeding population
Project A5: Wood quality	Dr C Harwood and Mr M Hamilton	A/Prof B Potts (A1), Dr R Vaillancourt (A4) and Mr P Gore (*seedEnergy*)	Genetic control of shrinkage and collapse in *E. nitens*
	Dr C Harwood and Mr D Stackpole	A/Prof B Potts (A1), Dr R Vaillancourt (A4) and Mr K Joyce	Relationship between growth and wood properties in a *E. nitens*
Project A7: Molecular genetic improvement for tropical and sub-tropical production	Dr M Shepherd Prof R Henry	Dr R Vaillancourt (A4) Dr D Steane (A4)	Molecular phylogeny of *Corymbia*
	Dr M Shepherd Prof R Henry	Dr R Vaillancourt (A4) Mr J Freeman (A4)	Comparative mapping of *Corymbia* and *Eucalyptus*
	Dr M Shepherd Prof R Henry	Dr R Vaillancourt (A4) A/Prof B Potts (A1)	Gene pool management of *Corymbia* sp. and hybrids.
	Dr M Shepherd Prof R Henry	Dr R Vaillancourt (A4) Ms F Poke (A4)	Molecular variation in the CCR gene in spotted gums

International links	CRC staff	Collaborator	Research
Project P1:	Dr R Smethurst	Dr N Comerford (Gainsville, USA) and Dr N	Modelling nutrient uptake

International links	CRC staff	Collaborator	Research
Project B1: Site productivity	Dr P Smethurst	Dr N Comerford (Gainsville, USA) and Dr N Barros (Vicosa, Brazil)	Modelling nutrient uptake
	Dr P Smethurst	Dr L Goncalves (Sao Paulo, Brazil)	Silviculture of eucalypts
	Dr P Smethurst	Dr R Sojka	Soil quality concepts
	Dr P Smethurst	Ms C Nardon	Establishing shelter belts
Project B3: Silvicultural systems	Dr C Beadle and Dr C Mohammed	Dr A Rimbawanto, Dr E Hardyanto and Mr R Irianto	Pruning and thinning *Acacia mangium* in Indonesia
	Dr D Race and Dr C Beadle	Mr D Utama, Ms A Adiwinata Nawir and Mr M Ridha Hakim	Community partnerships in forestry in Indonesia
Project B4: Modelling production and wood quality	Dr P Sands	Dr L Esprey (ICFR)	Productivity modelling
	Dr A O'Grady	Prof M Tyree (USDA)	Hydraulic conductance of trees
	Dr. P Sands and Ms S Koh	Prof M Tyree (USDA)	Water and solute transport in trees
National links			
Project B1: Site productivity	Ms M Ottenschlaeger	Mr G Samsa (TC)	Leaf are index training and measurement
	Dr P Smethurst	Dr S Lisson (CSIRO SE)	Waste water distribution
Project B3: Silvicultural systems	Dr C Beadle	Mr J Hickey (FT), Mr G Britton (Britton Bros), Mr N Smith (GL), Mr A Warner (PFT), Mr S Riley (FFIC) and Mr T Groves (Corinna Timbers)	Blackwood wood quality
	Dr C Beadle and Mr D Worledge	Mr W Lee (Brighton Council)	Effluent irrigation of pines
	Dr D Close, Dr C McArthur and Dr C Beadle	Mr D Cliff (Narramine Transplants) and Mr P Boland (Floriana)	Seedling management
	Dr N Davidson and Dr C Beadle	Ms M Weeding (S Midlands Council), Mr A Lyons (PFT), Dr P Volker (FT) and Mr J Duddles (GA)	Rural tree decline
Project B4: Modelling production and wood quality	Dr M Battaglia	Dr D White (CSIRO), Dr D Mendham (CSIRO), Dr J McGrath (FPC) and Dr J Kinal (CALM)	Balancing drought risk and production in Mediterranean climates
	Dr A O'Grady	Dr P Cook (CSIRO) and Dr T Brodribb (UTas)	Ground water use by vegetation. Hydraulic vulnerability
	Dr M Battaglia and Dr A O'Grady	Prof M Adams (UWA) and Prof R McMurtrie (UNSW)	Cellular automata modelling to prediction size class distribution and mortality in plantations
	Dr M Battaglia	Australia-New Zealand Vegetation Function Network	Third-generation models of carbon assimilation and water expenditure
Within-centre links			
Project B1. Site productivity	Dr P Smethurst	Dr M Battaglia (B4)	Predictions of leaf area index and growth responses to fertilisation
	Dr P Smethurst	Dr C McArthur (RP)	Use of non-palatable browsing deterrents
Project B3: Silvicultural systems	Dr C Beadle and Dr P Smethurst	Dr N Mendham (UTas) and Mr P Adams (FT)	Weed management
	Dr C Beadle, Dr C Mohammed and Ms D Wiseman	Dr T Wardlaw (FT)	Green pruning of *E. globulus*
	Dr D Close	Mr I Bail (TC), Mr I Ravenwood (GL), Mr S Hunter (WAPRes) and Mr A Cannon (FEA)	Seedling management
	Dr D Race	Mr I Bail (TC)	Managing community anxiety
Project B4: Modelling production and wood quality	Dr M Battaglia	Dr P Smethurst (B1)	Modelling fertiliser response
	Dr M Battaglia	Dr C Mohammed (C5) and Dr E Pinkard (C5)	Impact of *Mycosphaerella*; analysis of stem decay data
	Mr D Mummery	Ms R Pryor (UTas)	Landscape waterlogging
	Dr P Sands and Dr M Battaglia	Mr A Goodwin (FT)	Software development
	Dr P Sands	Dr C Beadle and Dr J Medhurst	Modelling blackwood growth

International links	CRC staff	Collaborator	Research
Project C1. Biology, ecology and economic impact of insect pests	Dr G Allen	Dr T Withers (NZ FRI) Dr D Kriticos (NZ FRI) Dr S Mansfield (NZ FRI)	Biocontrol of *Uraba lugens* in New Zealand
	Dr G Allen	Dr B Roitberg (Simon Fraser University, Canada) Ms J Perry (Simon Fraser University, Canada)	Egg laying decisions in predatory ladybirds
	Dr M Steinbauer Dr J Elek Dr G Allen	Dr D Kriticos (NZ FRI) Dr K Potter (NZ FRI)	Development of population model for autumn gum moth
	Dr J Elek	Mme. C Monjaret (*Institut National Agronomique* Paris-Grignon, France)	Feeding preference and parasitism of *C. bimaculata*
Project C2. Insect control techniques and IPM	Dr M Steinbauer Dr G Allen	Dr F Östrand (Lund University) Dr E Hedenström (Mid Sweden Uni) Ms A Nilsson (Mid Sweden Uni)	Sex pheromone of *M. privata*
	Dr J Elek	Dr P Govender (University of Pretoria)	Implications of forest certification on IPM methods
	Dr M Matsuki Dr G Allen	Dr J Brown (Washington State Uni)	Pest control methods without using insecticides
Project C3. Resistance of planting stock to vertebrate browsers	Dr J O'Reilly-Wapstra	Dr G Iason (Macauley Land Use Research Institute)	Volatile oils as herbivore defence
Project C5. Strategies to minimise loss due to fungal attack	Dr C Mohammed Dr K Barry Dr A Eyles Ms D Wiseman	A/Prof P Bonello (Ohio State Univ, USA) Dr E Hardiyanto (GMU, Indonesia) Dr R Irianto (FNCRDC, Indonesia) Dr S Ito (Mie University, Japan) Dr S Lee (FRIM, Malaysia) Dr L Macaskie (Univ of Birmingham, UK) Dr T Mitsunaga (Mie University, Japan) Dr A Rimbawanto (RDCBFTI, Indonesia Dr KT Smith (USDA Forest Service) Dr M Taksaki (Kyoto Pharmaceutical University, Japan) Dr S Woodward (Univ Aberdeen, UK)	Mechanisms of tree defence Wound tissue formation Kino stem defects
	Dr. C Mohammed Ms A Smith	Dr R Kennedy, Ms A Wakeham (Horticulture Research International) Dr M Dick (NZ FRI) Prof M Wingfield (FABI, Pretoria, S. Africa)	*Mycosphaerella* research
	Dr C Mohammed Ms M Yee	Dr T. Ranius (SLU, Uppsala, Sweden) Dr B Norden, Goteborg University, Sweden	Ecologically sustainable forest management: fungal and invertebrate biodiversity
National links			
Project C1. Biology, ecology and economic impact of insect pests	Mr A Rice Dr G Allen	Dr D Colless (CSIRO Ento, ANIC)	Taxonomy and identity of tachinid parasitoids of leaf beetles
	Dr G Allen	Dr N Davies (UTas) Dr P Walker (UTas)	Volatile profiles from key insect pests
	Dr M Steinbauer	Mr T Weir (ANIC)	Identification of scarab beetles
	Dr M Matsuki	Dr A Carnegie (State Forest of NSW)	Predicting the sirex wood wasp distributions in Australia, South Africa, South America, North America and NE Asia using CLIMEX
	Dr M Matsuki	Mr A Szito (Agriculture WA) Mr T Weir (ANIC)	Identification of pests and beneficial insects
	Dr M Matsuki	Dr C Reid (Australian Museum)	Identification of chrysomelid beetles
	Dr M Matsuki	Dr A Loch (NSW DPI)	Biology of natural enemies of pests on blue gum trees in SW WA
	Dr M Matsuki	Mr C Hutchinson (Hutchinson software)	*Development of the web-based database*
Project C2. Insect control techniques and IPM	*Dr M Matsuki*	Dr S Lawson (QDPI&F)	Sampling design for *Paropsis atomaria*
	Dr M Matsuki	*Mr G Price (State Forest of NSW)*	*Developing the interface between the CDI*

	Dr M Matsuki	Dr A Loch (NSW DPI)	Biology of natural enemies of pests on blue gum trees in SW WA
	Dr M Matsuki	Mr C Hutchinson (Hutchinson software)	*Development of the web-based database*
Project C2. Insect control techniques and IPM	*Dr M Matsuki*	Dr S Lawson (QDPI&F)	Sampling design for *Paropsis atomaria*
	Dr M Matsuki	Mr G Price (State Forest of NSW) Dr A Carnegie (State Forest of NSW)	Developing the interface between the CDI worksheet and database on forest health survey
	Dr M Matsuki	Dr S Lawson (QDPI&F) Dr A Carnegie (State Forests of NSW)	Pest / pathogen database
	Dr M Matsuki	WA Blue Gum Plantations Industry Pest Management Group	(1) Light trapping of *Heteronyx* beetles & (2) monitoring phenology of leaf development and *Gonipterus scutellatus*
	Dr J Elek	Mr J McBeath (Bayer Cropscience) Mr D Paton (Sumitomo Chemical	Evaluation of nicitinoid insecticides
Project C3. Resistance of planting stock to vertebrate browsers	Dr J O'Reilly-Wapstra	Dr W Foley (ANU)	NIR analyses of eucalypt leaves in relation to defensive chemistry
	Ms N Wiggins	A/Prof S McLean (UTas) Dr R Boyle (UTas) Dr C McArthur (USyd)	Effect of plant secondary metabolites on feeding behaviour in brushtail possums
	Ms P Loney	Dr G Jordan (UTas) Dr C McArthur (USyd)	Relationship between plant structure and herbivory
Project C4. Strategies to reduce vertebrate browsing damage	Ms N Wiggins	Dr C McArthur (USyd)	Effect of planting structure on browsing preferences
	Ms A Miller	Mr B Montgomery (FFIC) Dr T Bird (FFIC) Dr C McArthur (USyd)	Use of vegetation for reducing mammal browsing damage
Project C5. Strategies to minimise loss due to fungal attack	Dr C Mohammed Dr K Barry Dr A Eyles Ms D Wiseman	Mr N Davies (UTas) Dr S Lawson (QFRI)	Mechanisms of tree defence Wound tissue formation Kino stem defects
	Dr C Mohammed Ms L Pietrzykowski Ms A Smith	Dr T Booth (CSIRO-FFP, Canberra) Dr D Culvenor (CSIRO-FFP, Clayton) Dr C Stone (SF NSW) Dr A Carnegie (SF NSW)	*Mycosphaerella* research
	Ms M Yee Ms A Hopkins Ms K Harrison	Dr N Bougher (CSIRO-FFP, Perth) Ms G Gates (UTas) Dr D Ratkowsky (UTas) Dr J Simpson (SF NSW) Mr T Weir (ANIC/CSIRO Entomology)	Ecologically sustainable forest management: fungal and invertebrate biodiversity. Fungal taxonomy
Within-centre links			
Project C1. Biology, ecology and economic impact of insect pests	Dr L Rapley Dr G Allen Dr M Steinbauer	A/Prof B Potts (A1)	Genetic susceptibility of eucalypts to insect attack
	Dr M Matsuki	Dr D Close ( )	Phenols of *E. globulus*
	Dr M Matsuki	Dr J Elek (FT)	Biology of *Gonipterus scutellatus*
	Dr J Elek	Mr A Rice ( )	Parasitoids of *C. bimaculata*
	Dr J Elek	Dr L Pinkard ( )	Impact of insect defoliation on photosynthesis rate
Project C2. Insect control techniques and IPM	Dr M Steinbauer	Dr J Elek (FT) Mr R Bashford (FT)	Pheromone trapping of *M. privata* in Tasmania
	Dr J Elek	Dr M Matsuki (C1)	Use of crown damage index
	Dr M Matsuki	Dr J Elek (FT) Dr G Dutkowski (ETT) Ms J Butterworth (ETT) Ms T Bildstein (ETT)	Pest / pathogen database

Project C3. Resistance of planting stock to vertebrate browsers	Dr J O'Reilly-Wapstra	A/Prof B Potts (A1)	Genetic variability in resistance to browsing of *E. globulus* and *E. nitens* foliage
Project C4. Strategies to reduce vertebrate browsing damage	Ms A Miller	Mr C Barnes (GL) Mr C Berry (NS) Mr A Walsh (FT) Mr A Lyons (PFT) Dr P Smethurst (B3)	Use of vegetation for reducing mammal browsing damage
Project C5. Strategies to minimise loss due to fungal attack	Dr C Mohammed Dr K Barry Dr C Beadle Dr A Eyles Dr L Pinkard Dr P Smethurst Ms D Wiseman	Dr T Wardlaw (FT)	Mechanisms of tree defence Wound tissue formation Kino stem defects
	Dr C Mohammed Dr M Battaglia Dr C Beadle Ms E Pietrzykowski Dr L Pinkard A/Prof B Potts Ms A Smith Dr R Vaillancourt	Dr T Wardlaw (FT) Dr J Bulinski (Timbercorp) Mr K Wotherspoon (FT) Mr S Hunter (WAPRes)	*Mycosphaerella* research
	Dr C Mohammed Ms M Yee Dr Y Zi Qing Ms A Hopkins Ms K Harrison	A/Prof A Richardson (UTas) Dr T Wardlaw, Dr S Grove (FT)	Ecologically sustainable forest management: fungal and invertebrate biodiversity

Education and Technology Transfer Program

National links			
	Dr N Davidson and Dr C Beadle	Dr P Volker (FT), Mr A Lyons, Ms J Burrell	Publishing 'Farm Forestry Technical and Business Handbook'
	Dr N Davidson	Dr R Thornton (Bushfire CRC), Prof M Adams (U NSW)	Eucalypt decline in the absence of fire
	Dr N Davidson	Forestry Tasmania	On committees: 1. Long-term monitoring sites at Warra 2. Bushfire chrono-sequence
	Dr N Davidson and Dr C Beadle	Ms M Weeding (Midland Tree Committee), Dr P Volker (FT), Mr A Lyons (PFT), Mr J Duddles (GA)	Decision support system to combat rural tree decline
	Dr N Davidson, Dr C Beadle and Ms T Bildstein	Farmers and other landowners from the Midlands of Tasmania, politicians and other stakeholders	Field day to combat rural tree decline
	Dr N Davidson and Ms T Bildstein	Science communicators from other CRCs	Science communication
	Ms P Loney	National Science Week	Science communication
Within-centre links			
	Dr P Smethurst and Ms T Bildstein	CRC partners and scientists	Facilitation of adoption of CRC research
	Dr P Smethurst	Selected CRC partners	Technology transfer packages
	Ms T Bildstein	CRC staff and partners	CRC publication database and calendar
	Ms P Loney	CRC staff and partners	CRC newsletter 'Overstorey'
	Ms T Bildstein	CRC staff and partners	Coordination of CRC seminar series
	Dr N Davidson	University partners in the CRC	Coordination of intake of research students and joint activities across institutions
	Ms T Bildstein	CRC staff and partners	CRC website

RESEARCH

Genetic Improvement Program

Manager
A/Prof Brad Potts

Introduction

A major expansion of the eucalypt plantation estate has occurred over the last decade in Australia. Improved genetic quality of the plantation stock is essential if Australia is to be competitive in international markets when this estate is harvested. Large tree breeding programs being run by CRC partners demonstrate the importance of breeding and aim to increase the returns from wood production.

The research undertaken in the Genetic Improvement Program aimed to ensure that plantation stock was of the highest possible genetic quality. It aimed to improve the efficiency of breeding and ensured the genetic gains were rapidly and efficiently transferred to Australia's increasing plantation estate. In brief, the program aimed to:

- define appropriate breeding objectives for individual firms and the sector, from forest growers to industrial processors;
- identify selection criteria and methods for assessing wood quality, growth, pest and disease resistance, and other key traits, and statistical methods for their analysis;
- determine the molecular and quantitative genetic control of important traits, and how this changes with age, site and silviculture;
- improve strategies to select, breed and deploy elite genotypes;
- improve our ability to control and manipulate reproductive characteristics in order to optimise deployment systems;
- ensure rapid uptake of technological advances made in Australia and overseas, particularly in the rapidly changing field of molecular genetics; and
- provide training and education in forest genetics and breeding, and be a forum for discussion in Australia.

The eighth year of the CRC was used to complete genetic characterisation of current breeding populations, consolidate studies of solid wood traits, review genetic knowledge gained during the first stage of breeding and determine whether changes in breeding and deployment strategies are required. Only five of the original seven projects continued into the eighth year.

Project A1

Leader
A/Prof Brad Potts

Staff
Dr Luis Apiolaza
Mr Peter Gore
Prof Rod Griffin
Dr Greg Jordan
Mr Kelsey Joyce
Ms Marian McGowen
Mr David Pilbeam
Prof Jim Reid
Mr Paul Tilyard
Dr René Vaillancourt
Dr Dean Williams

Genetics and reproductive biology of eucalypts

Background

This project aimed to provide the basic biological information necessary for effective exploitation and management of temperate eucalypt gene pools. It was to determine the extent to which traits of economic and biological importance were under genetic control and amenable to artificial selection and breeding. Such traits include growth, wood quality, pest and disease resistance and reproductive characteristics. There continues to be a high demand for improved eucalypts for plantation establishment, and the project was to study factors affecting sexual reproduction in order to optimise eucalypt seed production systems. This project was closely linked to project A4 (Molecular genetics of eucalypts), and staff also supervised externally funded grants.

Field trip to Oji Paper Co. Ltd.'s Albany Forestry Research Centre during the CRC-SPF / STBA *E. globulus* review in Albany, Western Australia. From left to right participants were: Tony McRae, Chris Harwood, Shin-ichi Sukeno, Simon Hunter, Mike Powell, Nigel England, João Costa e Silva, Simon Whittock, (Greg Dutkowski and David Pilbeam hidden), Colin Matheson and Kelsey Joyce.

Outcomes

- Genetic research undertaken on *E. globulus* over the life the CRC-SPF was reviewed (Potts *et al.* 2004), and a workshop held with the STBA in Albany in February 2005 to identify where changes in breeding and deployment strategy were required.
- An extensive review of CRC-SPF and other publicly available information on genetic variation and genetic parameters in *E. nitens* was competed (Hamilton and Potts 2005) and a workshop summarising this and other CRC-SPF genetic research relevant to *E. nitens* breeding and deployment was held in Hobart in June 2005.
- A seed orchard manual detailing techniques for managing eucalypt seed orchards and controlled pollination was completed.

Outcomes from external grants

- A major study of genetic variation of diameter growth of *Eucalyptus globulus* in 28 progeny trials in Australia, Chile, Portugal and Spain was completed by visiting scientist Dr. João da Costa e Silva. Single-site analyses revealed significant subrace variance in 24 trials, and significant variance between open-pollinated families within subraces in all trials. Significant genotype by environment interaction (G x E) was detected within most countries but was higher across countries. Within Australia at least, some G x E appeared to be explained by differential susceptibility of subraces to water, light and (to a less extent) temperature stresses during summer. In particular, the King Island subrace showed a low adaptability to water deficit and high solar radiation.

Project A2

Breeding Strategies

Leader
Dr Greg Dutkowski

Staff
Dr Luis Apiolaza
Dr Bruce Greaves
Dr Yongjun Li
Mr Simon Whittock

Background

The project aimed to maximise the profit derived from the breeding programs of CRC partners. This was achieved through more accurate statistical models, integration of economic information, and evaluation of tree breeding and deployment strategies. Most of this work was channelled through the breeding program of the Southern Tree Breeding Association (STBA), which includes most CRC industrial partners. The project interacted closely with projects A1 (Genetics and reproductive biology of eucalypts) and A5 (Wood quality).

Outcomes

The TREEPLAN® software of the Southern Tree Breeding Association allows integrated analysis of many progeny trials. The data is standardised to a common additive variance and allows the error variance to be different for each site. This approach has been shown across a number of data sets to be very close to the likelihood of a full multivariate model where genotype by environment interactions are negligible.

- We can now answer new questions about genetic performance across trial sites. Using profile likelihood we can see if the heritabilty of a trait, and the ratio of additive to non-additive genetic effects, is the same across all trials. Restrictions on the correlation matrix can test if our allocation of trials to site types is correct, even if there is weak or no genetic linkage between some sites. We can also model the correlation between sites as a function of their differences on some environmental trend. With these we can get better predictions of performance for different site types.

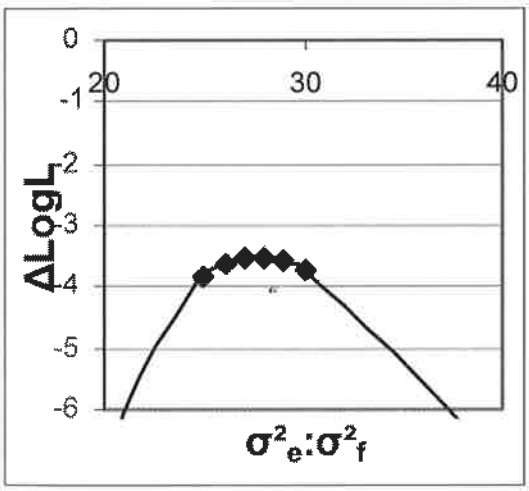


Figure 3: Profile likelihood shows that the heritability for growth is different on different sites.

- The use of spatial analysis has been demonstrate on data sets from Chile, Sweden and Portugal a its utility has been confirmed across all of the The Swedish growth data showed itself to have t highest within-site variation over small distance of any data sets analysed to date.

Outcomes from external grants

- 250 trees representing 10 *E. globulus* subrace were sampled from a 15-year-old base populati trial. Quarter-sawn and back-sawn boards we cut, kiln dried, reconditioned and graded wi final products showing significant and probabl exploitable variation between subraces in som characteristics including spring in green quarte sawn boards and board downgrade due to kil pockets.

- A model was developed for calculating gai from multi-trait combined index selection, as surrogate for BLUP in estimating expected ga from assessment-selection strategies. The mod was applied to the inclusion of NIR-predicte wood chemistry traits in breeding *E. globulus* fo kraft pulp.

- A model was developed to investigate the impa of revenue from carbon sequestration on economi breeding objectives for the production of pulpwoo for export from Australia. In a non-vertically integrated industry the correlation betwee breeding objectives including and excluding carbo revenues was very high with the relative weigh of key economic traits unaffected by inclusion carbon revenues in the breeding objective.

Project A4

Leader
Dr René Vaillancourt

Staff
Mr Jules Freeman
Mr Timothy Jones
Mr Andrew Milgate
Ms Fiona Poke
A/Prof Brad Potts
Prof Jim Reid
Mr Adam Smolenski
Dr Dorothy Steane
Mr James Worth

Molecular genetics of eucalypts

Background

Molecular tools are now being used in fingerprinting for quality control in breeding and deployment programs, in understanding gene flow, conducting paternity and outcrossing studies, understanding the genetic control of quantitative traits as well as providing unprecedented insights into plant genomes leading to the identification of genes of interest.

This project focused on eucalypts and aimed to use molecular markers to:

- provide a better knowledge of inbreeding, heterosis and genetic diversity in breeding and base populations of eucalypts;
- quantify factors affecting outcrossing rates patterns of gene flow, and contamination levels in seed orchards, in close cooperation with project A1 (Genetics and Reproductive Biology of Eucalypts); and
- characterise QTL (Quantitative Trait Loci) affecting commercially important traits (e.g. growth, wood properties and pest resistance).

Outcomes

- A variant of an important gene in the lignin pathway (CCR) was shown not to be associated with lignin variation in *E. globulus* despite being at a site that is evolutionarily conserved, and resulting in an amino acid substitution in the enzyme product of CCR.
- Molecular markers allowed the discovery of two biotypes of *Mycosphaerella cryptica* involved in a severe outbreak of leaf-blight disease in north west Tasmania. The two biotypes are widespread, differ in their culture morphology and one appeared to be more virulent and was more frequently found on damaged plants in the field.
- The A4 Project organised the 2nd International Symposium on "Molecular Genetics of Eucalypts" which was held in Hobart on 13 July at which molecular genetic research undertaken by the CRC was presented in the context of international progress in this field. Following the symposium, the CRC hosted a business meeting that founded The International Eucalyptus Genome Consortium (www.ieugc.up.ac.za/). Membership is open to all interested scientists and organisations throughout the world. As part of this initiative, a review of genomic research in eucalypts was completed for publication.

Delegates attending the 2nd Symposium on "Molecular Genetics of Eucalypts" in Hobart on 14th July, 2004.

Outcomes from external grants

- The level of selfing and bi-parental inbreeding in open pollinated seed of native *E. globulus* has been determined. It was estimated that mating between relatives (bi-parental inbreeding) may account for one third of the inbreeding depression in these open-pollinated progenies (see Major Development).
- Genetic diversity in the national breeding population of *E. globulus* was shown to be at least as high as that in comparable native populations (see Major Development).
- A set of microsatellite loci was developed from the complete sequence of the eucalypt chloroplast genome which may be useful for fingerprinting across the genus and even in other genera.

Project A5

Wood quality

Leader
Dr Chris Harwood

Staff
Ms Linda Ballard
Dr Emlyn Williams
Ms Kirsty Siu
Mr Matthew Hamilton

Background

Wood quality is one of the most important determinants of profitability, whether plantations are harvested for pulp, sawn timber or other solid wood products. However, wood property traits are expensive and difficult to measure and there is a poor understanding of their genetic control and relationships with breeding objectives. For these traits to be integrated into breeding and deployment programs it is essential to develop cost-effective, non-destructive sampling techniques which can be used on a large scale.

Work concentrated on:

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

This project has strong links with the CSIRO Fore Products Laboratory; some of the technologie developed there (SilviScan 2, cellulose content analys and Near Infrared Reflectance Analysis) have bee implemented and applied to genetic material in membe breeding programs for both *Eucalyptus globulus* and *E. nitens*.

Outcomes

- A study of two advanced-generation, control pollinated progeny trials of *E. globulus* showe that wood density and NIR-predicted cellulos and pulp lignin content were under strong geneti control, and the potential for substantial geneti gain through breeding was confirmed. Geneti correlations between growth, wood density an pulp yield were weak.
- Patterns of wood stiffness in plantation-grow *E. globulus* and *E. nitens* were evaluated an pronounced pith-to-bark gradients of increasing stiffness were demonstrated. However, outer wood fixed-height samples gave relatively poo prediction of overall log stiffness.

Linda Ballard analysing wood samples for cellulose and lignin using the NIR analyser.

Project A7

Leader
Prof Robert Henry

Staff
Ms Natalie Baker
Ms Shabana Kasam
Dr Mervyn Shepherd

Molecular genetic improvement for tropical and sub-tropical production

Background

Year eight was a transition year for Project A7, with the focus shifting from softwoods to hardwoods in preparation for the CRC for Forestry. Research commenced on the development of a molecular platform to support improvement in *Corymbia* spp (including the spotted gums and their hybrids) that are amongst the main plantation hardwood taxa for northern Australia. The first objective was to conduct a comparative analysis of the *Eucalypt* and *Corymbia* genomes and evaluate the scope for exploiting the genetic information base in *Eucalyptus* in *Corymbia*. The second objective was to strengthen and extend a molecular phylogeny of the *Corymbia* to provide improved understanding of the taxonomic relationships within the genus for gene pool management.

Outcomes

- A platform for comparative mapping was established with the identification of 90 microsatellite markers for construction of a framework genetic map in *Corymbia*. Analysis of cross-transfer of 272 from *Eucalyptus* and 35 *Corymbia* microsatellite markers was completed. Rates of transfer were typical for inter-generic transfer in plants (around 30%) and intersectional transfer within *Corymbia* was high (100%).
- Genetic diversity at 28 *Corymbia citriodora* subsp. *variegata* microsatellite loci was high (av. PIC=0.8). Fourteen new microsatellite markers were developed for this study.
- Around half of the data for a genetic map in *Corymbia* has been generated.
- Work to extend a molecular phylogeny in *Corymbia* commenced with the collection of material for 34 *Corymbia* and two *Angophora*. Intergenic transcribed sequence (ITS) was obtained for five new *Corymbia* species.

Mr Bihua Chen (visiting scholar) sampling *Corymbia cliftoniana* foliage for the molecular phylogenetic study

Sustainable Management Program

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 examined 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 played 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 provided a valuable adjunct to the work of other research organisations involved in the definition of criteria for sustainability.

Project B1

Leader
Dr Philip Smethurst

Staff
Dr Paul Adams
Mr Craig Baillie
Dr Chris Beadle
Ms Maria Ottenschlaeger
Mr Keith Churchill
Ms Sandra Hetherington
Mr Andrew Knowles
Ms Carolyn Ringrose
Mr Julian Smith
Ms Ann Wilkinson

Site productivity

Background

The aims of this project were to:

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

Outcomes

- Nine-year diameter responses of eucalypts and pines to herbicides applied at planting were assessed at several sites in Tasmania and Victoria. Responses to three years of total weed control range from insignificant to large (57 per cent increase) depending on site and species, with the response generally increasing with the degree of weed control, i.e. nil, spot, strip and total control.
- The concentration of potassium (K) in hydroponic solution that maximised the growth of very young *E. globulus* was lower than that for *P. radiata* (Fig. 4). Together with research on pines results suggest that soil solutions taken from the field and measured for K could possibly be used to predict K deficiency in the field.

High nitrogen (N)-fertilisation regimes (100 kg N ha^{-1} for 13 years) that increased tree growth also increased N turnover and nutrients retained in the forest floor but had minimal effect on rates of N mineralisation in the soil. CABALA predictions (including N pools and fluxes, tree growth, LAI etc.) were broadly consistent with these observations.

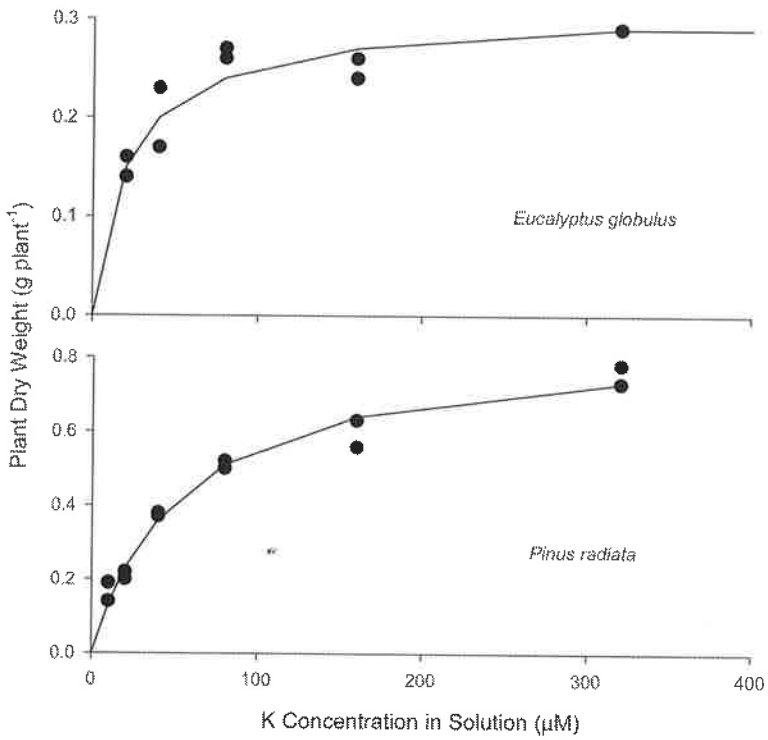


Figure 4: Low concentrations of K in solution (< 0.05 mM) limited the growth of *Eucalyptus globulus* and *Pinus radiata*, but the latter required higher concentrations to maximise growth.

Project B3

Leader
Dr Chris Beadle

Staff
Dr Paul Adams
Dr Philip Brown
Mr Keith Churchill
Dr Dugald Close
Dr Neil Davidson
Ms Sandra Hetherington
Dr Ryde James
Dr Sarah Jennings
Prof Peter Kanowski
Dr S Mahendrarajah
Dr Jane Medhurst
Mr Mark Neyland
Mr Petr Otahal
Ms Maria Ottenschlaeger
Dr Libby Pinkard
Dr Digby Race
Ms Jacki Schirmer
Dr Philip Smethurst
Ms Ingrid van Putten
Ms Ann Wilkinson
Ms Danielle Wiseman
Mr Dale Worledge

Silvicultural systems

Background

The aims of this project were to:

- provide guidelines for the preparation and management of seedling stock during plantation establishment;
- develop weed management systems that minimise the use of herbicides, including the use of non-competing species as cover crops;
- develop pruning, thinning and spacing systems that are suitable for converting industrial pulpwood plantations to clearwood regimes and for farm forestry;
- assess the benefits and costs of trees on farms, and the real or perceived barriers to 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

- Decay from pruned stubs was more common on sites that received added nitrogen (N) and phosphorus (P) fertiliser, and infections relate directly to the size of live branches. Rates of occlusion appear to be low but increase with crown height. Nitrogen fertiliser can enhance the growth of pruned trees; though a two-lift pruning regime that removes 60 per cent of the green crown results in significantly lower tree volumes than for unpruned controls.
- A species trial in the dry and cold environment of the Tasmanian Midlands showed that there were no differences in growth in the first year following planting between Tasmanian and mainland species tested. Tasmanian species generally were more robust and resistant to frost and browsing. *Monocalyptus* were more resistant than *Symphyomyrtus* species of eucalypts to browsing and drought.
- Four nitrogen application treatments resulted in foliar N concentrations from 0.63 to 1.82 per cent. Cineole was found to be a general seedling defence against herbivory (high in young and low in old leaves, but independent of N treatment) whereas levels of tannins and protein precipitable phenolics were inversely related to levels of foliar N.
- Seedlings with low foliar N increased their tannin content under ultra-violet (UV) exposure. Thus, leaf secondary chemicals appear effective at screening seedlings from UV exposure.
- While farmers and their surrounding rural communities are involved in plantation forestry, seldom are they initiators or 'drivers' of forestry development. Typically, they respond to forestry initiatives conceived and developed by government and plantation companies. As such, rural communities can often have a different perception of what 'successful' forestry is in terms of desirable development and environmental management to that of plantation companies. Rapid land-use change driven by government or the availability of new commercial opportunities can cause anxiety amongst local communities – farming and urban people – with concern that they are powerless to influence the process of change in their district.
- Most new plantations are established on cleared farmland, yet farming communities and other stakeholder groups unfamiliar with plantation forestry can be apprehensive or concerned about the implications of this industry. Plantation companies also have to adjust to living and working in a farmland setting with plantations abutting a range of neighbouring land uses. If companies fail to respond effectively to community and stakeholder concerns, then there appears little doubt that a backlash from segments of communities will constrain the expansion of plantation forestry. In recent years, companies pioneering forestry in farming regions have begun to develop strategies to try and address these concerns.
- New approaches have been developed for maintaining the health of native stands subject to tree decline.

Adjacent healthy and unhealthy stands of trees in the Tasmanian Midlands. These stands are used as part of an investigation into the attributes of healthy forests and the lessons that can be learned and applied to the management of the nearby declining forests

Project B4

Leader
Dr Michael Battaglia

Staff
Prof Larry Forbes
Ms Sharon Koh
Mr Daryl Mummery
Dr Tony O'Grady
Dr Peter Sands
Dr Mel Tyree
Mr Dale Worledge

Modelling production and wood quality

Background

The aims of this project were to:

- Produce process-based models that
  a) enable the productivity of plantations to be predicted,
  b) address specific management questions,
  c) have a transparent structure, and
  d) allow input data to be readily and cheaply obtained by forest managers.
- Define the effects of site and climatic factors on wood properties; determine the feasibility of altering wood properties via silvicultural treatments; and develop tools for predicting response of wood properties to environmental factors.
- Develop decision support systems for plantation management.

Outcomes

- A forest management scenario-builder graphic user interface for CABALA was developed and presented to industry at workshops.
- Phosphorus and base cation supply and uptake modules for CABALA were developed and tested against data from the Westfield nutrition trial wi satisfactory results.
- A model of the impacts of loss of effective leaf ar on light interception of plantation trees has be produced and is being integrated into stand grow models to assess the impacts of disease agents su as *Mycosphaerella* on stand production.
- PROMOD was used to produce spatial surfaces potential productivity of the south west Goulbour Catchment.
- Analysis of satellite imagery shows that up to 5 per cent of the wood vegetation in the Midland of Tasmania has suffered some sort of dieba or decline within the last decade (see Maj Developments).
- Quantified whole tree hydraulic conductanc and responses to drought that establishes th relationship between hydraulic constraints an productivity. This provides a process-bas understanding of whole tree response to drough and improves drought risk prediction.
- A soil water uptake model that includes roo distribution and water matric potential gradient through the soil-plant-atmosphere continuum wa developed. This can be used to partition total tre water used into groundwater and soil water uptak It is an advance on the linear mixing models fo predicting xylem isotopic composition.

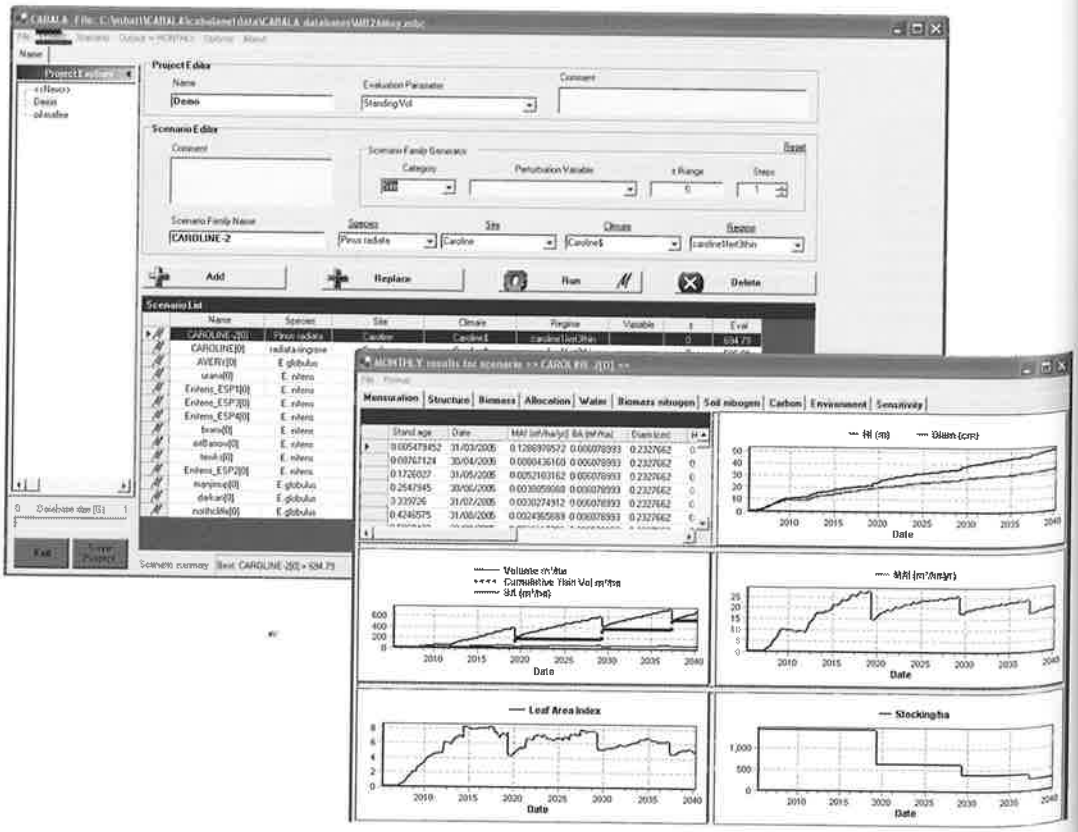


Figure 5: The CABALA graphic interface, showing an example of the application to predict results from sawlog silvicultural regimes.

Resource Protection Program

Manager
Dr Caroline Mohammed

Introduction

The aim of the Resource Protection Program was to:

- Develop a comprehensive understanding of the biology, ecology and impact of a number of key insect and vertebrate pests of eucalypt plantations in temperate Australia.
- Identify and study the biology and ecology, and control of a number of eucalypt fungal pathogens; to provide the basis for future development of integrated pest management (IPM) strategies.
- Develop efficient and effective monitoring protocols for some pest and disease species to determine if and when control is necessary.
- Develop IPM strategies for a number of key pests such as the Tasmanian leaf beetle (*Chrysophtharta bimaculata*), autumn gum moth (*Mnesampela privata*) and several marsupial herbivores.
- Develop management techniques and products to minimise the effects of pests and diseases on the quantity and quality of forest products, consistent with the principles of sustainable forest management.

Project C1

Leader
Dr Geoff Allen

Staff
Dr James Bulinski
Dr Jane Elek
Dr Mamoru Matsuki
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Dr Luke Rapley
Mr Hilton Redgrove
Mr Anthony Rice
Dr Martin Steinbauer
Ms Trudi Wharton

Biology, ecology and economic impact of insect pests

Background

The aim of this project was to provide a strong foundation of basic research on the biology and ecology of the major insect pest species across various geographic regions so that integrated pest management strategies (IPM) could be developed. Particular emphasis in the project centred upon the three major insect pests in south east Australia, *Mnesampela privata* (autumn gum moth), and the leaf beetles *Chrysophtharta agricola* and *C. bimaculata,* as well as their natural enemies. Other insect species studied include *Heteronyx* spp (Melolonthine scarab beetles), the eucalypt snout weevil *Gonipterus scutellatus*, and the pine aphid *Essigella californica*. Areas of research included phenology, host-plant interactions, natural enemies, mating systems, and impacts on tree growth.

Outcomes

- Levels of egg parasitism of *Gonipterus scutellatus* in Tasmania were undetectable at the beginning of October, but by late November averaged 50 per cent, and reached 80 per cent at some sites. In south west Western Australia they were typically less than 10 per cent in September (the peak egg-laying period of *G. scutellatus*), but were up to 100 per cent in December and January.
- A temperature-related development model of the phenology of the larval parasitoids of *C. agricola* is complete and will help optimise spray timing to reduce non-target impacts.
- Late summer larval *C. bimaculata* in the Florentine Valley sustained 15 per cent parasitism by several species of tachinid flies whereas tachinid parasitism of *C. agricola* reached upwards of 50 per cent.
- *C. bimaculata* adults preferentially select and feed on *Eucalyptus regnans* over *E. nitens*; six times as many beetles were trapped on *E. regnans* in the field, and in the laboratory beetles ate over twice as much leaf area of *E. regnans* compared to *E. nitens*.
- A summary was compiled of the biology of the natural enemies (including all insectivorous birds) of insect herbivores in blue gum plantations in the south west of Western Australia.
- A study of the relationship between development of blue gum leaves and populations of insect herbivores gave new insights into the blue gum–herbivore interactions in south west Western Australia:

(1) The peak of egg-laying by *Gonipterus scutellatus* was observed shortly after blue gum increased the rate of production of new leaves;

(2) Leaf production by blue gum trees continued throughout summer, but tree tops were repeatedly defoliated by adults beetles (*G. scutellatus*, *Chrysophtharta variicollis*, and *Cadmus excrementarius*); and

(3) Although blue gum trees appeared to be growing rapidly in November (after larval development of *G. scutellatus* is completed) and in autumn (after adult beetles have stopped feeding) new leaves were produced continuously from early spring to late autumn.

As a result of this study, a simple program to monitor leaf development and populations of *G. scutellatus* will be implemented by industry partners.

Project C2

Leader
Dr Geoff Allen

Staff
Dr James Bulinski
Dr Jane Elek
Dr Mamoru Matsuki
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Mr Luke Rapley
Mr Hilton Redgrove
Mr Anthony Rice
Dr Martin Steinbauer

Insect control techniques and IPM

Background

Forest managers have been looking for non-chemical options for insect control that are both effective and economically viable. Individual non-chemical control approaches may need to be used in conjunction with other options in an IPM strategy to achieve adequate control. This project has investigated a number of control options, including the use of more environmentally friendly chemical insecticides, for incorporation into IPM strategies as well as approaches to determine the most effective time to implement such strategies. This project has also been developing standardised sampli protocols and sampling designs, which can be used b anyone involved in assessment of population leve of pests and damage by pests and pathogens. Thes sampling protocols and sampling designs were base on sampling theory and were designed to reduce tim and effort required for assessments while increasi usability of assessment results.

Dr Mamoru Matsuki works with the IPMG group in Western Australia, holds regular field days and meetings with industry groups; and has made a major contribution to the production of the Pest & Pathogen Database.

Outcomes

- A Pest & Pathogen Database for eucalypt and pin plantations in Australia has been developed. Th database includes existing and potential pests an pathogens in plantations. Users are able to fin out:

  (1) Which pests and pathogens they are likely t encounter in their plantations

  (2) Which management actions are necessary in given month in a given region.

- Preliminary bioassays indicate that *Success* will not be effective at controlling *Gonipter scutellatus* larvae (or adults).

- Preliminary trials suggest that stem injectio with selective, nicitinoid insecticides ma provide effective protection of young eucalypt for at least three months against larval and adul chrysomelids.

- Economic decision thresholds have been developed for spraying autumn gum moth outbreaks on two-year old *Eucalyptus nitens*, based on realised and projected growth impacts following differing levels of a single defoliation event.

Subraces of *E. globulus* from Victoria were significantly more susceptible to oviposition by *Chrysophtharta agricola* whereas those belonging to the inland north-eastern Tasmanian sub-race were the least preferred by the beetles. Selections for plantings from this sub-race may also have some cross-resistance to autumn gum moth.

Project C3

Leader
Dr Julianne O'Reilly-Wapstra

Staff
Assoc Prof. Brad Potts
Mr Hugh Fitzgerald
Ms Prue Loney
Mr Stephen Paterson

Resistance of planting stock to vertebrate browsers

Background

A key method for reducing browser damage to eucalypts is to produce more resistant trees. This could be achieved by genetic and phenotypic manipulation of those trees. Our research was directed at identifying resistant genotypes, and predicting susceptibility of seedlings as a function of their environment. These three aspects were incorporated into an overall strategy for predicting and reducing browser damage of eucalypts at plantation establishment. Specific aims of this project were to:

- Determine the relative damage to, and preferences for, various plant types by browsing herbivores.
- Investigate the genetic basis of resistance and defensive chemistry of eucalypts, and also the effects of varying environmental conditions on this resistance.
- Investigate within-plant variation in resistance of eucalypts.

Outcomes

- In collaboration with the Australian National University we determined the genetic basis and heritability of defensive leaf chemistry of known genotypes in a *Eucalyptus globulus* seed orchard. We detected significant genetic variation in defensive chemistry between sub-races and between families within sub-race. High narrow sense heritabilites were calculated for some defensive compounds, namely the formylated phlouroglucinol compounds (FPCs).
- In captive feeding trials, pademelons and possums showed preferences for different leaf developmental stages. Pademelons preferred the mature leaves of *E. nitens* seedlings irrespective of nutrient treatment (where nutrient treatments were low, medium, and high). Under low nutrient conditions possums preferred mature and intermediate leaves, compared to young leaves. However, under high nutrient conditions these preferences changed, and possums preferred young leaves to those at any other developmental stage. Pademelon preference correlated significantly with the presence of sideroxylonal A+C (FPCs), and essential oil concentration. As sideroxylonal A+C concentrations decreased, pademelon intake increased. The basis for possum preferences across treatments is still being elucidated.

PhD student, Prue Loney, applying fertiliser treatments to seedlings for captive feeding trials

Project C4

Leader
Dr Julianne O'Reilly-Wapstra

Staff
Mr Hugh Fitzgerald
Ms Alison Miller
Ms Natasha Wiggins
Mr Stephen Paterson

Strategies to reduce vertebrate browsing damage

Background

This project addressed the problem of reducing browsing damage to seedlings using characteristics of the environment (whole plantation and its surrounding habitat).

Environmental characteristics should have a significant influence on browsers: how many are present, and how they use plantations and other habitats as refuges and feeding areas. The aims of this project were to:

- Understand the interaction between browsers and the environment, and the consequent damage to seedlings.
- Investigate the impact of vegetation immediately surrounding a seedling on its risk of being browsed.
- Develop methods for monitoring damage and predicting risk.
- Design appropriate options to reduce browsing damage through various planting strategies.

Outcomes

- The effect of presenting brushtail possums with a mixed diet of eucalypts compared with a monoculture diet of *Eucalyptus globulus* was investigated in a 70 x 5 metre captive feeding chamber.

  Browsing damage to *E. globulus* was similar whether seedlings were presented together with *E. regnans* seedlings (species mixtures at both ends of the chamber), or separated from *E. regnans* seedlings (a different *E. globulus* monoculture at each end of the chamber).

  Browsing damage to *E. globulus* adult foliage increased by 35 per cent when *E. tenuiramis* adult foliage formed part of the mixture at both ends of the chamber, compared with the diet when foliage of each species was separated by 70 metres. When the two eucalypt species were separated, possums travelled 47 per cent further and were not able to maintain intake (body weight). The composition of foliage and its spatial arrangement was an important factor affecting possum intake.

A series of captive animal trials was conducted to examine how the browsing of *Eucalyptus nitens* seedlings by pademelons was influenced by seedling quality and characteristics of vegetation (see Fig 6). Characteristics of both *E. nitens* seedlings and plant material placed around the eucalypt seedlings influenced browsing of seedlings. Intake of fertilised seedlings was always higher than intake of unfertilised (starved) seedlings. The relative palatability (palatable=grass and oats; unpalatable=bitter lupin), height (tall and short lupin) and abundance (abundant=four trays of oats; scarce= one quarter of a tray of oats) of vegetation within a patch (eucalypt seedling plus surrounding vegetation) all influenced browsing of seedlings. Seedlings were less browsed when surrounded by palatable than unpalatable vegetation; fewer possums browsed amongst tall compared to short vegetation; and fewer browsed when surrounded by abundant compared to scarce alternative food.

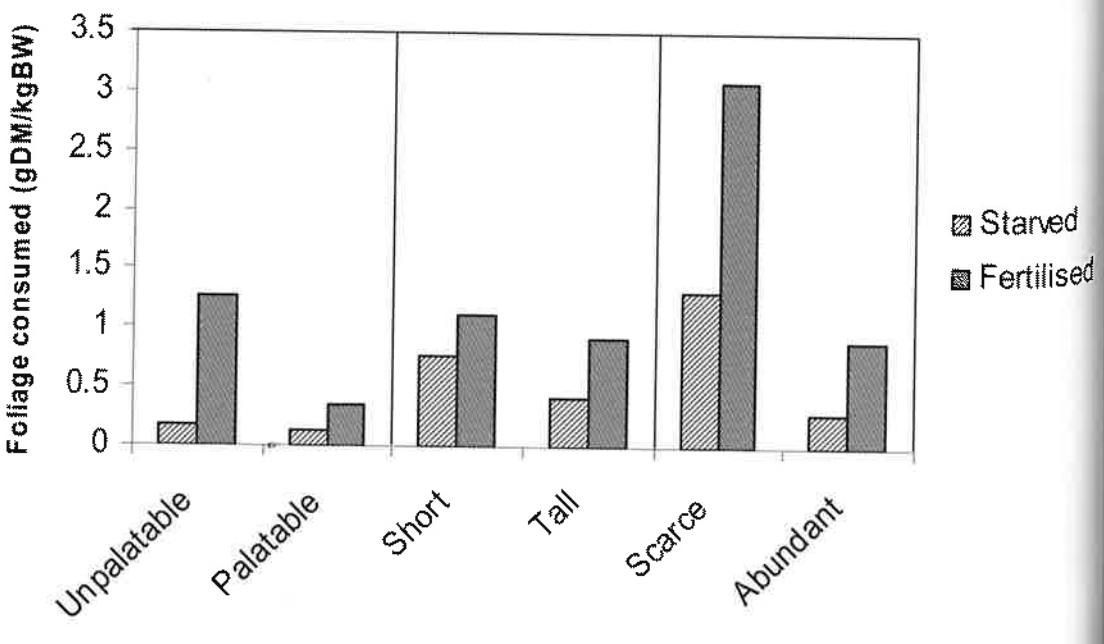


Figure 6: Intake of *E. nitens* foliage from starved and fertilised seedlings planted among different vegetation treatments

Project C5

Leader
Dr Caroline Mohammed

Staff
Dr Karen Barry
Dr Alieta Eyles
Ms Kate Harrison
Ms Anna Hopkins
Ms Elizabeth Pietrzykowski
Dr Libby Pinkard
Ms Anna Smith
Ms Danielle Wiseman
Ms Marie Yee
Mr Stephen Ridge

Strategies to minimise loss due to fungal attack

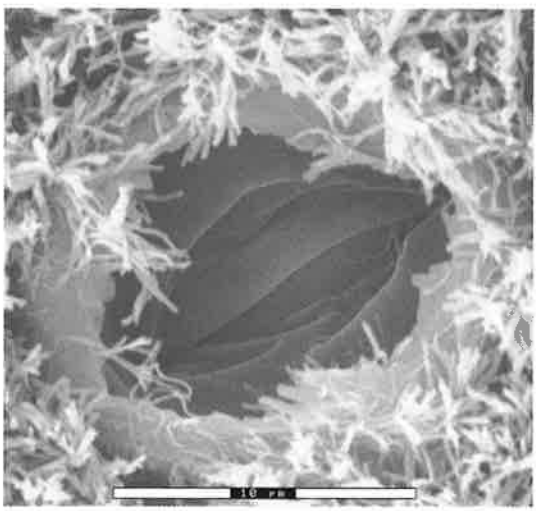
Background

The objective of this project was to develop management tools to limit the impact of microorganisms, such as stem decay fungi and leaf spot pathogens (e.g. *Mycosphaerella*).

Prescriptions have been developed in relation to the retention of habitat trees and coarse woody debris on the forest floor, with the aim of conserving the biodiversity of saproxylic fungal and invertebrate assemblages associated with Tasmanian *Eucalyptus obliqua* wet sclerophyll forests.

Outcomes

- The amount of clearwood produced after pruning can be modelled using branch height data, status and diameter, stub length, growth before and after pruning, and the distance required for a stub to occlude. In a trial in southern Tasmania, fertiliser did not appear to significantly affect these relationships. This suggests fertiliser applications can be made as required for the enhancement of growth rates and clearwood production after pruning.
- Algorithms developed from those spectra identified as most effective for discriminating between different classes of *Mycosphaerella* infection severity have been applied to the interpretation of digital multi spectral imagery. The spatial distribution in a plantation of three levels of infection (low, moderate, severe) can be differentiated from the imagery using these algorithms.
- Spectral studies have been conducted at the leaf level and crown level, to pioneer ground-based research prerequisite to developing the capacity to detect different stress conditions in *E. globulus*, using remotely acquired spectral imagery. Leaf level studies have highlighted the extent to which within-crown variation affects reflectance of healthy plants, in terms of age class, leaf type (adult versus juvenile) and within-age class. A novel crown-level experiment has quantified the effects of defoliation on reflectance spectra and top-down defoliation results in significantly greater spectral change than bottom-up defoliation.
- There have been major outcomes that have facilitated the process-based modelling of the impact of damage to the crown caused by biotic agents. Using *Mycosphaerella* as a case study, the impact of leaf necrosis and defoliation has been quantified at the leaf level. Effects of these changes at the leaf level on whole tree productivity have been determined. A model to calculate the impact of leaf damage and defoliation on stand productivity is being beta tested.
- Artificial defoliation trials have shown that there is a strong interaction between tree response to defoliation, the temporal and spatial pattern of crown damage, and different fertilisation regimes. Guidelines for the application of fertiliser to assist in the recovery of foliar damage and defoliation are under review.
- Factors generally considered to be involved in the resistance of eucalypts to foliar fungal infections were characterised (eg. leaf wax, stomatal distribution, the timing and strength of barrier zone formation, deposition of defence chemicals and accumulation/retention of photosynthetic pigments). The enhanced resistance to *Mycosphaerella* of *E. nitens* compared to *E. globulus* was attributed to the speed of barrier zone formation, which was directly related to the amount of and type of cell division occurring in the palisade mesophyll cells. This may also explain greater resistance manifest by different families of *E. globulus*.
- Data about the fungal and insect morphospecies present in three different age classes (69, 105 and more than 150 years old) of *E. obliqua* trees at Warra, southern Tasmania, clearly shows the greater abundance and diversity of species present in the older, compared to younger trees. This information indicates that, when planning for rotation times, managers should instigate those practices that allow the development of enough habitat features to maintain adequate levels of biodiversity in the forests.



Stomate on leaf from resistant *E. globulus* family bordered by heavy deposit of wax.

EDUCATION and TECHNOLOGY TRANSFER

Managers
Dr Neil Davidson
Dr Greg Dutkowski
Dr Philip Smethurst

Staff
Ms Taylor Bildstein
Dr Rebecca Boyle
Dr Philip Brown
Dr Eleanor Bruce
Ms Jill Butterworth
Prof Robert Clark
Dr Dugald Close
Dr David de Little
Dr David Doley
Mr Richard Doyle
Prof Robert Henry
Dr Mark Hovenden
Dr Sinniah Mahendrarajah
A/Prof Stuart McLean
Mr Digby Race
Prof Jim Reid
Dr Alistair Richardson
Dr Sergey Shabala
Dr Robert Wiltshire

Background

The Education and Technology Transfer Program objectives were to:

- Develop a national centre of excellence for postgraduate 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.
- Rapidly transfer technology arising from research conducted at the centre to industrial partners and other end users.
- Publish research of international quality so Australia and the CRC are seen as world leaders in plantation forestry.
- Raise community awareness of CRC activities and the value to Australia of a sustainably managed forest industry.

Education outcomes

- At the end of the life of the CRC-SPF 48 students were still enrolled in postgraduate projects (Table 4, CRC Research Students). The high rates of project completion have meant that student numbers have declined from a high of 76 in 2001/02, to 48 in June 2005 (Table 3).

There has been strong industry support for postgraduate programs. Ten of the enrolled postgraduate students were attracted from industry, 15 were on scholarships with industry support (APA-I, SPIRT/ARC, FFIC, LWRDC, FWPRDC, CSIRO, State Forests of NSW), and a further 17 were on competitive national scholarships (APA, ARC). Fourteen students had CRC top-ups to APA or university scholarships. Only six were supported solely by CRC-SPF PhD scholarships (see Tables 4, 5 and 6 for details).

Table 3: Numbers of postgraduate students*

Year	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
PhD	38	40	53	56	60	49	50	43
MSc	3	11	13	13	8	8	7	5
Hons	7	9	11	5	8	6	2	0
Total	48	60	77	74	76	63	59	48

*Honours are postgraduate students

Table 4: CRC-SPF Research Students

Table 4: CRC-SPF Research Students

First Name	Second Name	Degree	Funding	Start	Uni	Project	Supervisors	Program
Philip	*ALCOM*	*PhD*	*APAI*	*2005*	*ANU*	*Guiding early interventions in silviculture through predicting crown and canopy dynamics*	*Dr R James, Dr A Nicotra, Dr G Smith, Dr D Thomas, Prof J Bauhus*	*SM*
Sue	*BAKER*	*PhD*	*APA/CRC*	*2000*	*UTas*	*Conservation of beetles in managed forests*	*A/Prof A Richardson*	*RP*
Joanne	BURTON	PhD	GU/CRC	2002	GU	Links between carbon and nitrogen cycling processes in forest ecosystems	Dr Z Xu, Dr H Gharidi, Dr S Boyd, Prof J Hughes	SM
Greg	DUTKOWSKI	PhD	Ind staff	1996	UTas	Improvement of mixed models for prediction of breeding values in forestry	A/Prof B Potts, Dr A Gilmour	GI
Jules	FREEMAN	PhD	UTas/CRC	2001	UTas	Linkage mapping and QTL analysis of *Mycosphaerella* resistance in *Eucalyptus globulus*	Dr R Vaillancourt, A/Prof B Potts, Dr D Steane	GI
Carl	GROSSER	PhD	SPIRT/ARC	1999	UTas	Seed orchard molecular biology	Dr R Vaillancourt, A/Prof B Potts	GI
Matthew	HAMILTON	PhD	UTas/CRC	2003	UTas	Breeding methodologies for improving *Eucalyptus nitens*	A/Prof B Potts, Dr L Apiolaza, Dr C Harwood	GI
Kate	HARRISON	PhD	CRC	2002	UTas	Invertebrate assemblages associated with habitat features in *Eucalyptus obliqua* forests of southern Tasmania	Dr C Mohammed, Dr S Groves	RP
Craig	HAWKINS	MSc	Ind staff	1998	UTas	Response of *Brunonia australis* to forestry practices	Dr R Wiltshire, Dr P Barker	SM
Jim	HE	PhD	APA/CRC	2001	GU	Molecular bases of soil biological properties and processes in forest ecosystems	Dr Z Xu, A/Prof J Hughes, Dr I Phillips	SM
Anna	HOPKINS	PHD	APA/CRC	2002	UTas	Ecologically sustainable forest management: course woody debris	Dr C Mohammed, Dr S Groves	RP
Shaowei	HUANG	PhD		2004	SCU	Marker aided selection in tropical pines	Dr M Shepherd, Dr M Deiters	GI
Megan	JONES	PhD	SFNSW	1999	SCU	Gene flow and genetic diversity of hardwood plantations in New South Wales	Dr M Shepherd, Prof R Henry, Prof A Delves	GI
Rebecca	JONES	PhD	ARC APAI	2005	UTas	Eucalypt genepool management	Dr R Vaillancourt, A/Prof B Potts, Dr D Steane	GI
Tim	JONES	PhD	SPIRT/ARC	2000	UTas	Genetic relationships in the breeding population of *Eucalyptus globulus*	Dr R Vaillancourt, A/Prof B Potts	GI
Dominic	KAIN	PhD	FWPRDC	1998	ANU	Genetics of wood properties of *Pinus elliottii, P caribea* and their hybrid	Prof P Kanowski, Dr K Harding, Dr M Dieters, Dr B Li	GI
Rachel	KING	PhD	APA	2000	GU	Genetic variation in spotted gums and susceptibility to *Ramularia* desease	A/Prof J Hughes, A/Prof B Potts	GI
Andrew	KNOWLES	PhD	CRC	2000	UTas	K and Mg uptake by eucalypts and pines.	Dr S Shabala, Dr P Smethurst, Dr P Brown	SM
Sharon	KOH	PhD	CRC	2002	UTas	Mathematical modelling of tree growth	Dr P Sands, Prof L Forbes, Dr M Battaglia, Dr Mel Tyree	SM
Peter	KUBE	PhD	Ind staff	1996	UTas	Breeding objectives for production of sawlogs and pulpwood from plantation-grown *E. nitens*	Dr C Raymond, Prof J Reid	GI
Prue	LONEY	PHD	CRC	2002	UTas	Plant defences against mammalian browsing	Dr C McArthur, Dr G Jordan	RP
Marian	LORKIN	PhD	APA/CRC	2000	UTas	Reproductive biology of *Eucalyptus*	A/Prof B Potts, Dr R Vaillancourt	GI
Issa	MEDRAJ	PHD	ARC	2002	GU	Molecular nutrition of hoop pine: characterisation of ammonium transporter genes	Prof J Hughes, Dr Z Xu, Dr F Smith	SM
Andrew	MILGATE	PhD	SPIRT/ARC	1997	UTas	The genetic basis of resistance to *Mycosphaerella* in *Eucalyptus globulus*	Dr R Vaillancourt, Dr C Mohammed, Dr D de Little	GI/RP
Alison	MILLER	PHD	APA/FFIC	2003	UTas	Foraging by herbivores in relation to vegetation patchiness	Dr C McArthur, Dr P Smethurst	RP/SM
Daryl	MUMMERY	PhD	CSIRO	1999	UTas	Using landscape models to enhance plantation yield predictions	Dr E Bruce, Dr M Battaglia, Dr P Ryan	SM
Mark	NEYLAND	MSc	Ind staff	1998	UTas	Alternative silvicultural systems for regenerating native forest	Dr N Davidson, Dr C Beadle, Mr J Hickey, Prof J Bauhus	SM
Megan	NOSOVICH	PhD	ARC	2003	GU	Links between carbon and nitrogen cycling processes in forest ecosystems	Dr Z Xu, Dr S Boyd, A/Prof P Healy	SM
Julianne	O'REILLY-WAPSTRA	PhD	UTas/CRC	2000	UTas	Genetic and chemical resistance of *Eucalyptus globulus* and *E. nitens* to mammalian herbivores	Dr C McArthur, A/Prof B Potts	RP
Ann	PERRY	PhD	APA/CRC	2000	UQ	Wood quality assessment of plantation-grown *Flindersia brayleyana*	Dr D Doley, Dr A Muneri	SM
Elizabeth	PIETRZYKOWSKI	PhD	APAI	2002	UTas	Epidemiology and remote sensing of *Mycospaerella* leaf blight in plantation forestry	Dr C Mohammed, Dr T Booth, Dr C Beadle, Dr M Battaglia, Dr E Pinkard	RP/SM
Fiona	POKE	PhD	APA/CRC	2002	UTas	Lignin biosynthesis in *Eucalyptus globulus*	Prof J Reid, Dr R Vaillancourt	GI
Rebecca	PRYOR	MSc	CRC	2002	UTas	Waterlogging of *Eucalyptus globulus*	Dr N Davidson, Dr M Battaglia, Dr D Close	SM
Luke	RAPLEY	PhD	UTas/CRC	2000	UTas	Genetic variation in susceptibility of eucalypts to insect attack	Dr G Allen, A/Prof B Potts	RP/GI
Anthony	RICE	PhD	APA	1999	UTas	The ecology and host interactions of the larval parasitoids of *Chrysophtharta agricola*	Dr G Allen	RP
Carolyn	RINGROSE	MSc	Ind Staff	1999	UTas	N mineralisation in annually N-fertilised plantations	Mr R Doyle, Mr W Neilsen, Dr P Smethurst	SM
Jackie	SCHIRMER	PhD	APA/CRC	2000	ANU	Effectiveness of conflict resolution techniques in resource management disputes	Prof P Kanowski, Dr H Ross, Dr S Dovers	SM
Leon	SCOTT	PhD	CRC	1998	SCU	Molecular genetics of hoop pine	Dr M Shepherd, Prof R Henry, Dr M Deiters, Dr G Nikles	GI
Anna	SMITH	PhD	APA/CSIRO	2002	UTas	Risk and impact of *Mycospheaella* in plantations of *Eucalyptus globulus* and *E. nitens*	Dr C Mohammed, Dr C Beadle, Dr M Battaglia	RP/SM
Desmond	STACKPOLE	PhD	ARC APAI	2005	UTas	Unravelling the relationship between growth and wood properties in temperate eucalypts	A/Prof B Potts, Dr R Vaillancourt, Dr C Harwood, Dr P Volker	GI
Paul	TOON	MSc	ARC	1998	USC	Wood properties of hybrids between *Pinus elliottii* and *P. caribea* var. *hondurensis*.	Dr H Wallace, Dr K Harding	GI
Trudi	WHARTON	PhD	Industry	1999	ANU	Biology and ecology of *Essigella californica* (Hemiptera: Aphididae)	Dr R Floyd, Dr P de Barro, Dr P Cooper	RP
Simon	WHITTOCK	PhD	SPIRT/ARC	2001	UTas	Breeding for sustainability in *Eucalyptus globulus*	Dr L Apiolaza, A/Prof B Potts	GI
Natasha	WIGGINS	PhD	UTas/CRC	2002	UTas	Feeding behaviour in brushtail possums	Dr C McArthur, A/Prof S McLean, Dr R Boyle	RP
Danielle	WISEMAN	PhD	APA-I	2001	UTas	Pathology and physiology of pruned *Eucalyptus globulus*	Dr C Mohammed, Dr C Beadle, Dr E Pinkard	RP/SM
James	WORTH	PhD	APA	2004	UTas	*Nothofagus cunninghamii* biogeography	Dr R Vaillancourt, Dr G Jordan, A/Prof B Potts	GI
Marie	YEE	PhD	APA/CRC	1999	UTas	Saproxylic insects and their associations with wood decay in wet sclerophyll forests	Dr C Mohammed, Dr A Richardson, Dr R Taylor, Dr G Allen	RP
Janet	ZHANG	PHD	APA	2003	GU	Diversity of soil microbial populations in adjacent native forest and pine plantation	Prof B Patel, Prof Z Xu	SM

Table 5: Number of students in degrees and programs

Number of students		
Full/part-time		
Full-time		41
Part-time		7
	Total	48
Degree		
Honours		0
MSc		5
PhD		43
	Total	48
By CRC-SPF research program		
Genetic Improvement		19
Sustainable Management		17
Resource Protection		12
	Total	48

Table 6: Funding of postgraduate students

Funding of MSc and PhD	
CRC scholarship	6
APA scholarship	4
CRC top-up of APA scholarship	8
CSIRO top-up of APA scholarship	1
ARC	3
FFIC support of APA	1
APA-I	5
SPIRT/ARC	4
CSIRO	1
UTas/CRC top-up	5
GU/CRC top-up	1
CRC industry partners	1
SF/NSW	1
LWRDC	1
FWPRDC	1
Industry employed postgraduate	3
Unfunded postgraduate	2
Total	48

- Eight PhD, one MSc and one Honours student completed their degrees in this financial year: **Genetic Improvement Program**; Dominic Kain (PhD), Rachel King (PhD), Leon Scott (PhD), Peter Kube (PhD), Greg Dutkowski (PhD), Shaowei Huang (PhD).

  Sustainable Management Program; Tammie Harvest (Hons), Craig Hawkins (MSc)

  Resource Protection Program; Julianne O'Reilly-Wapstra (PhD), Luke Rapley (PhD).

- A further seven PhD and two MSc students submitted a thesis for examination during the year:

  Genetic Improvement Program; Tim Jones (PhD), Andrew Milgate (PhD), Simon Whittock (PhD), Paul Toon (MSc)

  Sustainable Management Program; Daryl Mummery (PhD), Carolyn Ringrose (MSc).

  Resource Protection program; Trudi Wharton (PhD), Anthony Rice (PhD), Marie Yee (PhD).

To view the titles of these students' theses, see the Publication section of this report

Table 7: Supervisors of CRC research students

Supervisor	Institution	No.	Supervisor	Instituition	No.
Dr G Allen	UTas	3	Dr G Jordan	UTas	2
Dr L Apiolaza*	FT	2	Prof P Kanowski	ANU	2
Dr P Barker*	NPWS	1	Dr B Li**	NCSU (USA)	1
Dr M Battaglia*	CSIRO FFP	5	Dr C McArthur*	CRC/UTas	4
Dr H Bauhus	ANU	2	A/Prof S McLean	UTas	1
Dr C Beadle*	CSIRO FFP	4	Dr C Mohammed	UTas/CSIRO FFP	7
Dr T Booth*	CSIRO FFP	1	Dr A Munari*	QFRI	1
Dr S Boyd	GU	2	Mr W Neilsen*	FT	1
Dr R Boyle	UTas	1	Dr A Nicotra	ANU	1
Dr P Brown	UTas	1	Dr G Nikles*	QFRI	1
Dr E Bruce	UTas	1	Prof B Patel	GU	1
Dr D Close*	Kings Pk WA	2	Dr E Pinkard*	UTas	2
Dr P Couper	ANU	1	Dr I Philips	GU	1
Dr N Davidson*	CRC/UTas	2	A/Prof B Potts*	CRC/UTas	13
Dr P de Barro*	CSIRO Ento	1	Dr C Raymond*	SFNSW	1
Dr D de Little*	Consultant	1	Prof J Reid	UTas	2
Prof A Delves	SCU	1	Dr A Richardson	UTas	2
Dr M Dieters*	QFRI/USC	3	Dr H Ross	ANU	1
Dr D Doley*	UQ retired	1	Dr P Ryan*	QFRI	1
Dr S Dovers	U Melb	1	Dr P Sands*	CSIRO FFP	1
Mr R Doyle	UTas	1	Dr S Shabala	UTas	1
Dr R Floyd*	CSIRO Ento	1	Dr M Shepherd*	CRC/SCU	3
Prof L Forbes	UTas	1	Dr P Smethurst*	CSIRO FFP	3
Dr A Gilmour*	NSW Ag	1	Dr F Smith*	CSIRO PI	1
Dr H Gharidi	GU	1	Dr G Smith*	SFNSW	1
Dr S Groves*	FT	2	Dr D Steane*	CRC/UTas	2
Dr C Harwood*	CSIRO FFP	2	Dr R Taylor*	NTPWC	1
Dr K Harding*	QFRI	2	D D Thomas*	SFNSW	1
A/Prof P Healy	GU	1	Dr M Tyree**	USDA FS	
Prof R Henry	SCU	2	Dr R Vaillancourt	UTas	9
Mr J Hickey*	FT	1	Dr P Volker*	FT	1
Prof J Hughes	GU	4	Dr H Wallace	USC	1
Dr R James	ANU	1	Dr R Wiltshire	UTas	1
			Prof Z Xu	GU	5

University departmental supervisors = 31
** Overseas supervisors = 1
* Supervisors not staff of university departments = 34
Total number of supervisors = 66

- New students who enrolled with the CRC-SPF in 2004/05 were Des Stackpole (UTas), Beck Jones (UTas) and Philip Alcorn (ANU).
- Ten of the CRC-SPF's PhD students received 18 grants and awards this year, including an Australian Academy of Science Young Researcher Award; three University of Tasmania Dean of Graduate Research Commendations; a Royal Society of Tasmania Doctoral Award; a Tasmanian Young Achiever Award; four Holsworth Wildlife Research grants; as well as other grants and prizes for best science papers, talks and posters; and funds to conduct research (see Grants and Awards section for details).
- Supervision of postgraduate and Honours students was widely distributed amongst CRC-SPF partner institutions such that 34 of the 66 supervisors of MSc and PhD projects were not staff of Australian university departments (see Table 7 for details).
- Undergraduate teaching by CRC-SPF staff encourages students to consider the study of forest sciences as a choice for higher degree. Eight CRC-SPF scientists, who were not staff of university departments, contributed to 11 university courses in fields allied to their research, involving of 341 students: Dr N Davidson in 'Plant Ecology' (UTas, 24 students), Dr J O'Reilly-Wapstra in 'Zoology II' (Animal Form and Function, UTas, 90 students) and in Botany II (Ecology of Tasmania, UTas 60 students), Dr P Smethurst in 'Soil Fertility' (UTas, 20 students), A/Prof B Potts in 'Molecular evolution' (UTas, 20 students) and 'Vegetation of

Tasmania' (UTas, 12 students), and Dr Dorothy Steane Botany 2 (UTas, 80 students). Dr Neil Davidson coordinates a four-year undergraduate course, 'Forest Ecology', and a 'Forestry' course shared between University of Melbourne and the University of Tasmania.

- Five postdoctoral fellows worked with the centre in 2004/05: Dr D Steane in molecular genetics (UTas, Hobart), Dr A O'Grady in root biomass turnover (CSIRO FFP, Hobart), Dr M Matsuki on insect pest management (insect pest management group, Western Australia), Dr L Rapley in insect ecology (UTas, Hobart), and Dr J O'Reilly-Wapstra in vertebrate browsing (UTas, Hobart).
- The CRC hosted eight visiting scientists during 2004/05.

Genetic Improvement Program

Quantitative geneticist, Dr Joao Costa e Silva, visited the University of Tasmania for two months in 2005 during which time he analysed data from several *E. globulus* trials and contributed to the breeding strategy review of *E. globulus* in Western Australia.

Professor Tom Whitham, Dr Joe Bailey and Dr Jen Schweitzer of the Northern Arizona University visited A/Prof Brad Potts in August to discuss collaborative research projects. During the visit both Professor Whitham and Dr Schweitzer presented seminars.

Sustainable Management Program

Dr Mel Tyree of the USDA Forest Service visited for four weeks in February. Sharon Koh worked with Mel, one of her supervisors, on her PhD project at the University of Adelaide.

Resource Protection Program

Dr John Brown of Washington State University, Pulman USA, visited the CRC entomology program in Tasmania in December. During that time he presented a seminar and exchanged research ideas on future research plans in chemical ecology in Tasmania. Dr Brown leads a successful program for insect control in poplars including pheromone-based control of the western poplar clearwing moth and carpenter worm moth, and insecticide based controls for cottonwood leaf beetle.

In January, Dr Darren Kriticos and Dr Karina Potter (NZFRI) also visited the entomology research group to discuss research progress on pheromone monitoring within Tasmania and the biocontrol program of *Uraba lugens* in New Zealand.

Technology transfer outcomes

During the year 2004/05 the CRC had published 285 journal papers, book chapters, theses and other publications (see Table 8).

Table 8: Publications and Technology transfer activities (July 2004 to May 2005)

Total publications	**183**
Journal	51
Journal (in press)	28
Books and book chapters	3
Theses	12
Confidential reports (including CRC technical reports)	26
Reports	5
Refereed conference proceedings	4
Conference proceedings	42
Industry news flashes	12
Total public presentations	**125**
Symposia	10
Conference presentations	21
Media reports	29
Seminars	33
Field days	7
Workshops	20
Short courses	5

Table 9: Major events

The second symposium on molecular genetics of *Eucalyptus* (July)
Plantation water use workshop (Hobart, Tasmania, August)
STBA/CRC-SPF *Eucalyptus globulus* breeding strategy review (Albany, Western Australia, February)
Eucalyptus nitens breeding strategy review (Hobart, Tasmania, June)
Mammal browsing workshop (February)
CABALA industry training (Perth, Western Australia, 3 May; Hobart, Tasmania, 13 May)
Solid wood workshop (May)
Bothwell tree decline field day (June)
Completion of the *Seed orchard manual* (June)

- A member's website provided a "one-stop-shop" for all CRC information. The system has offered a search and download facility of all CRC documents and events, as well as periodic emails notifying users of new documents and events in their areas of interest. Documents and events were available to groups nominated by the author so that intellectual property rights could be managed.
  The website has continued to grow in popularity, now with over one thousand active users. Over its lifetime so far it has received almost 10,000 logins (on average about 40 per week); the 1,400 full-text documents, which can be updated and reviewed in real time, have been downloaded over 20,000 times; and the 730 events on the members' calendar have received over 5,000 hits (about 100 per week).
- The website continues to grow; the tried and tested techniques that have made the members' website a success over the lifetime of the CRC-SPF will be adapted to meet the needs of the partners of the new CRC for Forestry.

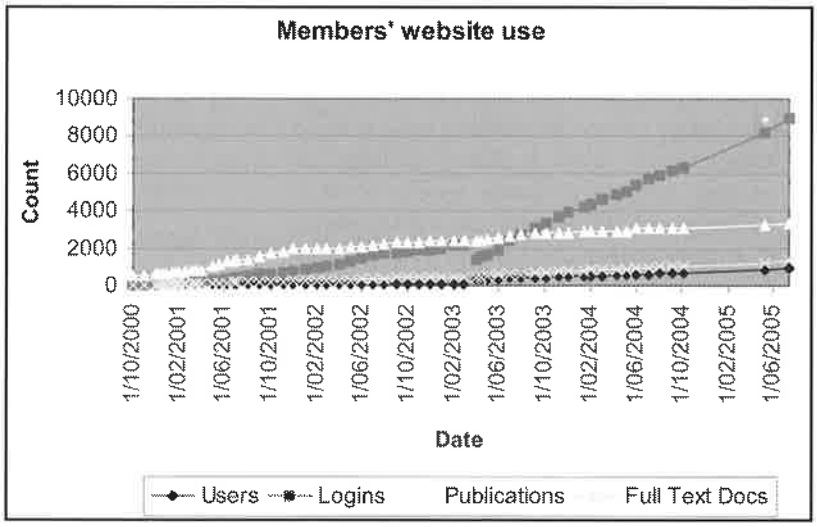


Figure 7: Members' website usage

Dr Neil Davidson talks to landholders about causes of tree decline at Bothwell, Tasmania.

UTILISATION AND APPLICATION OF RESEARCH

Strategy for the technology transfer program

The principal objective of the Technology Transfer Program was to transfer technology rapidly to the industrial partners and other end users. This involved the following steps:

1. *Involvement of industrial partners in planning research projects and running experiments*

   The Program Coordinating Committees of the CRC retained an overview of these research projects. They prioritised research and set 'deliverables' (research outcomes that could be directly used by industry). Most CRC research was conducted using company trials, or trials established on company land, so companies were involved at the outset with the planning and implementation of research projects and had ownership of them. Research plans for these experiments were lodged with the companies, and included an agreed protocol for the research. The company partners allocated staff time (in-kind contributions) to CRC research projects so that effective interaction could occur.

2. *Early transfer of results*

   The early transfer of results started with informal interactions while research was being conducted (phone, fax, email and visits to company sites). Formal transfer started with electronic "newsflash" fact-sheets (a double-sided A4-page summary of recent research): '*Beyond the Black Stump*' (Sustainable Management Program), '*Pest Off!*' (Resource Protection Program) or '*Hot Off the Seedbed*' (Genetic Improvement Program). Company responses then determined whether it was best to organise a seminar, workshop, short course or field day on the topic. Later stages of transfer were through technical reports, unrefereed papers and refereed journal papers.

   Technology Transfer Officers, Greg Dutkowski and Philip Smethurst liaised with industrial partners and researchers to develop a better understanding between these groups within the CRC, and to facilitate adoption of technology most appropriate to each industry partner's needs.

   A full list of technology transfer activities conducted by the CRC can be found in **Table 8** (page 34) or on the CRC-SPF website http://members.forestry.crc.org.au

Major technology transfer projects for 2004/05 were:-

- Eucalypt seed orchard manual
- Insect pest monitoring information system
- Leaf area index monitoring system
- CABALA growth model
- Mammal browsing monitoring system
- (See also Major Events, page 34)

Numerous smaller projects have been negotiated with individual partners.

Technology transfer plans were implemented for each research project. The plans were stored in an online database; which allowed easy monitoring and updating, and facilitated planned events to be fed into an online calendar of events.

The technology transfer team has worked to make existing research information more easily available. The members' web-site captures all CRC events and outputs so there is a "one stop shop" for all CRC information. The system offers search and download facilities for all CRC documents and events as well as periodic emails notifying users of new documents and events in their areas of interest. Documents and events are only available to groups that are nominated by the author, so that intellectual property rights can be managed.

Technology transfer also occurred through training provided by the CRC to its postgraduates. Recent graduates transfer new technology to their employers. During 2004/05 there were five company staff enrolled in PhD and MSc courses while still employed: Craig Hawkins (Forester, GL Limited); Mark Neyland (Research Officer, FT); Daryl Mummery (Experimental Officer, CSIRO FFP); Greg Dutkowski (Technology Transfer Officer, CRC-SPF); and Caroline Ringrose (Research Assistant, FT). Des Stackpole was previously with the Forest Science Centre, Victorian Government. A further 15 students are conducting research on scholarships supported by industry (APA-I, SPIRT/ARC, CSIRO, CRC Industry partners, FWPRDC, SFNSW).

The success of our students in obtaining employment in the forest industry was demonstrated by the following appointments this year:

- Dr Julianne O'Reilly-Wapstra has been employed as a post-doctoral researcher with the CRC and is the leader of two research projects.

- Danielle Wiseman was appointed as a silvicultual research scientist by the Oji Paper Company. She is based at their laboratory in Albany, Western Australia; and works on eucalypt plantations.
- Craig Hawkins has been appointed as a scientist to the Forest Practices Authority of Tasmania.
- Jim He has been appointed as a professor with the Beijing Eco-environmental Research Centre of the Chinese Academy of Sciences to work on both molecular ecology and environmental chemistry.
- Andrew Knowles is working as a regulatory analyst in the Network Division of Aurora Energy.
- Dr Robert Barbour has been appointed as a post-doctoral research fellow in forest genetics with the School of Plant Science at the University of Tasmania.
- Dr Alieta Eyles is a postdoctoral researcher at the Department of Plant Pathology, Ohio State University, United States of America.
- Dr Helen Nahrung is an entomologist with Forest Technologies, Horticulture and Forestry Science, Department of Primary Industries and Fisheries, Queensland.

Industrial Uptake

New technologies developed by the research programs, which have been transferred to industrial partners and other end users, are outlined below.

Genetic Improvement Program

- Information on levels of self-incompatibility of *Eucalyptus globulus* breeding population selections, which were obtained as part of a joint CRC/STBA research project, has been provided to partners to aid deployment decisions.
- Chloroplast DNA technologies, initially developed as part of a CRC project, have been used to determine the origin and genetic diversity among selections of unknown pedigree in an *E. globulus* breeding program.
- Spatial analysis methodology used in genetic evaluation of large breeding populations of *E. nitens* (belonging to one of the CRC partners) has been applied on a limited scale to data analyses of forestry organisations within Australia and overseas.
- The breeding and deployment strategy simulation software gSIM, developed by the CRC, has been used by the STBA to evaluate strategy decisions and measurement options.
- Data, such as NIR-predicted pulp yield provided from CRC research projects, has contributed to industry genetic evaluations of *E. globulus*.
- Through CRC analyses and literature reviews, the CRC has provided a database of information on standardised parameters for use in genetic evaluation of both *E. globulus* and *E. nitens*.
- The database of *E. nitens* and *E. globulus* native stand seed collections developed by the CRC is now regularly used to allocate germplasm to base genetic groups (i.e. races or subraces) for genetic evalution.
- Reviews of *E. nitens* and *E. globulus* genetics undertaken by the CRC are being used by partners to assist in reviewing their strategies for breeding and deployment.
- The genetic evaluation system development by the STBA in collaboration with the CRC has now lead to the development of an international genetic evaluation service company (PlantPlan Genetics Pty Ltd), staffed by the project leader of A2.

Sustainable Management Program

- Concerns for conserving nutrients in harvest debris and the forest floor has led to decreased use of burning on second rotation sites. A mini-windrow method is widely used in Tasmania on these sites to retain slash, minimise erosion and allow spot cultivation and other establishment treatments.
- The *Visual Guide* for measuring leaf area index has been further implemented and is now being used by seven partners to refine their scheduling of application of later-age fertiliser.
- Fertiliser is being applied routinely to enhance clear wood production but this practice is being managed carefully to minimise the development of large branches that are difficult to prune and are more susceptible to decay entry after pruning.

- The best practice approaches adopted in revegetation trials are being promoted to landholders and extended to include new approaches for maintaining the health of native stands subject to tree decline.

- Forestry is being redefined to meet a broad range of economic, environmental and social expectations. As part of this strategy, industrial partners continue to refine their own strategies for working with local communities as a means of embracing their support for plantation forestry and including public participation as an important facet of forestry planning.

- CABALA (Version 1.0) has been made available to partners and is being used by them to examine the effects of a range of silvicultural inputs on plantation productivity before they are implemented.

Resource Protection Program

- The Pest & Pathogen Database was made available on the CRC members' website, and it has been used by plantation managers to find out about pests or pathogens and management options.

- The model that predicts the feeding impact of *Chrysophtharta bimaculata* on *Eucalyptus nitens* and *E. globulus* was adjusted to allow for the additional impact of adult feeding, and to correct estimates of economic impact in the IPM system for managing *C. bimaculata*. This lowered the monitoring thresholds used by Forestry Tasmania, which improved protection of their eucalypt plantations from defoliation by leaf beetles.

- Crown damage index (CDI) was used by Forestry Tasmania as a basis for assessing post-summer defoliation damage in eucalypt plantations. Plantation health assessment using the CDI was also implemented by State Forests NSW and QDPI&F in the 2004/05 season.

- The insecticide *Success*® has now been registered for use on forest eucalypt plantations throughout Australia. It is used by Forestry Tasmania to replace a broad-spectrum insecticide on almost half the area that required protection from chrysomelid defoliation.

- The sampling protocol for *Gonipterus scutellatus* was implemented by Timbercorp, WAPRES, Great Southern Plantations, and Albany Plantations Forestry Ltd in the spring of 2004. The data were put into the decision support system, which streamlined the decision-making process and reduced the number of plantations that were sprayed.

- The sampling designs for *Chrysophtharta* beetles and *Mnesampela privata* were implemented by Timbercorp in the 2004/05 season. The decision support system streamlined the decision making process and reduced the number of plantations that were sprayed.

- Industry has included outcomes from mammal browsing research into its current plans for continued work to develop operational strategies for the management of mammal browsing damage.

- The research outcomes in respect to the application of fertilisation to assist in the recovery of foliage damage are under review by industry partners.

- A series of seven field days and meetings was held for the Integrated Pest Management Group (IPMG) across Western Australia

STAFFING AND ADMINISTRATION

Membership

There were several changes in membership of the CRC for Sustainable Production Forestry during 2004/05 that coincided with the eighth year extension of the CRC approved by the Department of Education Science and Training. From 1 July 2004 Department of Primary Industries Queensland, Griffith University, The University of Queensland, Grand Ridge Plantations and CSIRO Entomology ended their membership and fulfilled their obligations to the CRC. The remaining partners stayed with the CRC to the end of June 2005.

Staff and staff movements

During the eighth year, staff concentrated upon capturing extra value for industry from the CRC-SPF research program; research projects were winding down and several staff moved on. Dr Greg Dutkowski resigned to take up employment with Plantplan Genetics Pty Ltd, a wholly-owned subsidiary of CRC partner, the Southern Tree Breeding Association. Miss Jill Butterworth left her position in Technology Transfer to take up a position with the Menzies Research Institute in Hobart. Staff whose contracts ended during the year included Dr Luke Rapley and Mr Julian Smith, University of Tasmania. Mr Tony O'Grady has moved to other employment in the University of Tasmania but remains active in the CRC. The majority of existing staff were in the position to be offered contracts in the new CRC for Forestry. Temporary bridging contracts have been offered to many, until 31 December 2005, pending the startup of the CRC for Forestry.

Postgraduate students

CRC-SPF students who received their PhD degrees and new students starting with the CRC in 2004/5 are presented in the Education and Technology Transfer Program section of this report.

Administration

The number of meetings held by the Board and other committees during 2004/5 were as follows:

Board of Management	3
Management Committee	7
Advisory Committee	0
Program coordinating committees	
Genetic Improvement	1
Sustainable Management	1
Resource Protection	2

SPECIFIED PERSONNEL

Title, name and role	Contributing organisation	per cent of time in CRC
Prof Rod Griffin, Director	University of Tasmania	80
Prof Robert Henry, Deputy Director	Southern Cross University	30
Program managers		
Dr Chris Beadle (Sustainable Management)	CSIRO Forestry and Forest Products	80
Dr Caroline Mohammed (Resource Protection)	CSIRO Forestry and Forest Products/University of Tasmania	20
Associate Professor Brad Potts (Genetic Improvement)	University of Tasmania	100
Dr Neil Davidson, (Education and Technology Transfer)	University of Tasmania	100

PUBLICATIONS

Genetic Improvement Program

Journal

Barbour, RC, Potts, BM, Vaillancourt, RE (2005) Pollen dispersal from exotic eucalypt plantations. *Conservation Genetics* **6** 253-257.

Barbour, RC, Potts, BM, Vaillancourt, RE (2005) Gene flow between introduced and native *Eucalyptus species*: crossability of native Tasmanian *Eucalyptus* species with exotic *E. nitens*. *Australian Journal of Botany* **53** 465-477.

Burley, J, Kanowski, PJ (2005) Breeding strategies for temperate hardwoods. *Forestry* 78 199-208.

Costa e Silva, J, Dutkowski, GW, Borralho, NMG (2005) Across-site heterogeneity of genetic and environmental variances in the genetic evaluation of *Eucalyptus globulus* trials for height growth. *Annals of Forest Science* **62**(2) 183-191.

Hingston, AB, Gartrell, BD, Pinchbeck, G (2004) How specialised is the plant-pollinator association between *Eucalyptus globulus* ssp. *globulus* and the swift parrot *Lathamus discolor*? *Austral Ecology* **29**(6) 624-630.

Hingston, AB, Potts, BM (2005) Pollinator activity can explain variation in outcrossing rates within individual trees. *Austral Ecology* **30** 319-324.

Jones, RC, McKinnon, GE, Potts, BM, Vaillancourt, RE (2005) Genetic diversity and mating system of an endangered tree, *Eucalyptus morrisbyi*. *Australian Journal of Botany* **53**(4) 367-377.

McGowen, MH, Williams, DR, Potts, BM, Vaillancourt, RE (2004) Stability of outcrossing rates in *Eucalyptus globulus* seedlots. *Silvae Genetica* **53**(1) 42-44.

McKinnon, GE, Vaillancourt, RE, Steane, DA, Potts, BM (2004) The rare silver gum, *Eucalyptus cordata*, is leaving its trace in the organellar gene pool of *Eucalyptus globulus*. *Molecular Ecology* **13**(12) 3751-3762.

Milgate, AW, Potts, BM, Joyce, K, Mohammed, CL, Vaillancourt, RE (2005) Genetic variation in *Eucalyptus globulus* for susceptibility to *Mycosphaerella nubilosa* and its association with tree growth. *Australasian Plant Pathology* **34**(1) 11-18.

Patterson, B, Gore, PL, Potts, BM, Vaillancourt, RE (2004) Advances in pollination technique for large-scale production of *Eucalyptus globulus* seed. *Australian Journal of Botany* **52**(6) 781-788.

Patterson, B, Vaillancourt, RE, Pilbeam, DJ, Potts, BM (2004) Factors affecting outcrossing rates in *Eucalyptus globulus*. *Australian Journal of Botany* **52** 773-780.

Schimleck, LR, Kube, PD, Raymond, CA (2004) Genetic improvement of pulp yield in *Eucalyptus nitens* using cellulose content determined by NIRS. *Canadian Journal of Forest Research* **34**(11) 2363-2370.

Shepherd, M, Mellick, R, Toon, PG, Dale, G, Dieters, MJ (2005) Genetic control of adventitious rooting on stem cuttings in two *Pinus elliottii* x *P. caribaea* hybrid families. *Annals of Forest Science* **62** 403-412.

Steane, DA, Jones, RC, Vaillancourt, RE (2005) A set of chloroplast microsatellite primers for *Eucalyptus* (Myrtaceae). *Molecular Ecology Notes* **5** 538-541.

Thamarus, KA, Groom, K, Bradley, AD, Raymond, CA, Moran, GF (2004) Identification of quantitative trait loci for wood and fibre properties in two full sib pedigrees of *Eucalyptus globulus*. *Theoretical and Applied Genetics* **109**(4) 856-864.

Whitham, TG, Lonsdorf, E, Schweitzer, JA, Bailey, JK, Fischer, DG, Shuster, SM, Lindroth, RL, Hart, SC, Allan, GJ, Gehring, CA, Keim, P, Potts, BM, Marks, J, Rehill, BJ, DiFazio, SP, LeRoy, CJ, Wimp, GM, Woolbright, S (2005) All effects of a gene on the world: Extended phenotypes, feedbacks and multi-level selection. *Ecoscience* **11** 5-7.

In press

Apiolaza, LA, Raymond, CA, Yeo, BJ (2005) Genetic variation of physical and chemical wood properties of *Eucalyptus globulus*. *Silvae Genetica* (in press).

Elliot, F, Shepherd, M, Henry, RJ (2005) Verification of interspecific pine hybrids using paternally inherited chloroplast microsatellites. *Forest Genetics* (in press).

McKinnon, GE, Potts, BM, Steane, DA, Vaillancourt, RE (2005) Population and phylogenetic analysis of the cinnamoyl coA reductase gene in *Eucalyptus globulus* Labill. (Myrtaceae). *Australian Journal of Botany* (in press).

Milgate, AW, Vaillancourt, RE, Mohammed, CL, Powell, M, Potts, BM (2005) Genetic structure of a *Mycosphaerella cryptica* population. *Australasian Plant Pathology* (in press).

Poke, FS, Vaillancourt, RE, Potts, BM, Reid, JB (2005) Genomic research in *Eucalyptus*. *Genetica* (in press).

Schimleck, LR, Kube, PD, Raymond, CA, Michell, AJ, French, J (2005). Estimation of whole-tree kraft pulp yield of *Eucalyptus nitens* using near-infrared spectra collected from increment cores. *Canadian Journal of Forest Research* (in press).

Steane, DA (2005) Complete nucleotide sequence of the chloroplast genome from the Tasmanian blue gum, *Eucalyptus globulus*. *DNA Research* (in press).

Thumma, R, Nolan,M.F., Evans, R, Moran, GF (2005) Polymorphisms in Cinnamoyl CoA Reductase (CCR) are associated with variation in microfibril angle in *Eucalyptus* spp. *Genetics* (in press).

Conference proceedings

Dutkowski, GW (2004) Gains from clonal breeding and deployment. In '*Eucalyptus* in a Changing World'. Eds NMG Borralho, JS Periera, C Marques, J Coutinho, M Madeira, and M Tomé. 11-15 October Aveiro, Portugal. p. 163. (RAIZ, Instituto Investigação de Floresta e Papel: Aveiro, Portugal).

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Barry, KM, Mihara, R, Davies, NW, Mitsunaga, T, Mohammed, CL (2005) Polyphenols of *Acacia mangium* and *A. auriculiformis* with reference to heartrot. *Journal of Wood Science* (in press).

Hopkins, AJM, Harrison, KS, Grove, SJ, Wardlaw, TJ, Mohammed, CL (2005) Wood decay fungi and beetle assemblages associated with living *Eucalyptus obliqua* trees: early results from studies at the Warra Long Term Ecological Research Site, Tasmania. *Tasforests* (in press).

Irianto, RSB, Barry, KM, Hidayah, I, Ito, S, Fiani, A, Rimbawanto, A, Mohammed, CL (2005) Incidence, spatial analysis and genetic variation of root rot of *Acacia mangium* in Indonesia. *Journal of Tropical Forest Science* (in press).

Rice, AD (2005) The parasitoid guild of larvae of *Chrysophtharta agricola* Chapuis (Coleoptera: Chrysomelidae) in Tasmania, with notes on biology and a description of a new genus and species of tachinid fly. *Australian Journal of Entomology* (in press).

Short, MW, Schmidt, S, Steinbauer, MJ (2005) Key to the genera of large nocturnal Ichneumonidae (Hymenoptera) of Australia, with notes on flight activity of the guild. *The Australian Entomologist* (accepted).

Steinbauer, MJ (2005) Re-collection and tentative host record for *Hygia (Australocolpura) sandaracine* Brailovsky (Hemiptera: Coreidae, Colpurini). *The Australian Entomologist* **32** (accepted).

Wiggins, NL, Marsh, KJ, Wallis, IR, McArthur, C, Foley, WJ (2005) Sideroxylonal in *Eucalyptus* foliage modifies feeding patterns of an arboreal folivore. *Functional Ecology* (in press).

Conference proceedings

Allen, GR, Elek, J, Matsuki, M (2004) Managing leaf beetles in eucalypt plantations: non-target impacts, biocontrol and natural enemy recolonisation. Poster. *Proceedings of the XXII International Congress of Entomology*, Brisbane, Queensland, p. 26.

Baker, SC, Richardson, AMM, Barmuta, LA (2004) Relevance of edge and riparian effects to conservation of litter beetles in streamside reserves. In 'XXII International Congress of Entomology'. 15-21 August, Brisbane, Queensland.

Barry, KM (2004) Inhibition of heart rot fungi of tropical *Acacia* spp. by antifungal flavanones. In 'IV Asia-Pacific Mycological Congress'. 14-19 November, p. 117. Chang Mai University: Chang Mai, Thailand.

Barry, KM (2004) Incidence of *Acacia mangium* root rot in Indonesia. In 'IV Asia-Pacific Mycological Congress'. 14-19 November Chang Mai University: Chang Mai, Thailand.

Barry, KM (2004) Heart rot research of *Acacia mangium* in Indonesia – implications for management. In 'IV Asia-Pacific Mycological Congress'. 14-19 November Chang Mai University: Chang Mai, Thailand.

Harrison, KS, Hopkins, AJM, Grove, SJ, Wardlaw, TJ, Mohammed, CL (2004) Tree age, invertebrates and fungi. In '22nd International Congress of Entomology 2004'. 15-21 August, Brisbane, Queensland.

Harrison, KS, Hopkins, AJM, Grove, SJ, Mohammed, CL (2004) Saproxylic invertebrates in living trees in Tasmania's southern forests. In 'Ecological Society of Australia 2004 Conference'. 7-10 December Adelaide, South Australia.

Hopkins, AJM, Harrison, KS, Grove, SJ, Wardlaw, TJ, Mohammed, CL (2004) A molecular, classical and ecological approach to the study of wood decay fungi in living *Eucalyptus obliqua* in Tasmania. In 'Ecological Society of Australia Ecology 2004 Conference'. 7-10 December Adelaide, South Australia.

Hopkins, AJM, Harrison, KS (2005) Wood decay fungi and dead-wood dependent beetles in the southern forests of Tasmania. In 'Fungimap 3'. 29 April-3 May Gowrie Park, Tasmania.

Mohammed, CL, Battaglia, M, Pinkard, EA, Glen, M, Tommerup, I, Smith, A, Pietrzykowski, E, Barry, KM, Eyles, A, Beadle, CL (2004) New tools for cost effective health management in eucalypt plantations. In '*Eucalyptus* in a changing world'. Ed. NMG Borralho, p. 8. (RAIZ - Instituto de Investigacao das Floresta e Papel: Aveiro, Portugal)

O'Reilly-Wapstra, J, Potts, BM, McArthur, C (2004) Genetic variation and additive inheritance of resistance of *Eucalyptus globulus* to possum browsing. In '*Eucalyptus* in a Changing World'. Eds NMG Borralho, JS Periera, C Marques, J Coutinho, M Madeira, and M Tomé. 11-15 October. Aveiro, Portugal. pp. 203-204. (RAIZ, Instituto Investigação de Floresta e Papel: Portugal).

Rapley, LP, Allen, GR, Potts, BM (2004) Does feeding by autumn gum moth larvae induce changes in *Eucalyptus globulus* leaf chemistry? In 'Entomology: Strength in Diversity. XXII International Congress of Entomology'. 15-21 August Brisbane, Queensland.

Rice, AD, Allen, GR (2004) In 'International Congress of Entomology' Host defense and parasitoid reproductive strategies limit niche breadth in a host-parasitoid system. Brisbane, Queensland. p. 84.

Yee, M (2004) Why do large logs host saproxylic beetles of conservation importance? In '22nd International Congress of Entomology 2004'. 15-21 August. Brisbane, Queensland.

Report

Yee, M, Grove, SJ, Richardson, A, Mohammed, CL (2004) Brown rot in inner heartwood: why large logs support characteristic saproxylic beetle assemblages of conservation concern. Insect biodiversity and dead wood. Proceedings of a symposium at the International Congress of Entomology, Brisbane, Australia, August 2004. Athens, United States of America.

Confidential Report

Matsuki, M. (2005) Effects of defoliation on growth of *Eucalyptus globulus* in SW WA. Revised. 13pp.

Matsuki, M. (2005) Economic analysis of variation in stocking rates and tree death. 8pp.

Matsuki, M. (2005) Biodiversity and phenology of insects found on blue gum trees in six P2002 plantations near Albany, WA. 20pp

Matsuki, M. (2005) Vertebrate biodiversity in blue gum plantations near Albany, WA. 20pp

Matsuki, M. (2005) Seasonal changes in leaf production, insect populations, and levels of defoliation in six P2002 plantations near Albany, WA. 16pp.

Matsuki, M (2005) Phenology of leaf development in *Eucalyptus globulus*, the life cycle of *Gonipterus scutellatus*, and seasonal changes in damage caused by it. 14 pp.

Matsuki, M, Loch, AD (2005) Natural enemies of insect herbivores in blue gum plantations in south west Western Australia. 29 pp.

McArthur, C, Close, DC, Brown, PH, Hovenden, MJ, Beadle, CL, Holz, GK, Hagerman, AE (2005) Understanding and manipulating stress physiology of eucalypt seedlings to improve survival and growth. ARC Final Report Linkage Project. CRC-SPF, Hobart, Tasmania.

Paterson, SC, Fitzgerald, H, Matsuki, M (2004) Seasonal pattern of leaf production and its effects on population dynamics of *Chrysophtharta bimaculata*, *C. agricola* and their natural enemies. Technical Report No. 144. 26 pp. CRC-SPF, Hobart, Tasmania.

Theses

O'Reilly-Wapstra, JM (2004) The phenotypic and genetic basis to browsing resistance of *E. globulus* to marsupial herbivores. PhD, School of Zoology, University of Tasmania, Hobart, Tasmania.

Rapley, LP (2004) *Eucalyptus* leaf chemistry and variation to insect attack. PhD, School of Agricultural Science, University of Tasmania, Hobart, Tasmania.

Yee, M (5 A.D.) The ecology and habitat requirements of saproxylic beetles native to Tasmanian wet eucalypt forests: potential impacts of commercial forestry practices. PhD, School of Agricultural Science, University of Tasmania, Hobart, Tasmania.

Industry newsflashes: *Pest Off!*

Baker, SC (2005) Wider streamside reserves and wildlife habitat strips will help maintain beetle biodiversity. Pest Off! 33.

Close, DC, McArthur, C, Hagerman, AE, Fitzgerald, H (2004) Seedling nutrient status and leaf age affects herbivore defence chemicals in *E. nitens* seedlings. Pest Off! 27.

Elek, JA, Beveridge, N (2005) Integrated pest management thresholds for Tasmanian eucalyptus leaf beetles should include damage from adult feeding. Pest Off! 31.

Hopkins, AJM, Harrison, KS, Grove, SJ, Wardlaw, TJ, Mohammed, CL (2005) Wood decay fungi and dead wood-dependent beetles in living *Eucalyptus obliqua* trees in southern Tasmania. Pest Off! 29.

Loney, P, McArthur, C, Jordan, GJ (2005) Browsing by pademelons is affected by sideroxylonal. Pest Off! 32.

Rapley, LP (2005) When should we spray? Autumn gum moth defoliation up to 50 per cent doesn't affect wood volume in a *Eucalyptus nitens* plantation. Pest Off! 30.

Rapley, LP (2005) Genetic variation in *Eucalyptus globulus* in relation to susceptibility from attack by the southern eucalypt leaf beetle and autumn gum moth. Pest Off! 28.

Education and Technology Transfer

Conference Proceeding

Kanowski, PJ (2004) In 'Forest Research and Education in the 21st Century'. Ed. Seoul National University. 12 October Seoul, Korea. (IUFRO: Seoul).

Media Activities

Radio, TV and online

ABC Local Radio, 936AM (2004) "Nights across Tasmania". Interview with Anna Hopkins and Kate Harrison about presentation of postgraduate research projects. 24 November.

ABC Radio (2004) Interview with Dorothy Steane about sequencing chloroplast DNA. 14 July.

ABC Radio (2004) Interview with J Williams and A Gerrand about plantation water use. 31 August.

ABC Radio News Bulletin (2005) Report about rural tree decline in the Midlands of Tasmania, featuring Neil Davidson. 17 January.

ABC Radio, Rural Report (2005) Interview with Geoff Allen about reduced chemical usage for insect pest control in plantations. 6 January.

ABC Radio, *The Country Hour* (2005) Interview with Geoff Allen and D Kriticos about Aussie itchy grubs rub kiwis up the wrong way. 1 February.

ABC Radio, *The Country Hour* (2005): Interview with Neil Davidson about rural tree decline in the Midlands of Tasmania. 18 May.

Radio National (2004) Interview with René Vaillancourt and D Grattapaglia about the molecular biology of eucalypts. 16 July.

ABC TV Tasmania (2004) Interview with Dorothy Steane about sequencing chloroplast DNA. 14 July.

ABC TV (2004) Interview with J Williams and A Gerrand about plantation water use. 31 August.

Radio National (2004) Interview with René Vaillancourt about the molecular biology of eucalypts. 23 September.

Southern Cross Television Tasmania (2004) Interview with Dorothy Steane about sequencing chloroplast DNA. 14 July.

WIN TV Tasmania (2004) Interview with Dorothy Steane about sequencing chloroplast DNA. 14 July.

ABC Radio 936 (2004) Interview with René Vaillancourt and D Grattapaglia about the molecular biology of eucalypts. 16 July.

ABC Science Online (2004) By gum! Eucalypt DNA to be sequenced, featuring René Vaillancourt. 22 September.

ABC Radio (2005) Winner of Young Achiever Award - science category, interview with Fiona Poke. 19 April.

ABC Radio *The Country Hour* (2005) Interview with Fiona Poke, winner of Young Achiever Award - science category. 21 April.

Media Activities

Newspaper and magazine articles

Bildstein, T (2005) Maximising research value in hardwood plantations. *Australian Forest Grower* 28 (1) p.8.

Bildstein, T (2005) New forestry CRC to continue state's leading-edge research. *True Blue* p.3.

Bildstein, T (2005) Research into making sawlog plantations more profitable. *Australian Forest Grower* p.8.

Mounster, B (2005) Good medicine for farm's sick bushland, featuring Neil Davidson. *Tasmanian Country* pp.18-19.

Mounster, B (2005) Possum problem has trees in trouble, featuring Neil Davidson. *Tasmanian Country* p.20

Breeding for resistance in *E. globulus*, with Dr Julianne O'Reilly-Wapstra (2004) *Tasmanian Country*. Hobart, Tasmania. July.

By gum! Mapping the chloroplast genome, with Dr Dorothy Steane (2004) *Unitas*. Hobart, Tasmania. 27 July.

Plantation water use with Dr Neil Davidson (2004) *The Mercury*. Hobart, Tasmania. 31 August.

Sequencing chloroplast DNA: tree prints exposed by gum, with Dr Dorothy Steane (2004) *The Mercury*. Hobart, Tasmania. 15 July.

Taking a stand on tree decline (2005) featuring Neil Davidson. *Derwent Valley Gazette*. 22 June. Page 3.

Winner of Tasmanian Young Achiever Award - science category, Ms Fiona Poke; article by Liz Bailes (2005) *Unitas*. Hobart, Tasmania.

Winner of Young Achiever Award - science category, Ms Fiona Poke; interview by Amanda Allie (2005) *The Advocate*. Burnie, Tasmania. 20 April.

PUBLIC PRESENTATIONS

Presentations that also appear as conference proceedings or abstracts are cited in the Publications section of this annual report.

Genetic Improvement Program

Dutkowski, GW (2004) Across site analysis with ASReml. Presentation, 'North American quantitative forest genetics group meeting'. 2 November. Charleston, South Carolina.

Dutkowski, GW (2004) Progeny trial analysis with ASReml. Course, 16-17 August. Umeå, Sweden.

Dutkowski, GW, Greaves, BL, McRae, TA (2004) Quantitative methods for tree breeders. Course, 19-22 October. Aveiro, Portugal.

Dutkowski, GW (2005) *E. nitens* genetic resources. Seminar, '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Dutkowski, GW (2005) gSIM breeding strategy simulator. Presentation, 'STBA *Eucalyptus globulus* breeding strategy review workshop', for the Southern Tree Breeding Association. 22-24 February. Albany, Western Australia.

Dutkowski, GW (2005) gSOOP seed orchard management tool. Presentation, 'STBA *Eucalyptus globulus* breeding strategy review workshop', for the Southern Tree Breeding Association. 22-24 February. Albany, Western Australia.

Griffin, AR (2004) Genome research - a breeders perspective. Presentation, '2nd symposium on molecular genetics of *Eucalyptus*'. 15 July. Hobart, Tasmania.

Griffin, R (2005) Chilean experience with breeding *E. nitens*. '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Hamilton, M (2005) Review of genetic parameters (including update on PhD work). '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Harwood, C (2005) Future CRC wood property research with *E. nitens*. '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Harwood, C (2005) Genetic improvement for solid wood products: some considerations. Seminar, 'Solid wood production from temperate eucalypt plantations seminars and discussion'. 12 May. Hobart, Tasmania.

Jones, T (2005) Local genetic dynamics in *Eucalyptus globulus*. Presentation, for Mediterranean Forest Research Unit. 21 June. INRA Centre, Avignon, France.

Jones, T (2005) Local genetic dynamics in *Eucalyptus globulus*. Seminar. 13 May. Hobart, Tasmania.

Joyce, K (2005) Gunns Ltd *E. nitens* breeding programme. '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

McGowen, MH (2005) The genetic control of sexual reproduction in *Eucalyptus globulus*. Seminar, 15 April. Hobart, Tasmania.

Moran, GF (2004) Molecular genetics of *Eucalypts* at CSIRO. Presentation, '2nd symposium on molecular genetics of *Eucalyptus*'. 15 July. Hobart, Tasmania.

Moran, GF (2005) Molecular work *Eucalyptus nitens*. '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Potts, BM, Lawrence, R, Minchin, PR, Whitham, T (2004) Eucalypt hybridisation and heteroblasty affect biodiversity of dependent communities. Invited presentation at "Entomology: strength in diversity. XXII international congress of entomology'. 15-21 August. Abstract published on CD. Brisbane, Queensland.

Potts, BM, Barbour, RC, Vaillancourt, RE (2005) Assessing the risk of pollen-mediated gene flow from plantation eucalypts. Invited presentation, 'Private forestry extension conference', for Department of Primary Industries, Victoria. 21-22 June. Wimmera, Victoria.

Potts, BM (2005) Overview of CRC-SPF research relevant to *E. nitens* breeding. '*Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Potts, BM, Costa e Silva, J, Dutkowski, GW, Apiolaza, LA, O'Reilly-Wapstra, JM, Vaillancourt, RE, Pilbeam, DJ (2005) Advances in quantitative genetic studies of *Eucalyptus globulus*. Presentation, '*E. globulus* breeding strategy review'. 22-24 February. Albany, Western Australia.

Potts, BM, McGowen, MH, Patterson, B, Vaillancourt, RE, Williams, DR, Gore, PL, Pilbeam, DJ (2005) Reproductive biology of *Eucalyptus globulus*. Presentation, '*E. globulus* breeding strategy review'. 22-24 February. Albany, Western Australia.

Shepherd, M (2004) Linkage mapping and QTL analysis in outbred and inbred organisms. Invited short course facilitator 'Genetic mapping and QTL analysis in outbreeding tree species and rice', for University of Kebangsaan. Malaysia. 23-27 November.

Shepherd, M (2004) *Corymbia* genetics at Southern Cross University. Presentation, '2nd symposium on molecular genetics of *Eucalyptus*'. 15 July. Hobart, Tasmania.

Shepherd, M, Lee, D, Baker, N, Kasam, S, Ochieng, J (2005) *Corymbia* genetics at Southern Cross University. Presentation, '*Corymbia* research meeting', for Queensland Department of Primary Industries and Fisheries. 1-2 June. Gympie, Queensland.

Steane, DA (2004) Sequencing the chloroplast genome of *Eucalyptus globulus*. Presentation, '2nd Symposium on molecular genetics of *Eucalyptus*'. 15 July. Hobart, Tasmania.

Vaillancourt, RE, Potts, BM, Jones, T, Steane, DA (2005) Molecular studies of *E. globulus* populations and OP seed composition. '*E. globulus* breeding strategy review'. 22-24 February. Albany, Western Australia.

Whittock, SP (2004) Carbon revenues and economic breeding objectives in *Eucalyptus globulus* pulpwood plantations. Seminar, 17 September. University of Tasmania, Hobart, Tasmania.

Whittock, SP, Apiolaza, LA, Greaves, BL, Dutkowski, GW, Potts, BM (2004) Coppice, carbon and cash: second rotation *Eucalyptus globulus* pulp-wood plantations. Seminar. Hobart, Tasmania.

Whittock, SP, Apiolaza, LA, Greaves, BL, Dutkowski, GW, Potts, BM (2005) Coppice, carbon and cash: second rotation *Eucalyptus globulus* pulp-wood plantations. Presentation at 'STBA *E. globulus* breeding strategy review', 22-24 February. Albany, Western Australia.

Williams, DR (2005) Forestry Tasmania *E. nitens* breeding programme. *Eucalyptus nitens* breeding workshop'. 1 June. Hobart, Tasmania.

Williams, ER, Moran, GF, Butcher, PA (2004) Mapping, QTLs and microarrays. Seminar. 5 November. Hobart, Tasmania.

Sustainable Management Program

Barry, KM (2005) Pruning-related decay and defence mechanisms: the fundamentals of controlling decay spread. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Battaglia, M (2005) CABALA industry training. 3 May. Perth, Western Australia.

Battaglia, M (2005) CABALA industry training. 13 May 2005. Hobart, Tasmania.

Beadle, CL (2005) Silvicultural prescriptions for solid-wood plantations: what makes them work. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Bird, T (2005) How did we get here and where are we going? Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Close, DC (2004) How a little eucalypt seedling copes in a harsh world. 8 October. University of Tasmania, Hobart, Tasmania.

Davidson, NJ (2004) Tree decline. Presentation. 4 October. University of Western Australia.

Davidson, NJ (2004) High altitude tree decline and rural tree decline. Seminar for DPIWE Nature Conservation Branch. 30 November. Hobart, Tasmania.

Davidson, NJ (2004) Plantation water use workshop. 30 August. Hobart, Tasmania.

Davidson, NJ (2004) Rural tree decline. Public forum. 17 November. Oatlands, Tasmania.

Elek, J, Allen, GR, Matsuki, M (2004) Success® is an alternative to Dominex® for managing leaf beetles in eucalypt plantations. Poster. *Proceedings of the XXII International Congress of Entomology*, Brisbane, Queensland, p. 26.

Mohammed, CL (2005) An interdisciplinary approach to the study and management of stem defect in eucalypts. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Nolan, G. (2005) Prospects for sustainable solid wood products from a eucalypt plantation resource. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

O'Grady, AP (2005) Determination of groundwater use by vegetation in tropical ecosystems. Presentation, 'International Association of Hydrogeologists' workshop on groundwater and surface water interactions' 26-27 May. Darwin, Northern Territory.

O'Grady, AP, Eamus, D, Cook, PG, Lamontagne, S (2005) Groundwater use by riparian vegetation in the Northern Territory. Presentation. 'International Association of Hydrogeologists Workshop on Groundwater and Surface Water Interactions' 26-27 May. Darwin, Northern Territory.

Pryor, R, Davidson, NJ, Close, DC, Battaglia, M (2004) Improved waterlogging tolerance is conferred by fertilisation of *Eucalyptus globulus* and *E. nitens*. Poster. 'COMBIO Conference'. 26-30 September. Perth, Western Australia.

Smethurst, PJ (2004) Australian plantation forestry: sustainability and nutrient management. Seminar for University of Freiburg. 30 September. Freiburg, Germany.

Smethurst, PJ (2004) Nitrogen mineralisation: research and applications in Australian Forestry. Seminar for Department of Forestry/IPEF, University of Sao Paulo. August. Brazil.

Smethurst, PJ (2004) Managing plantation forests sustainably: an Australian perspective. Seminar for Forest Research Institute of Baden-Wurttemburg. 29 September. Freiburg, Germany.

Smethurst, PJ (2004) Policy, riparian forests, and water quality: an Australian perspective. Seminar for Department of Forestry, Iowa State University. September. United States of America.

Volker, PW (2005) Eucalypt plantations: creating a new solid-wood resource for Tasmania. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Wardlaw, TJ (2005) Rotational-scale strategies for the silvicultural management of growth, wood quality and defect. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Washusen, R (2005) Factors limiting the processing and recovery of solid wood from eucalypt plantations. Seminar. 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. 12 May. Hobart, Tasmania.

Resource Protection Program

Allen, GR (2004) Behaviour and ecology of eucalypt feeding insects. Presentation for Simon Fraser University School of Biological Sciences. Vancouver, Canada.

Allen, GR (2005) Growing trees with reduced chemical usage. Seminar. 'Growing trees with reduced chemical usage'. 8 February. Hobart, Tasmania.

Allen, GR (2005) Insect-eucalypt research in Tasmania. Presentation, for Graduate School of Agriculture, Kyushu University, Fukuoka, Japan.

Baker, SC (2005) Tasmanian fauna. Presentation for University of Tasmania. Hobart, Tasmania.

Baker, SC (2005) Impacts of clearfell logging on litter beetles: are reserve corridors effective? Seminar. Hobart, Tasmania.

Baker, SC (2005) Unexpected response of terrestrial litter beetles to riparian zones of first order streams in Australian wet eucalypt forest. Seminar. Hobart, Tasmania.

Barry, KM (2005) Monitoring stress - a ground-up approach to aid detection and quantification of stress in eucalypt plantations by remote sensing. Seminar. 'Growing trees with reduced chemical usage'. 8 February. Hobart, Tasmania.

Harrison, KS, Hopkins, AJM, Grove, SJ, Mohammed, CL (2005) Saproxylic invertebrates and tree age in *Eucalyptus obliqua* in the southern forests of Tasmania. Presentation, 'Deadwoodology seminars at Forestry Tasmania' 18 March. Hobart, Tasmania.

Hopkins, AJM, Harrison, KS, Grove, SJ, Wardlaw, TJ, Mohammed, CL (2005) Wood decay fungi and tree age in *Eucalyptus obliqua* in the southern forests of Tasmania. Invited presentation, 'Deadwoodology seminars at Forestry Tasmania'. Hobart, Tasmania.

Loney, P, McArthur, C, Jordan, GJ (2004) Possum and pademelon preference for plant parts. Presentation, 'Ecological Society of Australia 2004 conference' 7-10 December. Adelaide, South Australia.

Matsuki, M. (2004) Discussion about results of this year's euc weevil population assessment results, euc weevil phenology project, control options and schedule; plus research projects on *Heteronyx* beetles for coming season. Meeting for IPMG (TC, WAPRes, GSP, APFL, FPC, Hansol PI). 3 November. Agriculture Western Australia, Albany, Western Australia.

Matsuki, M. (2004) Discussion about the timing of spraying using the results of the weevil phenology project, plus discussion about a trial using kaolin clay with John Brown, Washington State University. Field Day for IPMG (TC, GSP, APFL). 22 October. Emu Run Plantation, Albany, Western Australia.

Matsuki, M. (2004) Introduction to the eucalypt weevil population assessment, protocols for the population assessment and phenology project, data collection in the field, data entry, data analysis, and decision making. Field day for IPMG (APFL). 17 August. APFL office and mill, Albany, Western Australia.

Matsuki, M. (2004) Orientation for field crew from Great Southern Plantations and Timbercorp who will be participating in the euc weevil population assessment. Field day for IPMG (GSP and TC). 7 September. Great Southern Plantations, Albany, Western Australia.

Matsuki, M. (2004) Orientation for the field crew from WAPRes who will be participating in the euc weevil population assessment and phenology project; data collection, data entry, data analysis, and decision making. Field day for IPMG (WAPRes). 19 August. Diamond Mill, WAPRes Manjimup, Western Australia.

Matsuki, M. (2004) Orientation with the field crew from Timbercorp and GSP who will be participaing in the euc weevil phenology project. Field day for IPMG (Great Southern Plantations and Timbercorp attended). 13 August. Wandana plantation Albany, Western Australia.

Matsuki, M. (2005) Recent pest activities in south west Western Australia; results of the *Heteronyx* phenology project, birdguard; planning the weevil assessment for the approaching season; and the recent interaction with the CRC. Meeting for IPMG (Timbercorp, WAPRes, GSP, APFL, FPC, Hansol PI attended). 4 August. Diamond Mill, WAPRes Manjimup, Western Australia.

Matsuki, M. (2005) We do not have breeding seasons, but many other species do. Why is that? (The role of seasonal changes in resource availability in the timing of breeding season in two species of leaf beetles in Tasmania). Seminar at the School of Animal Sciences, University of Western Australia. 21 April. Perth, Western Australia.

Miller, A, McArthur, C, Smethurst, PJ (2004) Being eaten: what's more influential - you or your neighbour? Presentation, 'Ecological Society of Australia 2004 conference' 7-10 December. Adelaide, South Australia.

Miller, A, McArthur, C, Smethurst, PJ (2005) Predicting the consumption of individual plants by generalist marsupial herbivores in a heterogeneous environment. Presentation, '49th Australian Mammal Society Annual Meeting' 7-9 July. Sydney, New South Wales.

O'Reilly-Wapstra, J (2005) Mammal browsing research at the CRC-THF and CRC-SPF. Presentation, 'Mammal browsing forum' 8 February. Hobart, Tasmania.

O'Reilly-Wapstra, J (2005) Mammal browsing research. Seminar, 'Mammal browsing forum'. 8 February. Hobart, Tasmania.

O'Reilly-Wapstra, J (2005) Mammal browsing in Tasmania and research into alternative management strategies. Presentation, 'Forestry and Forest Industries Council annual dinner'. 20 April. Burnie, Tasmania.

O'Reilly-Wapstra, J (2005) NIRS. Rapidly predicting eucalypt defensive chemistry. Presentation, 'Growing trees with reduced chemical usage' 8 February. Hobart, Tasmania.

O'Reilly-Wapstra, J (2005) Using NIR to identify germplasm of increased defensive chemistry and resistance to vertebrate browsing. Seminar, 'Growing trees with reduced chemical usage'. 8 February. Hobart, Tasmania.

Pinkard, EA (2005) Keeping the trees green and prunable: managing and combating biotic stress. Seminar, 'Solid wood production from temperate eucalypt plantations: seminars and discussion'. Hobart, Tasmania.

Rapley, LP (2005) Timely intervention - when should we spray. Seminar, 'Growing trees with reduced chemical usage'. 8 February. Hobart, Tasmania.

Steinbauer, MJ (2005) Clever sampling combined with application of GumMoth will help improve current management of the autumn gum moth. Seminar, 'Growing trees with reduced chemical usage'. 8 February. Hobart, Tasmania.

Walsh, A (2005) Vertebrate pest management. Seminar, 'Mammal browsing forum'. 8 February. Hobart, Tasmania.

Wiggins, NL, McArthur, C, McLean, S (2004) Effects of PSMs and plant spatial arrangement on brushtail possums. Presentation, 'Ecological Society of Australia 2004 conference' 7-10 December. Adelaide, South Australia.

Education and Technology Transfer

Bildstein, T (2005) Rural tree decline: a national disaster. Press release. 1 page. (University of Tasmania, Hobart, Tasmania).

Bildstein, T (2005) Young achiever recognised for blue-gum innovations. Press release. 1 page. (University of Tasmania, Hobart, Tasmania).

Davidson, NJ (2004) Research at the CRC for Sustainable Production Forestry, presentation for The Hutchins School. Hobart, Tasmania.

Davidson, NJ (2005) Keeping your forest healthy: The pattern and process of tree decline and what can be done about it. Field day. Bothwell, Tasmania.

Dutkowski, GW (2004) Progeny trial analysis with ASReml. Course, 16-17 August. Umeå, Sweden.

Dutkowski, GW, Greaves, BL, McRae, TA (2004) Quantitative methods for tree breeders. ASREML course, 19-22 October. Aveiro, Portugal.

Dutkowski, GW (2005) gSOOP seed orchard management tool. Presentation, 'STBA *Eucalyptus globulus* breeding strategy review workshop' 22-24 February, for Southern Tree Breeding Association. Albany, Western Australia.

GRANTS AND AWARDS

Genetic Improvement Program

Grant or award	Awarded for	Duration	Recipients	Amount $
Dean of Graduate Research Commendation Award, University of Tasmania	Outstanding doctoral thesis, 2004		Dr Robert Barbour	
Royal Society of Tasmania Annual Doctoral Award	Doctoral thesis		Dr Robert Barbour	$1000
Southern Cross Tasmanian Young Achievers Award	Science and technology section		Ms Fiona Poke	
Australian Academy of Science Young Researchers Award	Testing approaches for the simple prediction of breeding values in forest trees across progeny trial sites with heterogenous variances	6 weeks	Dr Greg Dutkowski	$7,500
Australian Research Council Discovery Grant	Genetic legacy of climate change in Australian temperate forests	3 years	Dr René Vaillancourt	$225,000
ARC Special Research Initiatives (Hill *et al.*)	Discovering the past and present to shape the future: networking environmental sciences for understanding and managing Australian biodiversity.	5 years	A/Prof Brad Potts (one of 50 chief investigators on the network application)	$1.5 million
Frontiers in Integrative Biological Research (a US National Science Foundation program). (Whitham *et al.* Northern Arizona University: lead institution)	Community genetics, heritability and evolution: consequences of extended phenotypes	5 years	A/Prof Brad Potts (one of 10 partner investigators on the grant)	$US 5 million

Sustainable Management Program

Grant or award	Awarded for	Duration	Recipients	Amount $
Australian Research Council	Australia-New Zealand Research Network for Vegetation Function	2005-8	Dr M Westoby, Prof M Adams (Dr Michael Battaglia, listed scientist)	$2.5 million
International Association of Hydrogeologists	Groundwater and surface water interactions-invited speaker	2005	Dr Tony O'Grady (CRC-SPF)	$1,000
Land and Water Australia	A framework to provide for the assessment of environmental water requirements of groundwater-dependent ecosystems	2005-8	Dr P Howe, Dr R Evans, Dr Tony O'Grady	$250,000
Natural Heritage Trust	A decision support system for combating tree decline	2004-5	Dr Neil Davidson	$193,500

Resource Protection Program

Grant or award	Awarded for	Duration	Recipients	Amount $
Dean of Graduate Research Commendation Award, University of Tasmania	Outstanding doctoral thesis, 2004		Dr Julianne O'Reilly-Wapstra	
Dean of Graduate Research Commendation Award, University of Tasmania	Outstanding doctoral thesis, 2004		Dr Luke Rapley	
FWPRDC	Fertilisation and forest health: preventing or offsetting biotic leaf loss in eucalypt plantations	1 year	Dr Caroline Mohammed, Dr Michael Battaglia, Dr Christine Stone, Dr Angus Carnegie, Dr Philip Smethurst	$150,000
ARC Linkage	Determining generic indicators of stress in eucalypt leaves for application to the remote sensing of canopy condition and productivity modelling	3 years	Dr Karen Barry, Dr Caroline Mohammed, Dr Chris Beadle, Dr Michael Battaglia, Dr Christine Stone, Dr Angus Carnegie, Dr M Martin and Dr N Davies	$270,000
ACIAR	Stem rots in plantation hardwoods in Indonesia and southeast Australia	18 months	Dr Caroline Mohammed, Dr Chris Beadle, Dr Anto Rimbawanto	$250,000
Ecological Society of Australia best poster by a student	Being eaten: what's more influential – you or your neighbour?		Ms Alison Miller	$500
Ecological Society of Australia Best Spoken Paper, Runner-up	Effects of PSMs and plant spatial arrangement on brushtail possums		Ms Natasha Wiggins	$250
Ecological Society of Australia Student Research Grant	Interactions between a native mammalian herbivore and a eucalypt plantation species; for project costs.	6 months	Ms Natasha Wiggins	$250
Ecological Society of Australia Travel Grant	Science Meets Parliament	1 week	Ms Prue Loney	$450
Haldane Prize	Best Young Author, 2004; for *Fuctional Ecology* 18, 677-684.		Dr Julianne O'Reilly-Wapstra	A year's subscription and offer of support to attend the British Ecological Society annual meeting.
Holsworth Wildlife Research Fund	Invertebrate assemblages associated with habitat features in *Eucalyptus obliqua* in the southern forests of Tasmania	1 year	Kate Harrison	$4,000
Holsworth Wildlife Research Fund	Succession of stem decay fungi in *Eucalyptus obliqua* in southern Tasmania	1 year	Anna Hopkins	$4,000
Australian Biological Resources Study; Department of the Environment and Heritage	To attend the Ecological Society of Australia conference at the University of Adelaide	1 week	Anna Hopkins	$550
Holsworth Wildlife Research Fund	Interactions between a native mammalian herbivore and a eucalypt plantation species; for project costs.	6 months	Ms Natasha Wiggins	$2,300
Holsworth Wildlife Research Fund	Understanding patch selection by a native mammalian herbivore for managing browsing	9 months	Ms Alison Miller	$2,500
Maxwell Ralph Jacobs Fund	Understanding patch selection by a native mammalian herbivore for managing browsing	9 months	Ms Alison Miller	$1,500
NZFRI	Biocontrol program for parasitoids of the gum leaf skeletoniser	1 year	Dr Geoff Allen	NZ $20,000
NZFRI	Isolation of pheromone components from Tasmanian gum leaf skeletoniser populations	3 months	Dr Geoff Allen	NZ $4,500
University of Tasmania Institutional Research Grant Scheme	Ontogenetic effects on the expression of genetic variation in plant defensive chemistry	1 year	Dr Julianne O'Reilly-Wapstra	$20,000

CONSULTANCIES

Sustainable Management (B1):

Laboratory analyses, $30,000.

Genetic Improvement:

Consultancy with	for	Duration	Recipients	Amount
STBA	Progeny analysis for Gunns *E. nitens* breeding program.	3 months	Dr Greg Dutkowski	$25,102
UniTas Consulting	Evaluation of merit of Timbercorp and ITC genetic material.	1 day	Dr Greg Dutkowski	$1,920

PERFORMANCE INDICATORS

Cooperative arrangements

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

Most CRC research was conducted using company trials, or trials established on company land, so companies were involved at the outset with the planning and implementation of research projects and had ownership of them. Plans for experiments were lodged with the companies, and included an agreed protocol for research. The company partners allocated staff time (in-kind contributions) to CRC research projects so effective interaction could occur. The Program Coordinating Committees (PCCs) of the CRC retained an overview of the research projects. They prioritise research and set 'deliverables' (research outcomes that could be directly used by industry). The PCCs were chaired by industry representatives and consisted largely of the partners' staff to ensure that they were involved in setting research priorities.

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

Documented visits to individual CRC partners and between nodes of the CRC (Hobart, Canberra, Brisbane, Gympie) totalled 187 person-days for 2004/05.

- *Proportion of joint publications with other research groups*

Fifty-seven (33 per cent) of the 171 technical publications (book chapters, refereed publications, in-press, unrefereed publications, confidential reports, theses) were written with other research groups.

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

There were eight visitors to the CRC:

Genetic Improvement: Quantitative geneticist, Dr Joao Costa e Silva, visited the University of Tasmania for two months in 2005 during which time he analysed data from several *E. globulus* trials and contributed to the breeding strategy review of *E. globulus* in Western Australia. Professor Tom Whitham, Dr Joe Bailey and Dr Jen Schweitzer of the Northern Arizona University visited Associate Professor Brad Potts in August 2004 to discuss collaborative research projects. During the visit both Prof Witham and Dr Schweitzer and Jen presented seminars.

Sustainable Management: Dr Mel Tyree, who worked with Ms Sharon Koh and Dr Peter Sands on the writing of a manuscript (4 weeks).

Resource Protection: Dr John Brown of Washington State University, Pulman USA, visited the CRC entomology program in Tasmania in December. During his time he presented a seminar and exchanged research ideas on future research plans in chemical ecology in Tasmania. Dr Brown leads a successful program for insect control in poplars including pheromone-based control of the western poplar clearwing moth and carpenter worm moth, and insecticide based controls for cottonwood leaf beetle. In January, Dr Darren Kriticos and Dr Karina Potter (NZFRI) also visited the entomology research group to discuss research progress on pheromone monitoring within Tasmania and the biocontrol program of *Uraba lugens* in New Zealand.

- *The degree of interaction among scientific staff at dispersed locations on core activities of the research program, included:*
- *the economic importance and genetic control of growth, stem characteristics and wood properties at the quantitative and molecular levels*

The genetics program is structured to ensure close interaction between projects both within and across nodes of the CRC. The quantitative and molecular genetics projects are paired to ensure synergies between these different fields. For example, A1 and A4 work closely together on the molecular genetics of temperate eucalypts. The breeding strategies project A2 integrates research in the other temperate projects for strategy development. There is also regular interaction between the various groups working in the same field across different nodes. They are linked by common technologies, and technological advances made in one project are usually directly relevant to the other projects. For example, the quantitative genetics projects interact on the application of genetic models and use of specialised programs (e.g. ASREML) for estimating genetic parameters and breeding values. Collaboration between the two molecular projects A4 and A7 is occurring in the use of AFLP molecular markers in a eucalypt mapping populations and molecular relationships within and between *Corymbia* and *Eucalyptus*. Project A2 works with scientists from GL, STBA, CSIRO and FT on the use of ASREML software for the analysis of their data. Project A1 is conducting research projects on the genetics of *E. globulus* across Australia in southern (UTas and FT) and northern Tasmania (GL) and in Western Australia (WACAP). Aspects of this work are being undertaken in collaboration with the STBA. Project A2 also works closely with STBA on the development of data management and analysis systems, as well as breeding, deployment and analysis strategies. For example, a study of genetic parameters in the first series of second generation breeding trials of

E. globulus has been completed along with a contract analysis of GL *E. nitens* breeding population.

Project A5 has strong links with CSIRO scientists in Melbourne in research on Silviscan, cellulose content analysis and near infrared reflectance analysis, as well as with project A3 in Canberra and the project is also working with the STBA on studying genetic parameters of specific wood property traits.

Several projects involve collaboration between Genetic Improvement Program (GI) projects A1 and A5 and the Sustainable Management Program (SM), and there is considerable linkage between GI, SM and the Resource Protection Program (RP) on the genetics of pest and disease resistance and the modelling on disease risk and impact.

There is considerable linkage between the Genetic Improvement, Sustainable Management and the Resource Protection research programs on the genetics of pest and disease resistance and the modelling on disease risk and impact.

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

Project A2 provides research results from the southern node projects for the breeding and deployment strategies of industry. It has strong links with most industrial partners and is closely integrated with STBA's *Eucalyptus* breeding program (to which many of the temperate partners belong) and its spin-off company *seedEnergy*. This link is enhanced by the co-location of one of the managers of *seedEnergy*, Peter Gore, on the University of Tasmania campus. The CRC has representation on the STBA Board (Greg Dutkowski), Technical Committee, and Research, Quantitative Genetics and Data Management sub-committees (Dr Greg Dutkowski and Dr René Vaillancourt), which has assisted in the transfer of technology from the program to this and other partners. Project A1 interacts closely with STBA and its members in providing research to back new seed production systems being developed for *E. globulus*. It also collaborates with STBA and *seedEnergy* on research into self-incompatibility and flowering time in arboreta and seed orchards across Australia. Project A2 has been closely involved with scientists in the STBA in the design and implementation of TREEPLAN® and STBA-DMS® breeding value prediction and data management systems. This year the Genetic Improvement program was involved in the organisation of workshops reviewing breeding strategies for both *E. globulus* and *E. nitens* which involved all southern projects and most industrial partners in Australia.

- *pruning and thinning*

Dr Chris Beadle and Ms Taylor Bildstein organised a workshop in Hobart that brought together all interested parties in solid-wood production from temperate eucalypt plantations. Forty delegates attended and there were ten presentations that covered growing (silviculture), protecting (pests and diseases), defining (breeding and wood quality) and sustaining (product mix and the future) the resource. A monograph is being prepared that will be distributed to partners and published in a national journal.

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

Fourteen years of funding have permitted investigation of the long-term effects of fertiliser application (100 kg of nitrogen [N] per hectare for 13 years) on the nitrogen dynamics at the site. At a site where tree growth was increased, this was accompanied by increased N turnover and nutrients retained on the forest floor but there was no significant effect on rates of N mineralisation.

- *forestry extension as a tool for assisting forest owner, farmer and stakeholder decision-making*

Dr Digby Race has brought together the work directed towards encouraging rural communities to embrace and accept the benefits of tree planting. The conclusion is that rural landowners tend not to drive forestry development themselves, rather they respond to initiatives brought forward by private companies and government. It is the way that this is done that has created anxiety in rural communities. The CRC researchers have worked with industrial partners to help them refine their own strategies for working with local communities as a means of embracing their support for plantation forestry and including public participation as an important facet of forestry planning.

Dr Neil Davidson has used research, a focus group, a field day and the media to show landowners new approaches for maintaining the health of native stands subject to tree decline. This initiative promises to have some impact at last on reversing a serious and increasing problem affecting large areas of woodland in the drier and colder parts of Tasmania.

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

Ten years of vigorous application has resulted in the first dynamic and user-friendly process-based model

of stand growth (CABALA Version 1.0) being made available to industry partners. CABALA can examine the consequences of a range of silvicultural inputs on productivity in the current and subsequent rotations.

- *measurement of leaf area index in the field*

Ms Maria Ottenschlaeger completed an extended period of training for industry partners in the use of the *Visual Guide* for measuring leaf area index in eucalypt plantations growing throughout Southern Australia. She has also shown them how the *Visual Guide* can be used to make decisions as to whether plantations should be fertilised or not.

- *investigation of pathogens of forest insect pests*

This research in Tasmania has essentially concluded following the retirement of Dr John Madden (now honorary CRC Fellow). Industry was satisfied with the progress that had been made and was keen for other areas to be pursued.

- *studies of the ecology and behaviour of insect herbivores in temperate Australia*

There was high degree of collaboration between all locations involving all those working in resource protection coordinated by Dr Mamoru Matsuki (CRC and IPMG, WA) while constructing the interactive pest database. The database has been *beta* tested and undergone peer review

- *impact of insect pests at plantation establishment*

Dr Mamoru Matsuki (CRC and IPMG, WA) has included establishment pests in his assessment of the impact of insect pests on eucalypt plantations.

- *genetic and chemical basis of eucalypt resistance to browsing*

Dr Julianne O'Reilly-Wapstra completed her PhD thesis on genetic variation of resistance of *E. globulus*, under supervision from both Dr Clare McArthur (supervisor) and A/Prof Brad Potts (co-supervisor, Genetic Improvement Program). Projects from the vertebrate browsing section of RP in Hobart closely interact with the GI program in research related to resistance breeding and three PhD students are jointly supervised.

- *investigation of pathogens of plantation trees*

Research on stem decay, mechanisms of tree defence and wound tissue formation has continued between Dr Caroline Mohammed (CSIRO, UTas), and Dr Tim Wardlaw (FT). *Mycosphaerella* research in respect to several aspects (risk and impact modelling, resistance, epidemiology) has continued between Dr Mohammed and several companies in Tasmania (FT, GL) and Western Australia (Timbercorp, WAPRes). A new project was generated as a result of progress in the *Mycosphaerella* arena concerned with offsetting or preventing biotic damage through the timely use of fertilisation was funded by FWPRDC, FT, GL and SFNSW.

- *biodiversity of fungal and insect assemblages in wet* Eucalyptus *forest*

Ms Marie Yee submitted her thesis, which was on the conservation and biodiversity of insect and rot assemblages in coarse woody debris, under supervision by Dr Caroline Mohammed, and Dr Simon Grove of FT. The project was financially supported by FT and GL. Two other PhD students are currently supervised by Dr Mohammed and partially supported in this area of research in collaboration with FT and co-supervised by Drs Simon Grove and Tim Wardlaw of FT. This project has resulted in several presentations to a wide audience; to the media, at industry seminars and academic conferences.

Research and researchers

- *Papers in refereed journals*

In 2004/05 the Centre produced a total of 171 publications, 51published in refereed journals, four in refereed conference proceedings and 28 in-press; as well as three book chapters, 73 unrefereed publications and 12 theses.

- *Book chapters covering the results of the Centre's research*

Three book chapters were written in 2004/05 (see the Publications section).

-

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

There were two invited presentations in 2004/05:
Brad Potts was invited to present a plenary address at the IUFRO conference '*Eucalyptus* in a changing world' at Aveiro, Portugal, 11-15 Oct, a subplenary talk at 'Forests in the balance: linking tradition and technology', XXII IUFRO World Congress, Brisbane; a talk at "Entomology: strength in diversity. XXII international congress of entomology 15-21st August 2004, Brisbane, Queensland' and to talk at 'Private forestry extension conference', Wimmera, Victoria, 21-22 June (Department of Primary Industries, Victoria).

Anna Hopkins was an invited speaker at the third national Fungimap conference organised by the Royal Botanic Gardens Victoria and the Tasmanian Central North Field Naturalists' Club, at Mt Roland; 29 April-3

May. Her talk was 'Wood decay fungi and dead-wood dependent beetles in the southern forests of Tasmania'.

- *Number and value of competitive grants awarded*

Twenty competitive grants were awarded to CRC staff during the last financial year, totalling $10,402,600. Several of these were prestigious, highly competitive ARC awards such as ARC Discovery.

- *Honours and awards*

For details, please see Grants and Awards section, pp. 57-58.

Dr Robert Barbour, Dr Julianne O'Reilly Wapstra and Dr Luke Rapley received University of Tasmania Dean of Graduate Research Commendation Awards for their outstanding doctoral theses, 2004.

Dr Robert Barbour received the Royal Society of Tasmanian Annual Doctoral Award.

Ms Fiona Poke received the Southern Cross Tasmanian Young Achievers Award in the science and technology section.

Ms Alison Miller received the Ecological Society of Australia's 'Best poster by a student' award.

Dr Julianne O'Reilly-Wapstra received the Haldane Prize for best young author, for an article in *Functional Ecology*.

Ms Kate Harisson, Ms Anna Hopkins, Ms Alison Miller and Ms Natasha Wiggins each received a Holdsworth Wildlife Fund research bursary.

Ms Alison Miller also received the Maxwell Ralph Jacobs Fund research bursary.

Ms Anna Hopkins received an Australian Biological Resources Study; Department of the Environment and Heritage Award, to attend the Ecological Society of Australia conference.

Education and training

- *Time spent by researchers on research training*

There are 43 PhD and five MSc students enrolled with CRC-SPF. It is recognised that each student takes five to ten per cent of a researcher's time to supervise. This is equivalent to 2.4–4.8 person years of research training.

- *Number of postgraduate students working in the Centre*

The Centre has 48 postgraduate students (see Table 5).

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

Genetic Improvement	19
Sustainable Management	17
Resource Protection	12

- *Number of enrolments in special courses*

Forest Ecology, a special undergraduate course in Plant Science at the University of Tasmania, has three students enrolled. In addition, there was a wide range of workshops and field days organised to train staff (see list of major events in the Education and Technology Transfer section; and the Public Presentations section). The total number of enrolments for all these courses was 2,293.

- *Quality and number of postdoctoral fellows attracted*

Five postdoctoral fellows worked with the Centre in 2003/04: Dr Dorothy Steane in molecular genetics (UTas, Hobart), Dr Anthony O'Grady in root biomass turnover (CSIRO FFP, Hobart), Dr Mamoru Matsuki on insect pest management (Insect Pest Management Group, WA), Dr Luke Rapley in insect ecology (UTas, Hobart), and Dr Julianne O'Reilly-Wapstra in vertebrate browsing (UTas, Hobart).

- *Rate and percentage of completion of higher degrees*

Eight PhD, one MSc and one Honours student completed their degrees during this financial year:

Genetic Improvement Program; Dominic Kain (PhD), Rachel King (PhD), Leon Scott (PhD), Peter Kube (PhD), Greg Dutkowski (PhD), Shaowei Huang (PhD).

Sustainable Management Program; Tammie Harvest (Hons), Craig Hawkins (MSc)

Resource Protection Program; Julianne O'Reilly-Wapstra (PhD), Luke Rapley (PhD).

A further seven PhD and two MSc students submitted a thesis for examination during the year: Genetic Improvement Program; Tim Jones (PhD), Andrew Milgate (PhD), Simon Whittock (PhD), Paul Toon (MSc)

Sustainable Management Program; Daryl Mummery (PhD), Carolyn Ringrose (MSc).

Resource Protection Program; Trudi Wharton (PhD), Anthony Rice (PhD), Marie Yee (PhD).

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

Details of employment for completing PhD and Honours students of 2004/05:

Sustainable Management Program;

- Andrew Gibbons (PhD), Research Officer, Private Forests Reserves Program,
- Ross Peacock (PhD), Vegetation and Landscape Assessment Unit, Centre for Natural Resources, NSW Department of Infrastructure, Planning and Natural Resources,
- Paul Adams (PhD), Manager Forest Nutrition, FT,
- Chris O'Hara (PhD), Nutrient Management in Agriculture, Department of Primary Industries, Victoria,
- Greg Unwin (PhD), Lecturer (farm forestry), University of Tasmania,
- Grant Westphalen (PhD), Marine Ecologist, University of Adelaide,
- Cameron Shield (Hons), Research Officer (hops), Cascade Brewery,
- Andrew Laird (Hons), Weeds Officer, West Coast Council.

Resource Protection Program;

- Alieta Eyles (PhD), Postdoctoral Fellow, defence responses, Ohio University, USA,
- Julianne O'Reilly-Wapstra, Lecturer (mammalian browsing), University of Tasmania,
- Luke Rapley, Post doctoral Fellow (insect ecology), University of Tasmania,
- Djirilina Burton (Hons), Browsing Research Officer, FT.

Genetic Improvement Program;

- Robert Barbour (PhD), Forest Geneticist (gene flow), University of Tasmania
- Gay McKinnon (PhD), contract research in molecular genetics of *Eucalyptus* at the University of Tasmania
- James Worth (Hons), Conducting a PhD in Forest molecular genetics, University of Tasmania

Past students (and staff) of the CRC that have been appointed to key posts in industry:

2003/04

- Dr Peter Volker (who recently completed PhD with the CRC) was Acting Chief Scientist during 2004 at FT

2002/03

- Dr Peter Volker was appointed Principal Research Officer (Plantations), FT
- Dr Luis Apiolaza (CRC post-doctoral fellow) was appointed Principal Forest Biometrician at FT
- Dr Dean Williams (who recently completed a PhD with the CRC) was appointed Research Scientist (tree improvement) at FT

Application of research

- *Degree of adoption of research results by industry*

Twenty four items of CRC technology were taken up by industry this year (see Industry Uptake, in Utilisation and Application of Research section).

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

Thirty-one technical reports were produced by the Centre, 26 of which were in the CRC-SPF Technical Report series. In addition, 12 technical news sheets ("newsflash publications") were released and four articles appeared in newsletters of member organisations.

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

Two consultancies were conducted during 2004/05 (see Grants and Awards and Consultancies section). Advice was also provided through participation on national committees. For example, Greg Dutkowski (GI) was a member of the STBA Board, on the Technical Committee of STBA and three subcommittees of the STBA Technical Committee, and is also a member of Research Working Group 1 (RWG1, Forest Genetics). Dr Brad Potts (GI) was a member of RGW1, is on the subcommittee for Forest Genetic Resources, and is on the Biodiversity Advisory Panel for the Tasmanian Government's 'State of the Environment Report'. Dr Julianne O'Reilly-Wapstra (RP) has close links with industry and government through the 'Browsing damage management group' (BDMG), as well as direct interaction with industry (see Grants and Awards). Dr Neil Davidson (SM) has had close interaction with organisations advising farm foresters through collaborative work on methods of combating rural tree decline.

- *Number of presentations to companies or user groups*

The CRC-SPF ran a wide range of technology transfer activities for partners during 2004/05. There were 96 public presentations including 31 conference or symposia presentations and 33 seminars as well as 20

workshop presentations, five short courses and seven field days.

- *Number and financial contribution of potential users*

During the eighth year, the CRC-SPF had 14 members, including most of the major wood producing companies in Australia. Each partner committed cash and/or in-kind contributions to the Centre (see financial tables). In addition, partners may provide funds to support particular projects (see Grants and Awards). Private Forests Tasmania and other end-users of our technology, e.g. Greening Australia, have given in-kind support to run technology transfer exercises for farmer groups.

- *Number of visitors from user groups*

As the partners in the Centre represent our main user group, many of the 187 person-days involved in within-CRC visits came from users of the technology we developed (see Performance Indicator 2 under Cooperative Arrangements).

- *Number of media or trade journal presentations*

In the last year, 12 articles relating to Centre activities appeared in newspapers and industry newsletters, and 17 segments in the electronic media (13 radio and four television).

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

In 2004/05 CRC-SPF gave 96 public presentations (31 conference or symposia presentations and 32 seminars), and ran 20 workshops, five short courses and seven field days, to transfer results to industry and the public. An estimated 2,293 people attended these activities.

Management and budget

- *Establish procedures to report on progress and achievements*

Plans in place included a Strategic Plan and Business Plan, and a set of 'deliverables' agreed upon to meet industry expectations of progress in research areas. The quality and quantity of research was monitored and reviewed, and its value to industry has been assessed through Program Coordinating Committees, the Advisory Panel, the Board, and the Annual Report.

- *Timely and accurate reporting of progress*

The CRC has reported in a timely and accurate manner against the 'deliverables' set for industry and the milestones set by each project and program. These were 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*

Other than the withdrawl of partners in the eighth year, there were five changes to staffing, during 2004/05 (see Staffing and Administration).

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

All projects completed their milestones within the planned time and budget, with the exception of two that were agreed by industry as no longer relevant to their needs.

- *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 2004/2005

At September 2005, when this report was finalised, the CRC had ceased operations from 30 June 2005 and was due to windup its residual activities by 30 September 2005.

Summary of significant accounting policies
All funds under the Cooperative Research Centre's control are administered through the University of Tasmania's Financial Management Information System (FMIS).

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 FMIS, excluding outstanding debtors at 30 June each year.

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 FMIS 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. All assets will be transferred to a partner entity by 30 September 2005 as per the Commonwealth Agreement.

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. During 2004/05 an extension to the Commonwealth Agreement for an additional year was executed so that the CRC SPF would continue until 30 June 2005.

(f) Allocation from Commonwealth Grant
During 2004/05 the CRC received the usual four quarterly grant payments.

(g) Management comment to qualifications in audit report.
(i) The predicted in-kind contributions for Norske Skog, SCU and Timbercorp were not reduced in accordance with a reduction in direct in-kind activities during the year and this is reflected in their actual contributions. Funds for the operating year were leveraged against alternate grants eg ARC and therefore actual in-kind and cash contributions were reduced by the amount being put into other areas.

Budget Tables

ATTACHMENT A

Cooperative Research Centre for Sustainable Production Forestry
Summary of Base Grant Funds 2004/2005

Opening Cash Balance at 1/7/04	**1,487,414**
Add Income	947,463
Less Expenditure	
Salaries, scholarships and associated costs	1,482,558
Consumables	714,225
Equipment	0
Total Expenditure	2,196,783
Closing Balance at 30/6/05	**238,094**

Deloitte

Audit Report

INDEPENDENT AUDIT REPORT TO THE DEPARTMENT OF EDUCATION, SCIENCE AND TRAINING REPRESENTING THE COMMONWEALTH
(RE: COOPERATIVE RESEARCH CENTRE FOR SUSTAINABLE PRODUCTION FORESTRY)

Scope

We have audited the current year actual information presented in the financial statement of the Cooperative Research Centre for Sustainable Production Forestry ("the Centre") as set out in Tables 1,2,3 and 4 of the Annual Report for the year ended 30 June 2005. The parties to the Centre are responsible for the preparation and presentation of the financial statement and for ensuring compliance with the CRC Commonwealth Agreement ("the Agreement"). We have conducted an independent audit of the financial statement and of compliance with the requirements of the Agreement in terms of clauses 4(1) and 4(2) 'Contributions', 5(1), 5(2) and 5(3) 'Application of the Grant and Contributions', 9(1) and 9(5) 'Intellectual Property' and 12(2) and 12(4) 'Financial Provisions' in order to express an opinion on it to the parties to the Centre and the Department of Education, Science and Training representing the Commonwealth.

The financial statement has been prepared by the parties to the Centre for the purposes of fulfilling their annual reporting obligations under clause 14(1)(e) of the Agreement for distribution to the Department of Education, Science and Training representing the Commonwealth. We disclaim any assumption of responsibility for any reliance on this report or on the financial statement to which it relates or to any person other than the parties to the Centre and the Department of Education, Science and Training representing 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 and included such tests and procedures as we considered necessary in the circumstances. These procedures have been undertaken to form an opinion whether, in all material respects:

1. Researcher contributions and contributions from Partners (excluding Supporting Partners) equalled or exceeded the amount of the grant and the amount of contributions committed to in the budget (clauses 4(1) and 4(2));
2. The grants and contributions were used only for the activities of the Centre (clause 5(1));
3. The total yearly expenditure on activities of the Centre under each Head of Expenditure did not differ by more than 20% or $100,000 (whichever is the greater amount) from the allocation in the budget without prior approval by the Commonwealth (clause 5(2));
4. Capital items acquired from the grant and the contributions on acquisition vest as provided for in the Agreement (clause 5(3));
5. The intellectual property on all contract material vests as provided for in the Agreement (clause 9(1));
6. The researcher did not assign or license intellectual property in any contract material having the potential for commercialisation without imposing on the assignee, licence conditions and did not do so without the prior approval of the Commonwealth (clause 9(5));
7. The researcher ensured that proper accounting standards and controls were exercised in respect of the grant and that contributions, income and expenditure in relation to the activities of the Centre were recorded separately from other transactions of the researcher (clause 12(2));
8. The researcher ensured that cash contributions were paid into and expended from the Centre account (clause 12(4)); and
9. The financial statement presents fairly the sources of funding, the application of that funding and the financial position of the Centre for the financial year in accordance with the cash basis of accounting.

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Inherent Limitations
Because of the inherent limitations of any compliance procedure it is possible that errors and irregularities may occur and not be detected. An audit is not designed to detect all weaknesses in the Centre's compliance with the Agreement as an audit is not performed continuously throughout the period and the audit procedures performed on the Centre's compliance with the Agreement are undertaken on a test basis.

Any projection of the evaluation of the compliance with the Agreement to future periods is subject to the risk that the procedures over compliance with the Agreement may become inadequate because of changes in conditions or circumstances, or that the degree of compliance with them may deteriorate.

The audit opinion expressed in this report has been formed on the above basis.

Qualifications
The following Partners (excluding Supporting Partners) did not contribute amounts equal to or in excess of the amount of the contributions committed to in the budget as required by clause 4(2):

	In Kind Contributions	
Partners	***Amount Contributed*** **$ '000**	***Amount Committed*** ***$'000***
Norske Skog Paper Mills (Australia) LTD	141.7	190.0
Southern Cross University	328.8	472.8
Timbercorp LTD	131. 9	196.8

Total yearly expenditures on the activities of the Centre under each Head of Expenditure differed by more than 20% or $100,000 (whichever is the greater amount) from the allocation in the budget without prior approval by the Commonwealth as follows:

Head of Expenditure	***Total Expenditure*** **$ '000**	***Amount Budgeted*** ***$'000***
Other	714.2	922.0

Qualified Audit Opinion
In our opinion, except for the effects on the financial statement of the Cooperative Research Centre for Sustainable Production Forestry, if any, and the extent of non-compliance with the requirements of the Agreement, arising from the matters referred to in the qualification paragraph, for the financial year ended 30 June 2005, in all material respects:

1. Researcher contributions and contributions from Partners (excluding Supporting Partners) equalled or exceeded the amount of the grant and the amount of contributions committed to in the budget (clauses 4(1) and 4(2));
2. The grants and contributions were used only for the activities of the Centre (clause 5(1));
3. The total yearly expenditure on activities of the Centre under each Head of Expenditure did not differ by more than 20% or $100,000 (whichever is the greater amount) from the allocation in the budget without prior approval by the Commonwealth (clause 5(2));
4. Capital items acquired from the grant and the contributions on acquisition vest as provided for in the Agreement (clause 5(3));
5. The intellectual property on all contract material vests as provided for in the Agreement (clause 9(1));
6. The researcher did not assign or license intellectual property in any contract material having the potential for commercialisation without imposing on the assignee, licence conditions and did not do so without prior approval of the Commonwealth (clause 9(5));

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7. The researcher ensured that proper accounting standards and controls were exercised in respect of the grant and that contributions, income and expenditure in relation to the activities of the Centre were recorded separately from other transactions of the researcher (clause 12(2));
8. The researcher ensured that cash contributions were paid into and expended from the Centre account (clause 12 (4)); and
9. The financial statement presents fairly the sources of funding, the application of that funding and the financial position of the Centre for the financial year in accordance with the cash basis of accounting.

Deloitte Touche Tohmatsu

DELOITTE TOUCHE TOHMATSU

L.T Cox
Partner
Chartered Accountants
Hobart, 14 September 2005

All STAFF RESOURCES (2004/2005)

ATTACHMENT B

Organisation	Main Activity	Total % Time	% Spent on Research Program GI	SM	RP	Total on Research	% Spent on Educn	% Spent on Commln Program	% Spent on CRC Admin
Australian Forest Growers									
D Geddes	E	1					1		
Total		1	0	0	0	0	1	0	0
CSIRO Forestry & Forest Products									
D Mummery	R	80		80		80			
M Battaglia	R	35		35		35			
C Beadle	R	40		40		40			
P Sands	R	70		70		70			
C Harwood	R	30	15	15		30			
E Williams	R	10	10			10			
C Baillie	T	90		90		90			
M Ottenschlaeger	T	100		100		100			
K Churchill	T	60		60		60			
D Worledge	T	80		80		80			
B Denton	T	5				0			5
J Ellis	A	5				0			5
P Coles	A	5				0			5
S Nambiar	A	5				0			5
C Carlyle	A	5				0			5
Total		620	25	570	0	595	0	0	25
Forest Enterprises Australia									
R Jacobson	R	2					2		
D Barker	R	1					1		
T Cannon	A	2					1		0
Total		5	0	0	0	0	4	0	0
Forestry Tasmania									
J Elek	R	40			40	40			
A Walsh	R	40			40	40			
P Volker	R	15	15			15			
L Apiolaza	R	16			16	16			
P Adams	R	10		10		10			
J Lesek	T	65	65			65			
T Kincade/ D Burton	T	40			40	40			5
C Ringrose	T	25		25		25			5
S Grove	R/A	5				0			5
T Wardlaw	R/A	20				0			20
J Hickey	R/A	3				0			3
H Drielsma	R/A	3				0			3
Total		282	80	35	136	251	0	0	41
Gunns Limited									
C Barnes	A	10		4	4	8			2
K Joyce	T	27	7	7	6	20			7
I Blanden	A	5				0			5
I Ravenwood	A	15	5			5			10
Total		57	12	11	10	33	0	0	24
Norske Skog Paper Mills									
S Hetherington	R	6		2	1	3	1		2
C Berry	R	4	1	1		2	1		1
A Bradley	T	4			1	1			
B Burns	T	1			2	2			
A Willems	A	2				0			2
Total		17	1	3	4	8	2	0	5

All STAFF RESOURCES (2004/2005)

ATTACHMENT B

Organisation	Main Activity	Total % Time	% Spent on Research Program GI	SM	RP	Total on Research	% Spent on Educn	% Spent on Commln Program	% Spent on CRC Admin
Private Forests Tasmania									
A Warner/Lyons/Castely	R	5		2		2	3		
Total		5	0	2	0	2	3	0	0
SeedEnergy									
P Gore	R	10	10			10			
D Boomsma	R	2	2			2			
Total		12	12	0	0	12	0	0	0
Southern Cross University									
R Henry	R	30	20			20	5		5
D Tikel	R	20	20			20			
E Evans/J Gilmour	A	10				0			10
B Pagotto	A	10				0			10
K Lindner	A	10				0			10
P Baverstock	A	5				0			5
Total		85	40	0	0	40	5	0	40
Southern Tree Breeding Association									
T McRae	R	15	15			15			
D Pilbeam	R	10	10			10			
M Powell	R	2	2			2			
Total		27	27	0	0	27	0	0	0
The Australian National University									
P Kanowski	R	40		10		10	30		
D Race	R	25		25		25			
J Bauhus	R	15				0	15		
R James	R	10				0	10		
Total		90	0	35	0	35	55	0	0
Timbercorp									
J Bulinski	R	23	2	2	14	18			5
I Bail	R/A	15	4	3	3	10			5
H O'Sullivan	R	12	9			9			3
G Samsa	R	7		6		6			1
A Dickinson	R	2	1	1		2			
R Piggott	R	5	1	2	2	5			
B Bradshaw	R	7		5		5			2
S Macleod	R	1			1	1			
R Gillies	R	1	1			1			
Q Clasen	R	2		2		2			
A Tys	R	1		1		1			
T Browning	A/R	2				0			2
A Soanes	T	2		1	1	2			
M Anning	T	1			1	1			
C Saykao	A/R	1	1			1			
M Diedrichs	A/R	1		1		1			
R Mitchell	T	1		1		1			
D Sheldon	T	3	1	1	1	3			
Total		87	20	26	23	69	0	0	18

All STAFF RESOURCES (2004/2005)

ATTACHMENT B

Organisation	Main Activity	Total % Time	% Spent on Research Program GI	SM	RP	Total on Research	% Spent on Educn	% Spent on Commln Program	% Spent on CRC Admin
University of Tasmania									
B Potts	R	50	50			50			
C McArthur/OReilly Wapstra	E	37			12	12	25		
G Allen	R	50			50	50			
N Davidson	R/E	50		25		25	25		
R Vaillancourt	R	45	45			45			
R Wiltshire	R	10				0	10		
S Jennings	R	15		15		15			
C Mohammed	R	15			15	15			
G Jordan	R	10				0	10		
K Barry	R	5				0	5		
J Reid	A	15	5			5	5		5
A Richardson	A/E	10				0	10		
P Brown	E	10				0	10		
D Close	E	2				0	2		
S Shabala	E	2				0	2		
E Bruce	E	2				0	2		
L Forbes	E	5				0	5		
R Doyle	E	2				0	2		
N Mendham	E	10				0	10		
S McLean	E	2				0	2		
R Boyle	E	2				0	2		
L Pinkard	E	5				0	5		
R Griffin	R/A	40	5			5			35
P Lane	A	5				0			5
R Clark	A	20				0	15		5
A Koutoulis	A	10				0	5		5
A Smolenski	T	35	15	5	10	30			5
L Johnson/C Blackman	T	10	5	5		10			
C Jones	A	10				0			10
J Noble	A	5				0			5
B Rumbold	A	5				0			5
S Jones	A	5				0			5
A Glenn	A	5				0			5
Total		504	125	50	87	262	152	0	90
WA Plantation Resources									
M Bamess/A Hartmann	R	25		2	23	25			
S Hunter	R	25	5	3	7	15			10
Nursery/Casual Staff	T	15	5	5	5	15			
R Breidahl	R	5	0	1		1			4
I Telfer	R	2	1			1			1
S Martyn	R	2	2			2			
P Durrell	R	2	2			2			
C Palmer	A	2							2
S Tomita	A	2							2
Total		80	15	10	35	61	0	0	19

Organisation		Main Activity	Total % Time	% Spent on Research Program GI	SM	RP	Total on Research	% Spent on Educn	% Spent on Commln Program	% Spent on CRC Admin
CRC Funded										
M Matsuki	Utas	R	100			100	100			
K Siu	CSIRO FFP	T	35	35			35			
D Steane	Utas	R	80	80			80			
B Potts	Utas	R	50	50			50			
C Beadle	CSIRO FFP	R	40		40		40			
M Battaglia	CSIRO FFP	R	50		50		50			
J O'Reilly-Wapstra	Utas	R	50			50	50			
L Rapley	Utas	R	30			30	30			
C Mohammed	Utas	R	20			20	20			
P Smethurst	CSIRO FFP	R	78		28		28	50		
D Race	ANU	R	40		40		40			
R Henry	SCU	R	30				0			30
Res Assistant	SCU	R	100	100			100			
G Dutkowski	Utas	E	100	90			90	10		
J Neilson	Utas	A	100				0			100
S Caswell	Utas	A	80				0			80
J Butterworth/T Bildstein	Utas	E/A	100				0	100		
P Tilyard	Utas	T	75	75			75			
L Ballard	Utas	T	25	25			25			
J Smith	Utas	T	50		50		50			
A Wilkinson	Utas	T	100		100		100			
V Patel	Utas	T	50			50	50			
S Paterson	Utas	T	100			100	100			
H Fitzgerald	Utas	T	75			75	75			
A Morgan	Utas	T	70	10		10	20	15		35
N Davidson	Utas	E	50				0	50		
R Griffin	Utas	A	40				0			40
Total			1718	465	308	435	1208	225	0	285
			1718				1208			

SUMMARY OF CONTRIBUTIONS IN PERSON YEARS

	Total Person Years (inc support staff)	Person Years Spent on Research Program GI	SM	RP	Total on Research Programs	Person Yrs Spent on Educn Program	Person Yrs Spent on Commln Program	Person Yrs Spent on CRC Admin
Total Contributed	18.8	3.6	7.4	3.0	13.9	2.2	0.0	2.6
Total funded by CRC	17.2	4.7	3.1	4.4	12.1	2.3	0.0	2.9
Grand total	36.0	8.2	10.5	7.3	26.0	4.5	0.0	5.5
Proportion of total professional (%) staff resources in each activity	100.0	22.9	29.2	20.3	72.4	12.4	0.0	15.2

SUPPORT STAFF 2004/05(inc in above SummaryTable)

Contributed	
Organisation	Number of Staff (Person Years)
CSIRO FFP	3.65
Forestry Tasmania	1.30
Gunns Limited	0.27
University of Tasmania	0.75
Timbercorp	0.07
WACAP Treefarms	0.15
Total	6.19

CRC Funded (by Employing Organisation)	
Organisation	Number of Staff (Person Years)
University of Tasmania	7.3
CSIRO FFP	0.4
Southern Cross University	1.0
Total	8.7

CRC for Sustainable Production Forestry (19960002)
Financial Information - Table 1
In-Kind Contributions (dollars in $'000)

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	Actual																Totals to 2004-05			Totals for 8 years		
	1997-98		1998-99		1999-00		2000-01		2001-02		2002-03		2003-04		2004-05							
	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Diff	Actual/Proj	Agr'mt	Diff
Core participants																						
Australian Plantation Timber Ltd (INACTIVE)																						
Salaries	0	0	0	0	0	0	83	83	0	83	0	83	0	83	0	0	83	332	-249	83	332	-249
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	118	117	0	117	0	117	0	117	0	0	118	468	-350	118	468	-350
Total	0	0	0	0	0	0	201	200	0	200	0	200	0	200	0	0	201	800	-599	201	800	-599
CSIRO																						
Salaries	816	825	840	803	896	770	783	770	989	770	988	770	905	770	605	593	6,822	6,071	751	6,822	6,071	751
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	1,650	1,721	1,750	1,680	1,721	1,618	1,694	1,618	1,855	1,618	1,799	1,618	1,681	1,618	1,322	1,005	13,472	12,496	976	13,472	12,496	976
Total	2,466	2,546	2,590	2,483	2,617	2,388	2,477	2,388	2,844	2,388	2,787	2,388	2,586	2,388	1,927	1,598	20,294	18,567	1,727	20,294	18,567	1,727
Forestry Tasmania																						
Salaries	137	93	157	102	188	112	156	124	158	136	151	149	157	164	177	147	1,281	1,027	254	1,281	1,027	254
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	179	115	169	126	240	139	199	152	185	168	183	183	190	203	200	178	1,545	1,266	279	1,545	1,266	279
Total	316	208	326	228	428	251	355	276	343	304	334	334	347	367	377	325	2,826	2,293	533	2,826	2,293	533
Grand Ridge Plantations Pty Ltd (INACTIVE)																						
Salaries	66	85	82	85	58	85	67	85	34	85	61	85	52	85	0	0	421	595	-174	421	595	-174
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	136	121	125	121	108	121	120	121	13	121	287	121	155	121	0	0	944	847	97	944	847	97
Total	202	206	208	206	166	206	187	206	47	206	348	206	207	206	0	0	1,365	1,442	-77	1,365	1,442	-77
Griffith University (INACTIVE)																						
Salaries	164	127	109	126	110	126	83	126	89	127	127	127	111	127	0	0	793	886	-93	793	886	-93
Capital	0	0	20	0	20	0	20	0	20	0	20	0	20	0	0	0	120	0	120	120	0	120
Other	151	116	117	116	118	116	89	116	96	117	136	117	119	117	0	0	825	815	10	825	815	10
Total	315	243	246	242	248	242	192	242	204	244	283	244	250	244	0	0	1,738	1,701	37	1,738	1,701	37
Gunns Limited																						
Salaries	263	100	252	100	155	100	218	100	210	100	66	100	55	100	80	70	1,299	770	529	1,299	770	529
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	369	216	313	216	158	216	128	216	100	216	92	216	91	216	91	98	1,342	1,610	-268	1,342	1,610	-268
Total	632	316	565	316	313	316	346	316	310	316	158	316	146	316	171	168	2,641	2,380	261	2,641	2,380	261
Norske Skog Paper Mills (Australia) Ltd																						
Salaries	34	25	21	28	24	28	30	28	24	28	15	28	16	28	17	38	181	231	-50	181	231	-50
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	186	171	171	161	199	161	188	161	143	161	122	161	112	161	125	153	1,246	1,290	-44	1,246	1,290	-44
Total	220	196	192	189	223	189	218	189	167	189	137	189	128	189	142	191	1,427	1,521	-94	1,427	1,521	-94
Queensland Department of Primary Industries and Fisheries (INACTIVE)																						
Salaries	450	322	422	322	417	322	460	322	487	322	510	322	276	322	0	0	3,022	2,254	768	3,022	2,254	768
Capital	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	28	28	0	28
Other	526	380	384	380	427	380	383	380	380	380	363	380	164	380	0	0	2,627	2,660	-33	2,627	2,660	-33
Total	1,004	702	806	702	844	702	843	702	867	702	873	702	440	702	0	0	5,677	4,914	763	5,677	4,914	763
Southern Cross University																						
Salaries	63	60	68	60	70	60	71	60	75	60	88	60	90	60	99	93	624	513	111	624	513	111
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	190	249	288	249	301	249	307	249	361	249	468	249	314	249	230	380	2,459	2,123	336	2,459	2,123	336
Total	253	309	356	309	371	309	378	309	436	309	556	309	404	309	329	473	3,083	2,636	447	3,083	2,636	447
Timbercorp Limited																						
Salaries	0	0	0	0	21	24	115	94	89	94	92	94	84	94	107	65	508	465	43	508	465	43
Capital	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	2
Other	5	0	5	0	5	62	273	221	196	221	223	199	199	199	25	132	931	1,034	-103	931	1,034	-103
Total	5	0	5	0	28	86	388	315	285	315	315	293	283	293	132	197	1,441	1,499	-58	1,441	1,499	-58
University of Tasmania																						
Salaries	385	387	403	387	411	387	455	387	472	387	506	386	535	386	523	505	3,690	3,212	478	3,690	3,212	478
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	703	701	825	763	792	763	829	763	845	763	875	763	901	763	932	947	6,702	6,226	476	6,702	6,226	476

Total	1,088	1,088	1,228	1,150	1,203	1,150	1,284	1,150	1,317	1,150	1,381	1,149	1,436	1,149	1,455	1,452	10,392	9,438	954	10,392	9,438	954
WACAP Treefarms Pty Ltd																						
Salaries	66	55	71	55	63	55	56	55	61	55	64	55	60	55	25	25	466	410	56	466	410	56
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	107	115	113	115	113	115	116	115	116	115	115	115	120	115	35	35	835	840	-5	835	840	-5
Total	173	170	184	170	176	170	172	170	177	170	179	170	180	170	60	60	1,301	1,250	51	1,301	1,250	51
Total in-kind from core participants																						
Salaries	2,444	2,079	2,426	2,068	2,413	2,089	2,577	2,234	2,688	2,247	2,668	2,259	2,341	2,274	1,633	1,536	19,190	16,766	2,424	19,190	16,766	2,424
Capital	28	0	20	0	22	0	20	0	20	0	20	0	20	0	0	0	150	0	150	150	0	150
Other	4,202	3,905	4,260	3,927	4,182	3,940	4,444	4,229	4,289	4,246	4,663	4,241	4,046	4,259	2,960	2,928	33,046	31,675	1,371	33,046	31,675	1,371
Total	6,674	5,984	6,706	5,995	6,617	6,009	7,041	6,463	6,997	6,493	7,351	6,500	6,407	6,533	4,593	4,464	52,386	48,441	3,945	52,386	48,441	3,945
Supporting participants																						
Australian Forest Growers																						
Salaries	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	8	0	8	8	0	8
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0	1	1	8	-7	1	8	-7
Total	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	9	8	1	9	8	1
Forest Enterprises Australia Pty Ltd																						
Salaries	0	0	0	0	0	0	5	0	4	0	2	0	6	0	3	0	20	0	20	20	0	20
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	1	1	2	0	2	0	2	1	2	0	2	2	11	-9	2	11	-9
Total	0	0	0	0	0	1	6	2	4	2	2	2	7	2	3	2	22	11	11	22	11	11
Gunns Limited																						
Salaries	6	5	25	5	28	5	15	5	0	5	0	5	0	5	0	0	74	35	39	74	35	39
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	35	35	42	35	13	35	11	35	0	35	0	35	0	35	0	0	101	245	-144	101	245	-144
Total	41	40	67	40	41	40	26	40	0	40	0	40	0	40	0	0	175	280	-105	175	280	-105
Private Forests Tasmania Pty Ltd																						
Salaries	0	0	0	0	10	4	6	8	11	8	3	8	0	8	2	2	32	38	-6	32	38	-6
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	17	8	0	16	4	16	1	16	0	16	0	0	22	72	-50	22	72	-50
Total	0	0	0	0	27	12	6	24	15	24	4	24	0	24	2	2	54	110	-56	54	110	-56
Seedenergy Pty Ltd																						
Salaries	0	0	0	0	0	0	0	0	11	9	19	9	31	9	13	21	74	48	26	74	48	26
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	2	2	3	2	2	2	13	3	20	9	11	20	9	11
Total	0	0	0	0	0	0	0	0	13	11	22	11	33	11	26	24	94	57	37	94	57	37
Servo-Ag Pty Ltd (INACTIVE)																						
Salaries	0	0	0	0	11	4	9	7	0	7	0	7	0	7	0	0	20	32	-12	20	32	-12
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	22	6	12	11	0	11	0	11	0	11	0	0	34	50	-16	34	50	-16
Total	0	0	0	0	33	10	21	18	0	18	0	18	0	18	0	0	54	82	-28	54	82	-28
Southern Tree Breeding Association																						
Salaries	6	0	6	0	15	0	26	0	26	0	28	0	27	0	34	35	168	35	133	168	35	133
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	5	37	5	0	5	0	5	0	5	0	5	0	5	49	49	86	84	2	86	84	2
Total	6	5	43	5	15	5	26	5	26	5	28	5	27	5	83	84	254	119	135	254	119	135
The Australian National University																						
Salaries	59	64	59	64	63	64	67	64	72	64	106	64	109	63	104	51	639	498	141	639	498	141
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	178	112	178	112	188	112	202	112	215	112	317	112	327	112	312	71	1,917	855	1,062	1,917	855	1,062
Total	237	176	237	176	251	176	269	176	287	176	423	176	436	175	416	122	2,556	1,353	1,203	2,556	1,353	1,203
The University of Queensland (INACTIVE)																						
Salaries	9	25	24	25	24	25	25	25	25	25	14	25	0	25	0	0	121	175	-54	121	175	-54
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	10	47	47	47	47	47	47	47	47	47	26	47	0	47	0	0	224	329	-105	224	329	-105
Total	19	72	71	72	71	72	72	72	72	72	40	72	0	72	0	0	345	504	-159	345	504	-159
Total in-kind from supporting participants																						
Salaries	81	94	115	94	152	102	154	109	150	118	173	118	174	117	157	109	1,156	861	295	1,156	861	295
Capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	223	200	304	200	287	215	273	229	268	231	348	231	330	231	374	126	2,407	1,663	744	2,407	1,663	744

Total	304	294	419	294	439	317	427	338	418	349	521	349	504	348	531	235	3,563	2,524	1,039	3,563	2,524	1,039
Other in-kind non-participants																						
Salaries													0		0		0	0	0	0	0	0
Capital													0		0		0	0	0	0	0	0
Other													0		0		0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total in-kind contributions																						
Salaries	2,525	2,173	2,541	2,162	2,565	2,171	2,731	2,343	2,838	2,365	2,841	2,377	2,515	2,391	1,790	1,645	20,346	17,627	2,719	20,346	17,627	2,719
Capital	28	0	20	0	22	0	20	0	20	0	20	0	20	0	0	0	150	0	150	150	0	150
Other	4,425	4,105	4,564	4,127	4,469	4,155	4,717	4,458	4,557	4,477	5,011	4,472	4,376	4,490	3,334	3,054	35,453	33,338	2,115	35,453	33,338	2,115
Grand total in-kind (T1)	**6,978**	**6,278**	**7,125**	**6,289**	**7,056**	**6,326**	**7,468**	**6,801**	**7,415**	**6,842**	**7,872**	**6,849**	**6,911**	**6,881**	**5,124**	**4,699**	**55,949**	**50,965**	**4,984**	**55,949**	**50,965**	**4,984**

Notes

For 2004-05 financial year

Predicted inkind contributions for Norske Skog, Southern Cross University and Timbercorp were not reduced in accordance with participation in ARC Linkage projects and this is reflected in actual inkind reported for 2004/05.

CRC for Sustainable Production Forestry (19960002)
Financial Information - Table 2
Cash Contributions (dollars in $'000)

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Version 1.0.2078.32960-0109

	Actual																Totals to 2004-05			Totals for 8 years		
	1997-98		1998-99		1999-00		2000-01		2001-02		2002-03		2003-04		2004-05							
	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Diff	Actual/Proj	Agr'mt	Diff
Core participants																						
Australian Plantation Timber Ltd (INACTIVE)	0	0	0	0	0	0	50	50	0	50	10	50	6	50	0	0	66	200	-134	66	200	-134
CSIRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry Tasmania	23	15	19	15	15	15	12	15	18	15	15	15	15	15	30	30	147	135	12	147	135	12
Grand Ridge Plantations Pty Ltd (INACTIVE)	35	35	35	35	35	35	35	35	35	35	35	35	35	35	0	0	245	245	0	245	245	0
Griffith University (INACTIVE)	25	25	26	25	25	25	19	25	25	25	31	25	25	25	0	0	176	175	1	176	175	1
Gunns Limited	65	50	50	50	30	50	20	50	25	50	25	50	27	50	20	20	262	370	-108	262	370	-108
Norske Skog Paper Mills (Australia) Ltd	22	20	21	20	20	20	20	20	20	20	20	20	20	20	10	10	153	150	3	153	150	3
Queensland Department of Primary Industries a	25	25	50	25	0	25	25	25	25	25	50	25	0	25	0	0	175	175	0	175	175	0
Southern Cross University	100	100	100	100	100	100	100	100	100	100	100	100	100	100	42	42	742	742	0	742	742	0
Timbercorp Limited	0	0	0	0	0	13	50	50	63	50	50	50	50	50	9	9	222	222	0	222	222	0
University of Tasmania	0	0	3	0	0	0	0	0	0	0	0	0	100	0	265	265	368	265	103	368	265	103
WACAP Treefarms Pty Ltd	35	35	36	35	35	35	35	35	35	35	35	35	35	35	9	9	255	254	1	255	254	1
Total cash from core participants	330	305	340	305	260	318	366	405	346	405	371	405	413	405	385	385	2,811	2,933	-122	2,811	2,933	-122
Supporting participants																						
Australian Forest Growers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8	8	0	8	8	0
Forest Enterprises Australia Pty Ltd	0	0	0	0	0	1	2	3	4	3	3	3	3	3	3	3	15	16	-1	15	16	-1
Gunns Limited	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	2
Private Forests Tasmania Pty Ltd	0	0	0	0	0	10	18	20	3	20	3	20	3	20	3	3	30	93	-63	30	93	-63
Seedenergy Pty Ltd	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	3	4	3	1	4	3	1
Serve-Ag Pty Ltd (INACTIVE)	0	0	0	0	0	0	1	1	1	1	0	1	0	1	0	0	2	4	-2	2	4	-2
Southern Tree Breeding Association	0	0	0	0	0	0	0	0	0	0	0	0	5	0	18	18	23	18	5	23	18	5
The 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
The University of Queensland (INACTIVE)	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 supporting participants	1	1	3	1	1	12	22	25	9	25	7	25	13	25	28	28	84	142	-58	84	142	-58
Other cash																						
Non-participants													21	0	68	42	89	42	47	89	42	47
External grants													4	0	0	0	4	0	4	4	0	4
Contract research													33	0	0	0	33	0	33	33	0	33
Commercialisation													0	0	0	0	0	0	0	0	0	0
Education													0	0	0	0	0	0	0	0	0	0
Interest													74	0	66	20	140	20	120	140	20	120
New from existing starting cash													-33	0	0	0	-33	0	-33	-33	0	-33
Total other cash	769	0	91	0	294	0	143	0	135	0	181	0	99	0	134	62	1,846	62	1,784	1,846	62	1,784
CRC grant																						
Total grant	1,718	1,680	2,313	2,300	2,328	2,300	2,347	2,300	2,385	2,300	2,430	2,300	2,468	2,300	400	409	16,389	15,880	509	16,389	15,880	509
Grand totals																						
Total CRC cash contribution (T2)	**2,818**	**1,986**	**2,747**	**2,606**	**2,583**	**2,630**	**2,878**	**2,730**	**2,875**	**2,730**	**2,989**	**2,730**	**2,993**	**2,730**	**947**	**875**	**21,130**	**19,017**	**2,113**	**21,130**	**19,017**	**2,113**
Cash carried over from previous year (UB for previous year)			1,003		1,338		1,743		1,923		1,814		1,163		1,487							
(less) Unspent balance (UB)	1,003		1,338		1,743		1,923		1,814		1,163		1,487		237							
Total cash expenditure (T3)	**1,815**	**1,986**	**2,412**	**2,606**	**2,478**	**2,630**	**2,698**	**2,730**	**2,984**	**2,730**	**3,640**	**2,730**	**2,669**	**2,730**	**2,197**	**875**	**21,130**	**19,017**	**2,113**	**21,130**	**19,017**	**2,113**
Allocation of cash expenditure between basis of expenditure																						
Salaries	1,289	1,740	1,686	1,687	1,503	1,698	1,757	1,700	1,899	1,701	2,488	1,702	1,849	1,703	1,483	1,399	13,954	13,330	624	13,954	13,330	624
Capital	0	0	0	0	0	0	0	0	0	0	89	0	0	0	0	0	89	0	89	89	0	89
Other	527	795	724	915	974	905	940	905	1,085	905	1,063	905	820	900	714	922	6,847	7,152	-305	6,847	7,152	-305
Total	1,816	2,535	2,410	2,602	2,477	2,603	2,697	2,605	2,984	2,606	3,640	2,607	2,669	2,603	2,197	2,321	20,890	20,482	408	20,890	20,482	408

Notes
For 2004-05 financial year

For 2003-04 financial year

Cash totals include an adjustment of $34k for errors in unspent balance brought forward and outstanding debtors from previous years

CRC for Sustainable Production Forestry (19960002)
Financial Information - Table 3
Resources (dollars in $'000)

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	Actual																Totals to 2004-05			Totals for 8 years		
	1997-98		1998-99		1999-00		2000-01		2001-02		2002-03		2003-04		2004-05							
	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Actual	Agr'mt	Diff	Actual/Proj	Agr'mt	Diff
Summary of resources applied to activities of centre																						
Grand total (in-kind) from table 1 (T1)	6,978	6,278	7,125	6,289	7,056	6,326	7,468	6,801	7,415	6,842	7,872	6,849	6,911	6,881	5,124	4,699	55,949	50,966	4,984	55,949	50,966	4,984
Grand total (cash expenditure) from table 2 (T3)	1,815	1,986	2,412	2,606	2,478	2,630	2,698	2,730	2,984	2,730	3,640	2,730	2,669	2,730	2,197	875	20,893	19,017	1,876	20,893	19,017	1,876
Total resources applied to activities of centre (T1+T3)	8,793	8,264	9,537	8,895	9,534	8,956	10,166	9,531	10,399	9,572	11,512	9,579	9,580	9,611	7,321	5,574	76,842	69,982	6,860	76,842	69,982	6,860
Allocation of total resources applied to activities of CRC between heads of expenditure																						
Total salaries (cash and in-kind)	3,814	3,913	4,227	3,849	4,068	3,869	4,488	4,043	4,737	4,066	5,329	4,079	4,364	4,094	3,273	3,044	34,300	30,957	3,343	34,300	30,957	3,343
Total capital (cash and in-kind)	28	0	20	0	22	0	20	0	20	0	109	0	20	0	0	0	239	0	239	239	0	239
Total other (cash and in-kind)	4,952	4,900	5,288	5,042	5,443	5,060	5,657	5,363	5,642	5,382	6,074	5,377	5,196	5,390	4,048	3,976	42,300	40,490	1,810	42,300	40,490	1,810
Total	8,794	8,813	9,535	8,891	9,533	8,929	10,165	9,406	10,399	9,448	11,512	9,456	9,580	9,484	7,321	7,020	76,839	71,447	5,392	76,839	71,447	5,392

CRC for Sustainable Production Forestry (19960002)
Financial Information - Table 4
Allocation of resources between categories of activity for the 2004-05 financial year (dollars in $'000)

Generated Wednesday, 14 September 2005 at 11:33 AM
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Programme	Resource usage			
	Cash ($'000) [1]	In-kind ($'000)	Contributed staff (FTE) [2]	Cash funded staff (FTE) [2]
Research	1,538	3,816	14.0	12.1
Education	290	599	2.2	2.3
External communications	0	0	0.0	0.0
Commercialisation/Tech. transfer	0	0	0.0	0.0
Administration	369	709	2.6	2.9
Total	2,197 (T3)	5,124 (T1)	18.8	17.3

[1] Cash from all sources, including CRC programme
[2] Full time equivalent staff, excluding students

Notes
For 2004-05 financial year

ABBREVIATIONS

A/Prof	Associate Professor
AFG	Australian Forest Growers
AGBU, UNE	Animal Genetics and Breeding Unit, University of New England
ANIC	Australian National Insect Collection
ANU	The Australian National University
APA	Australian Postgraduate Award
APA-I	Australian Postgraduate Award - Industry
AGRF	Australian Genome Research Facility
BLUP	
CABALA	
CALM	Department of Conservation and Land Management, Government of Western Australia
CRC-SPF	Cooperative Research Centre for Sustainable Production Forestry
CRC-THF	Cooperative Research Centre for Temperate Hardwood Forestry
CSIRO SE	Commonwealth Scientific and Industrial Research Organisation, Sustainable Ecosystems
CSIRO Ento	Commonwealth Scientific and Industrial Research Organisation, Entomology
CSIRO FFP	Commonwealth Scientific and Industrial Research Organisation, Forestry and Forest Products
CSIRO PI	Commonwealth Scientific and Industrial Research Organisation, Plant industry
DPI, Vic	Department of Primary Industries, Victoria
ETT	Education and technology Transfer Program
FABI	
FEA	Forest Enterprises Australia Pty Ltd
FEA	Forest Enterprises Australia Limited
FFIC	Forests and Forest Industry Council of Tasmania
FNCRDC	Forest and Nature Conservation Research and Development Centre
Forestry SA	South Australian Forestry Corporation
Forests NSW	New South Wales Department of Primary Industries, Forests division
FPC	Forest Products Commission
FRIM	Forest Research Institute of Malaysia
FWPRDC	Forest & Wood Products R&D Corporation
FT	Forestry Tasmania
GA	Greening Australia
GI	Genetic Improvement Program
gSIM	A breeding strategy simulator computer program
GL	Gunns Limited
GMU	George Mason University
GSP	Great Southern Plantations
GU	Griffith University
ICFR	Institute for Commercial Forest Research

IPMG	Integrated Pest Management Group
LAI	Leaf Area Index
LWRDC	Land and Water Research and Development Corporation
NCSU (USA)	North Carolina State University
NIR	Near-infra red
NPWS	National Parks and Wildlife Service
NS	Norske Skog Paper Mills (Australia) Limited
NSW Ag and NSW Agriculture	New South Wales Department of Primary Industries (Agriculture division)
NSW DPI	New South Wales Department of Primary Industries
NTPWC	Northern Territory Parks and Wildlife Commission
NZ FRI	New Zealand Forest Research Institute
PFT	Private Forests Tasmania
QDPI&F	Queensland Government Department of Primary Industries and Forestry
QFRI	Queensland Forestry Research Institute
QTL	Quantitative Trait Loci
RDCBFTI	Research and Development Centre for Biotechnology and Forest Tree Improvement, Indonesia
RP	Resource Protection Program
SCU	Southern Cross University
sE	*seedEnergy* Pty Ltd
SFNSW	State Forests New South Wales
SLU	Swedish University of Agricultural Sciences
SM	Sustainable Management Program
SPIRT	Strategic Partnership with Industry - Research and Training, ARC
STBA	Southern Tree Breeding Association Inc
TC	Timbercorp Limited
UMelb	University of Melbourne
UNA, USA	University of Northern Arizona, United States of America
UNSW	University of New South Wales
UQ	University of Queensland
USC	University of the Sunshine Coast
USDA	United States Department of Agriculture
USDA FS	United States Department of Agriculture Forest Service
USyd	University of Sydney
UTas	University of Tasmania
UWA	University of Western Australia
WACAP	WACAP Treefarms Pty Ltd
WAPRes	WA Plantation Resources

Main picture: Trees respond to fungal attack by accumulating defensive chemicals in the leaf cells that are next to infected cells. This cross-section of a Tasmanian blue-gum leaf (*Eucalyptus globulus*) by PhD student Anna Smith shows the accumulation of phenolics (yellow) in response to fungal attack. (Picture courtesy Anna Smith).

Top insert: Dr Greg Dutkowski on a tour of Ence operations in the south of Spain. This *Eucalyptus globulus* trial plantation is eight years old. (Picture courtesy Dr Bruce Greaves).

Second insert: CRC-SPF PhD student Fiona Poke won the 2005 Tasmanian Young Achiever Award (science and technology category) for her work on lignin, a component of wood that is a waste product of the pulping process. (Picture courtesy University of Tasmania Media Office).

Third insert: PhD student Prue Loney applying liquid fertiliser to *Eucalyptus nitens* seedlings, which were later used to test whether pademelon browsing preferences were affected by the amount of fertiliser that had been applied. (Picture courtesy Djirilina Burton).

Bottom insert: Eucalypt pest *Heteronyx crinitus* feeding on a young *Eucalyptus nitens* shoot. (Picture courtesy Vin Patel).

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