COOPERATIVE RESEARCH CENTRE
FOR SUSTAINABLE PRODUCTION FORESTRY

Annual Report 02/03

CRC
AUSTRALIA

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

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.

Cooperative Research Centre
for Sustainable Production Forestry

ANNUAL REPORT 2002/03

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Cooperative Research Centres Program

Australian Forest Growers

CSIRO Entomology

CSIRO Forestry and Forest Products

Department of Primary Industries Queensland

Forest Enterprises Australia Pty Ltd

Forestry Tasmania

Grand Ridge Plantations Pty Ltd

Griffith University

Gunns Limited

Norske Skog Paper Mills (Australia) Limited

Private Forests Tasmania

seedEnergy Pty Ltd

Southern Cross University

Southern Tree Breeding Association Inc

The Australian National University

The University of Queensland

Timbercorp Limited

University of Tasmania

WACAP Treefarms Pty Ltd

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CHAIRMAN'S REPORT

After 5 years of hard and productive work the CRC has well deserved the very favourable outcome of the recent Fifth Year Review. To quote from the Stage 1 Report "... the quality of research was high across all programmes, and outstanding in some projects.... It is clear that the CRC-SPF enjoys an excellent international reputation for quality research.....The industry partners in the CRC-SPF are highly satisfied with research performance and outcomes....The quality and commitment of postgraduates and their research output is excellent.....The morale and motivation of the students is very high, and there is a unanimous feeling among the postgraduates that they are privileged to be an integral part of the CRC".

With this outcome, together with the independent confirmation of the very positive economic benefits flowing from the work of the CRC described elsewhere in this Report, a majority of partners are resolved that they wish to take further value from their investment by bringing core aspects of the current research program to a conclusion during an 8th year. Sufficient industry funding has been offered to allow us to approach the CRC Committee with the argument that this would be an excellent use of resources. Many aspects of forestry research inevitably take a long time and I am confident that this will pay dividends while also positioning the research networks created by the CRC to provide an ongoing service to industry beyond 2005.

One of the strong arguments in favour of investment in plantation forestry is that it provides a means for the nation to sustain a viable forestry and forest products industry while at the same time satisfying the concerns held by some sectors of the community regarding wood production from native forests. Observers of recent government actions in NSW, WA and Victoria will understand that access to a native forest wood resource can be modified within a very short timeframe and that this can have a severe impact on the forest industry. It is prudent to assume a continuation of the long-term national trend for an increasing proportion of wood supply from the plantation estate. "Getting it right first time" is a make-or-break principle in any plantation investment and I am clear that the CRC-SPF research scientists are playing a significant role in supporting the managers responsible for such decisions, and so contributing to the well-being of the industry.

I would like to conclude by taking this opportunity to welcome our new Deputy Director, Professor Robert Henry (from Southern Cross University). He replaces Dr Russell Haines (from QFRI).

John Kerin
Chairman

DIRECTOR'S REPORT

Last year's Annual Report was written during the development of a new bid for CRC funding. This bid was unsuccessful, but the subsequent industry support generated made it quite clear that the CRC is valued and that it is important to maintain our momentum so that we are in a strong position to secure a more positive outcome in 2004. Staff are committed to the proposition that we are not in a wind-down phase, but rather in transition, working hard to deliver value from past investment, with outcomes which also provide a platform for new science to help the forest industry face the competitive realities of the 21st century.

On the research front, the Genetic Improvement Program concluded a major survey of diversity in the DNA of *Eucalyptus globulus* (Blue Gum), Australia's most widely planted industrial plantation hardwood species. This knowledge is a valuable aid to ongoing breeding and seed production from improved varieties. The work of researchers from the Sustainable Management Program formed the core of an International Conference on Eucalypt Productivity in November 2002, which reviewed applications of current knowledge, and in particular process-based models, as predictive tools for forest managers. Marsupial browsing is a major factor determining establishment success in plantations, especially in Tasmania. Researchers in the CRC's Resource Protection Program have found that the concentration of a chemical (sideroxylonal) present in the foliage of Blue Gum, is associated with variation in browsing damage, raising the possibility that natural plant resistance may be used as a tool in managing this problem.

In total there were 63 PhD, MSc and Honours students enrolled in the CRC in 2002/03. Eight students successfully completed their post graduate degrees, with a further 5 PhD dissertations submitted. I take pleasure in acknowledging the achievement of Julianne O'Reilly-Wapstra who won an AFFA Science and Innovation Award for Young People. Our graduates continue to find ready industry-related employment. For example eight of our newly graduated PhDs are now working directly for industry or hold post doctoral fellowships which allow them to continue contributing in the research fields they developed within the CRC.

Continuing emphasis has been placed on value creation through Technology Transfer. There are now over 470 users of our new members web site (launched this year), which manages all CRC documents and information through a simple Web interface. Specific Technology Transfer Packages delivered during the year included a Eucalypt Seed Orchard Manual; a low cost monitoring system for mammal browsing damage; and a system for inventory of basic density in Blue Gum plantations. In addition to field days, short courses and workshops, we have sought to further improve communication by encouraging scientists to spend more time visiting industry partners for direct knowledge transfer projects.

During the past year, as we reviewed our objectives for the remaining life of CRC-SPF, we have been particularly reliant upon very practical initiatives from our industry partners and political supporters at all levels. The continued support of the Chairman and Board, including without exception those members from organizations who have chosen not to participate in a proposed Year 8 extension, has also contributed to a successful year. I am confident that the Management Team and all our research staff will repay this support through a well executed ramp down, and on-time delivery of the various outcomes of our program.

Professor Rod Griffin
Director

MANAGEMENT

The Board

The Board of Management of the Centre comprises an independent Chair, a representative of each Core Member organisation, the Director and Deputy Director of the Centre, 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 Centre. The management structure and links are shown in Figure 1.

Operation of the Centre 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), Prof Roger Sands (University of Canterbury, NZ), 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 Centre by implementing the policies set by the Board. The Committee comprises:
Prof Rod Griffin (Director)
Prof Robert Henry (Deputy Director)
Mr David Lyons (Business Manager)
Ms Shelley Caswell (Administrative Officer)
Program Managers:
A/Prof Brad Potts (Genetic Improvement)
Dr Chris Beadle (Sustainable Management)
Dr Clare McArthur (Resource Protection)
Dr Neil Davidson (Education and Technology Transfer)

CRC Board


Mr John Kerin
Chairman


Prof Rod Griffin
Director


Prof Robert Henry
Deputy Director


Dr David de Little
Chair, Advisory Panel


Mr Ron Beck
Executive Director Forestry
Department of Primary Industries Queensland


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


Mr Simon Penfold
General Manager
Grand Ridge Plantations Pty Ltd


Mr Ian Ravenwood
Plantation Division Manager-North West
Gunns Ltd


Dr Hans Driefsma
General Manager (Forest Management)
Forestry Tasmania


Mr Ian Bail
Project Manager
Timbercorp Technologies
Timbercorp Ltd


Prof Peter Baverstock
Pro-Vice-Chancellor (Research)
Southern Cross University


Dr Sadanandan Nambiar
Research Director
CSIRO, Forestry and Forest Products


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


Mr Richard Breidahl
General Manager
Plantation Operations
WACAP Treefarms Pty Ltd


Prof Roger Kitching
Chair of Ecology
Griffith University

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
Mr Peter Volker (Chair)
Prof Rod Griffin (Director)
A/Prof Brad Potts (Program Manager)
Ms Helen O'Sullivan (TC)
Mr Chris Berry (NS)
Mr Simon Hunter (WACAP)
Mr Kelsey Joyce (GL)
Dr Tony McRae (STBA)
Mr Ian Last (DPIQ)
Mr Simon Penfold (GRP)
Dr Neil Davidson (Program Manager ETT)

Sustainable Management Program
Ms Sandra Hetherington (Chair)
Prof Rod Griffin (Director)
Dr Chris Beadle (Program Manager)
Mr Chris Barnes (GL)
Mr Ian Last (DPIQ)
Mr Bill Neilsen (FT)
Mr Mark Bamess (WACAP)
Mr Stephen Elms (GRP)
Mr Ian Bail (TC)
Dr Neil Davidson (Program Manager ETT)

Resource Protection Program
Dr David de Little (Chair)
Prof Rod Griffin (Director)
Dr Clare McArthur (Program Manager)
Mr Chris Barnes (GL)
Mr Chris Berry (NS)
Dr James Bulinski (TC)
Dr Tim Wardlaw (FT)
Dr John Madden (Hon CRC Fellow)
Dr Ross Wylie (DPIQ)
Dr Neil Davidson (Program Manager ETT)

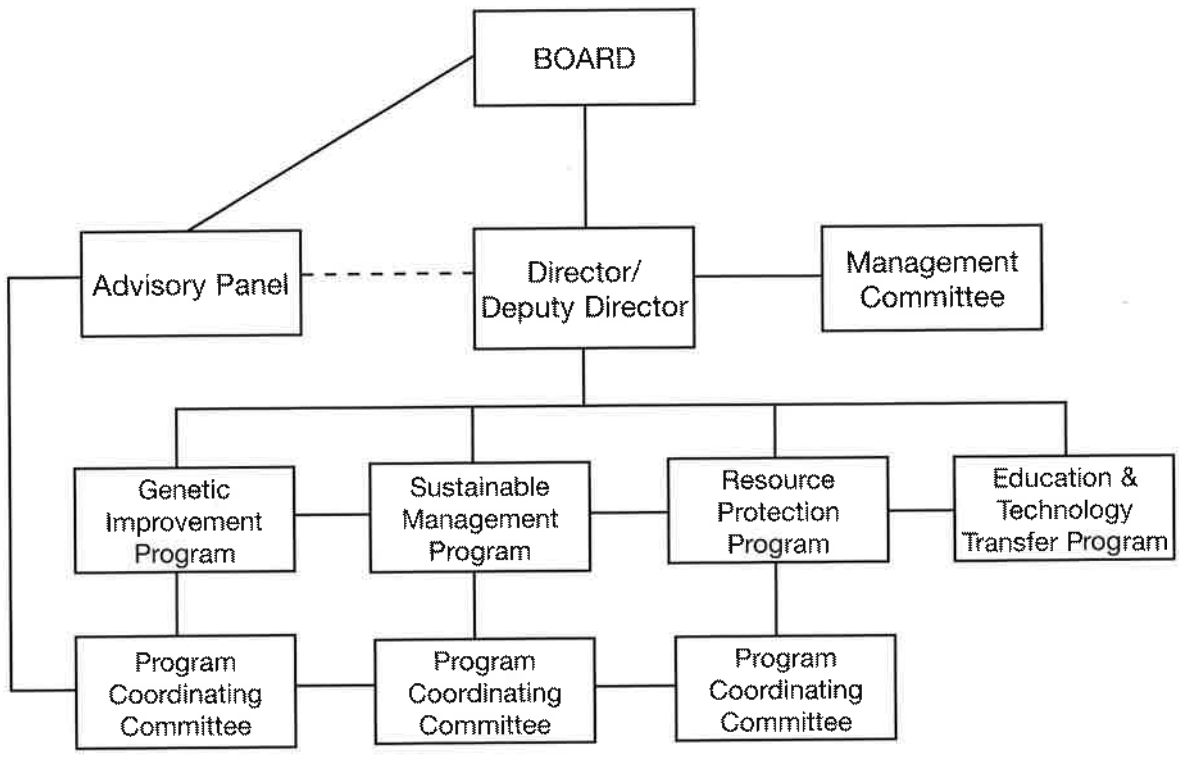


Figure 1. Management Structure

MAJOR DEVELOPMENTS

Economic evaluation of the CRC

With an annual production of sawlogs and pulplogs worth around $1.3 billion at the mill door, forestry is a significant industry and makes a vital contribution to many of Australia's regional economies. Forestry, wood and paper industries together contribute around one per cent of the nation's GDP, with an annual turnover of around $14 billion.

Australia, like many other countries, is switching its production base away from native forests toward plantations. Planting has been particularly active since 1995, with a record 120 000 hectares of new trees established in 2000. The current plantation estate totals over 1.4 million hectares. This expansion had provided a corresponding increase in the scale on which research outcomes from the CRC for Sustainable Production Forestry can be applied. In 2002 we enlisted the help of an independent organisation, the Centre for International Economics (CIE) in an effort to place a $ value on the contribution we are making to our industry. CIE selected six projects for detailed benefit:cost analysis (Table 1). These cover the range of research activities aimed at improvements in:

- the genetic potential of trees to enhance growth rates and wood quality and to reduce unit production costs
- silvicultural systems which add to wood quality and volume and the longer term value of the tree crop
- site selection and management systems which enhance growth and reduce unit production costs
- strategies for controlling pests and diseases which reduce production losses

CIE concluded that "The returns from the projects selected for detailed analysis far exceed the CRC's expenditure over its seven year term. Using these projects as a guide to the pay-offs from the entire portfolio of activities, it is clear that the Australian economy is achieving a very high rate of return on funds spent by the CRC. The partnerships and co-operative links formed between CRC researchers and industry is of major benefit to the forest industry. It is evident that these partnerships have promoted rapid adoption of research findings by forest companies. In the absence of the CRC uptake by industry would almost certainly be far less"

Source: May 2002, Centre for International Economics. "CRC for Sustainable Production Forestry: Economic Evaluation of R&D Portfolio."

Table 1: Present value costs, benefits and net returns from selected projects

Project	*R&D Cost*	*Benefits*	*Net benefits*	*Benefit: cost ratio*
	$ million	$ million	$ million	
Eucalypt breeding strategies	2.8	193.7	190.9	70
Development of wood quality tests for tree selection	1.4	193.7	192.3	137
Hybrid breeding of Exotic pines	1.8	54.6	52.8	30
Silvicultural systems (pruning and thinning)	1.8	131.7	129.8	71
Site selection and management decision aids	7.2	119.6	112.4	17
Mycosphaerella fungus control	0.52	2.36	1.8	5

[a] Assumes a 5 per cent discount rate

Source: CIE calculations

MAJOR DEVELOPMENTS

Microsatellite diversity in *Eucalyptus globulus*

Eucalyptus globulus is native to south-eastern Australia and is one of the most widely used plantation species in temperate regions of the world. Understanding the patterns of molecular genetic diversity in natural populations of *E. globulus* is important in order to understand (i) the levels of inbreeding and gene flow and (ii) the degree of differentiation between geographic races of the species. Approximately 400 native trees from wild populations covering most of the natural distribution of *E. globulus* were fingerprinted using 9 microsatellite DNA loci previously developed by the CRC-SPF (Figure 2). This is one of the largest microsatellite surveys yet undertaken of any eucalypt species.

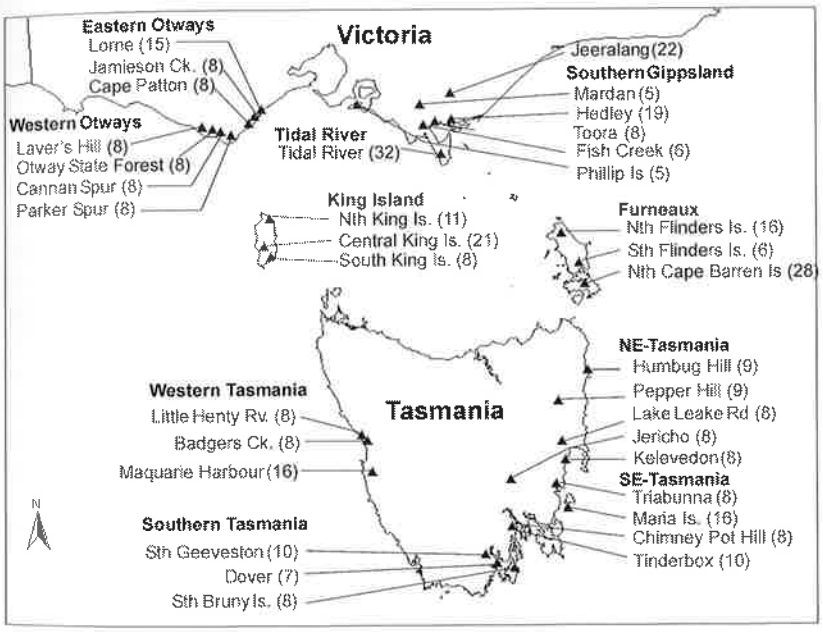


Figure 2: Distribution of localities and races (bold) of *E. globulus* sampled for microsatellite analysis. The number of trees sampled from each locality is shown in parentheses.

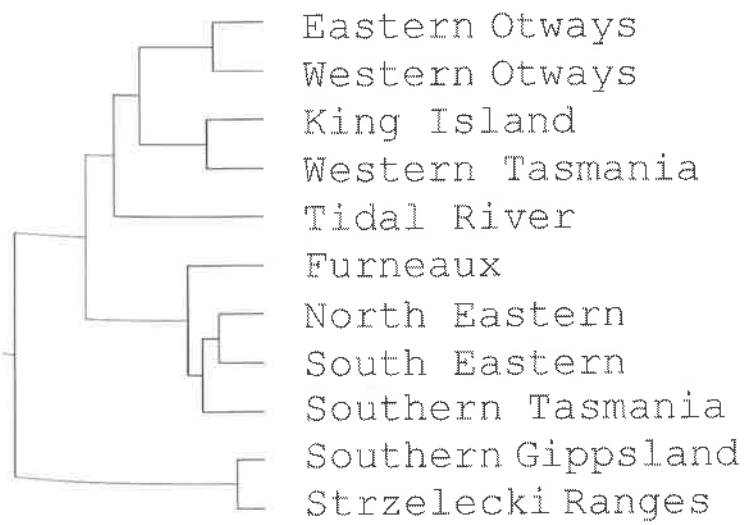


Figure 3: Relationship between *E. globulus* races shown through a UPGMA dendrogram based on Nei's genetic distances between races calculated using 9 microsatellite loci.

The three *E. globulus* races from eastern Tasmania (i.e. N.E., S.E. and S. Tasmania) were the most genetically diverse. King Island was the least genetically diverse (*He*) and had the lowest level of observed heterozygosity (*Ho*) of any of the races. This may be a result of inbreeding due to its isolation. The races of *E. globulus* were shown to form four tight groups (Figure 3): 1) the Otway Range (Victoria); 2) King Island with Western Tasmania; 3) all of eastern and southern Tasmania; and 4) South Gippsland and Strzelecki Ranges. The Western Tasmanian and King Island races had closer affinities to the Otway Range races than to the races of eastern Tasmania. The races of *E. globulus* from S. Gippsland and Strzelecki Ranges formed a group that was highly divergent from the rest of the races. The relationships between races are best explained by either recent or ancient gene flow. For example, the close affinities of the eastern Tasmanian races may be caused by frequent gene flow in the continuous populations, whereas the affinities of the isolated Otways, King Island and Western Tasmanian races may reflect their ancient links through seed dispersal during the last ice-age. The Tidal River and Furneaux races were outliers. The population of tall *E. globulus* at Tidal River on Wilson's Promontory had not been previously studied, and was actually intermediate in allele frequency between all of the races. The Furneaux race had closest affinities to the N.E. Tasmanian race (data not shown).

This microsatellite data is a valuable control for monitoring genetic diversity in breeding populations and plantations for forest certification and fingerprinting purposes and will be the foundation for studying the more complex relationship between populations of *E. globulus* and those of other closely related taxa on mainland Australia.

MAJOR DEVELOPMENTS

EucProd 2002 – IUFRO International Conference on Eucalypt Productivity

EucProd 2002 was the first of a series of international conferences designed to address factors that influence the growth and productivity of eucalypts. It was held in Hobart at the Grand Chancellor Hotel from the 10th-15th November, 2002. The aim of the conference was to:-

1. Present a synthesis of current knowledge in a form that would facilitate its inclusion in management systems to improve the quantity and quality of wood produced from plantations.
2. Work towards the representation of this understanding in process-based models that can be used as practical and predictive tools by forest managers.

The conference show-cased leading research on *Eucalyptus* used as a plantation species. The conference attracted 146 delegates from 17 countries. There were 52 oral and 55 poster presentations in five themes - environment, genetics, physiology, silviculture and modelling with, respectively, keynote presentations from Dan Binkley (Colorado State University, USA), Nuno Borralho (RAIZ, Portugal), David Whitehead (Landcare Research, New Zealand), Leonardo Gonçalves (University of São Paulo, Brazil) and Peter Sands (CSIRO Forestry and Forest Products).

There was a large contribution from the CRC-SPF, which demonstrated the quality of the research that has led to the development and management of the emerging hardwood plantation estate in Australia, and highlighted that much research does indeed find its way into management systems.

The Governor of Tasmania, Sir Guy Green, in his official opening noted "the papers at this conference … demonstrate that workers in your field have a well developed capacity to make optimal use of modelling techniques while recognising that the world of the computer model is virtual not real. Particularly telling examples include presentations showing disparities between the values predicted by models and those obtained by actual tests and measurements in the amount of carbon sequestration in plantations and the effects of various silvicultural methods on production". This was also a timely reminder that eucalypt plantations have an important role to play in not just production forestry but for managing carbon, water and salinity. Senator Ian Macdonald, the Federal Minister for Forests and the Environment also addressed the conference. He highlighted the significance of forestry to Australia, and the important role that research, and especially the incorporation of research into management, have to play in sustaining and developing the various forest industries. Dr Joe Landsberg, a former Chief of CSIRO Division of Forest Research, who has done much to promote the use of process-based models for forest management, led a closing plenary discussion.

An innovative feature of the conference was that all oral presentations were videoed and copied to CDs. CDs of each session, and a CD of the PowerPoint presentations and most posters, were made available to delegates. The journal Forest Ecology and Management will feature papers from EucProd 2002 in a special issue.

Participants at the EucProd 2002 Conference

MAJOR DEVELOPMENTS

Sideroxylonal helps explain resistance of *Eucalyptus globulus* to brushtail possums

Marsupial browsing is one of the major factors affecting the success of plantation establishment in many parts of Australia, particularly in Tasmania. The CRC-SPF has been undertaking research to help reduce this problem. One of the possibilities being explored is to find planting stock that is more resistant to such browsing. For browsing of juvenile *E. globulus* foliage by the common brushtail possum, the CRC-SPF has discovered that variation in browsing damage is associated with levels of a leaf chemical, sideroxylonal (a formylated phloroglucinol compound assayed by scientists at ANU). Fifty-four trees were assayed for variation in foliage intake by brushtail possums during controlled feeding trials. Thirty eight percent of the variation in intake between individual trees could be explained by differences in sideroxylonal concentration (Figure 4). When the trees were grouped on the basis of their locality of origin, significant differences in intake were evident. Significant, genetic based differences in sideroxylonal concentration explained 84% of this variation between localities. Trees originating from St. Helens in northern Tasmania have less sideroxylonal in their leaves than trees from other localities (Figure 5) and are less resistant to possums browsing, while trees originating from Jeeralang North in Victoria and from southern Tasmanian localities have more sideroxylonal and are more resistant.

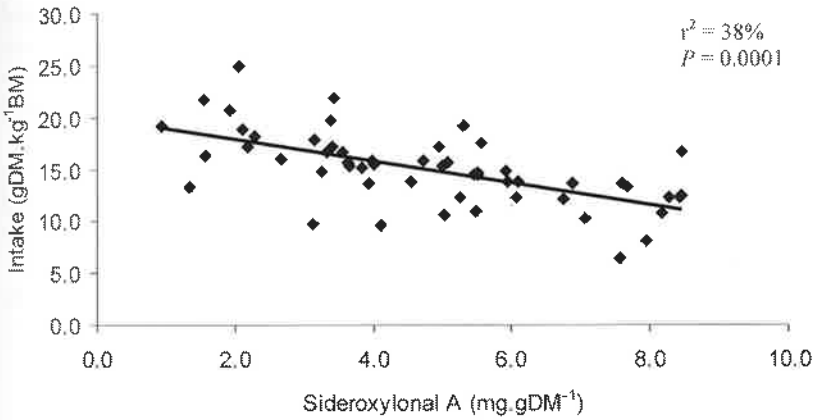


Figure 4: Relationship between intake of juvenile leaves (g of leaf dry matter [DM] per kg of possum body mass [BM]) from 54 individual *E. globulus* trees by brushtail possums and sideroxylonal A concentration in leaves (mg of sideroxlonal per g of leaf dry matter [DM]).

This research demonstrates the potential to use natural plant resistance (sideroxylonal concentration) to reduce browsing damage at plantation establishment by deploying or breeding more resistant seedlings. Having found crucial links between *E. globulus* resistance, leaf chemistry and genetics, there is a need to investigate tools to rapidly assay trees for sideroxylonal concentration. This investigation can then be expanded to include other economically important forestry species such as *E. nitens*.

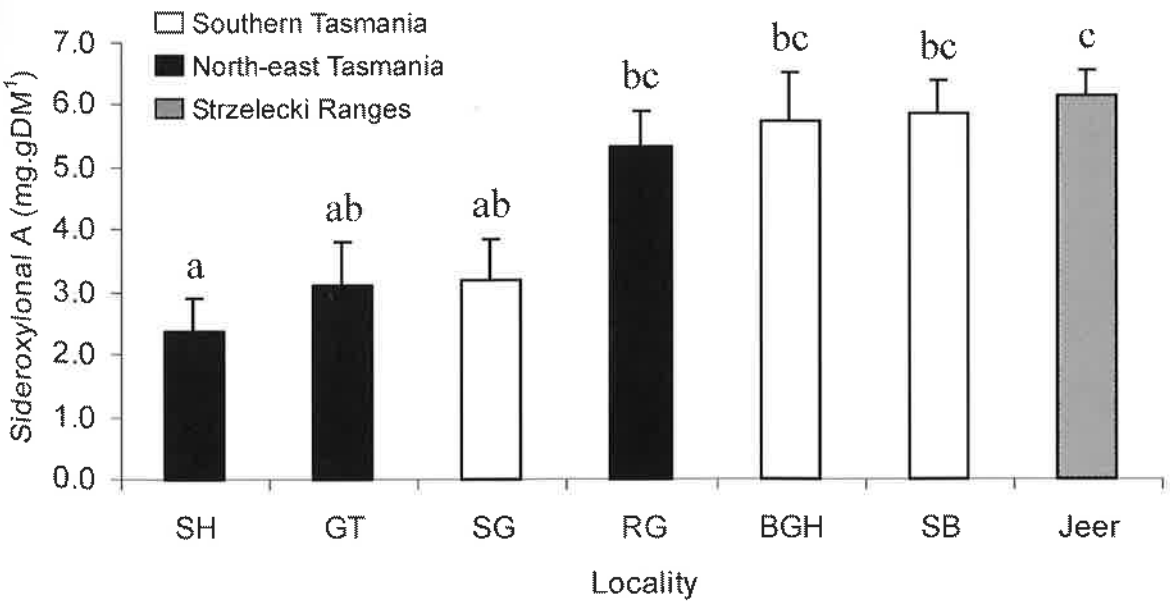


Figure 5: Concentration of sideroxylonal A in juvenile leaves from *E. globulus* trees, sourced from seven localities (least squares means with SE bars). The key indicates the race of each locality. Letters that differ indicate significant differences (P=0.05 after Tukey-Kramer adjustment for multiple comparisons). GT German Town, RG Royal George, BGH Blue Gum Hill, SG South Geeveston, Jeer Jeeralang North, SB South Bruny.

MAJOR DEVELOPMENTS

Keeping our partners up to date through the Web

An ever-increasing proportion of the sharing of ideas and information in the CRC-SPF is being conducted electronically. To facilitate this the CRC has developed a new members web site (http://members.forestry.crc.org.au) to keep partners and researchers up to date with the latest results. The new site manages all CRC documents and information on CRC events through a simple Web interface. The site has a security framework to ensure users only gain access to material relevant to their interests and status, and prevents access to confidential information outside a user's status. The system can keep users informed of the latest documents and events by periodic automatic emails, as well as allowing a user in a group to email other users in the same user group.

User access is determined by a username and a password, and privileges depend on the groups to which the user belongs. There is facility to search for documents. Regular automatic updates of the latest documents that match keywords for a particular user can be organised on a daily, weekly, or monthly basis. A wide range of file types can be uploaded and/or downloaded through the system (e.g. Word, Excel, Powerpoint, Zip, etc), and document downloads can be tracked. There is also facility for automated conversion of the above files to Adobe Acrobat format with password, copy and print protection.

There is a calendar of events with links to event information as well as WebCam access to CRC-SPF seminars.

The usage of this system has been steadily climbing, and currently there are over 470 users. The users are grouped into over 200 groups and have access to 650 full text documents, as well as 2000 citations, and 450 events. As well as servicing the CRC, there are 100 external users, including 50 overseas users (most from South America), who can see public documents and events.

Feedback forms are provided for comment, and suggestions and/or bugs are quickly acted upon. There is continual improvement arising from user feedback, as well as interest from other CRC's in adapting the system for their purposes.

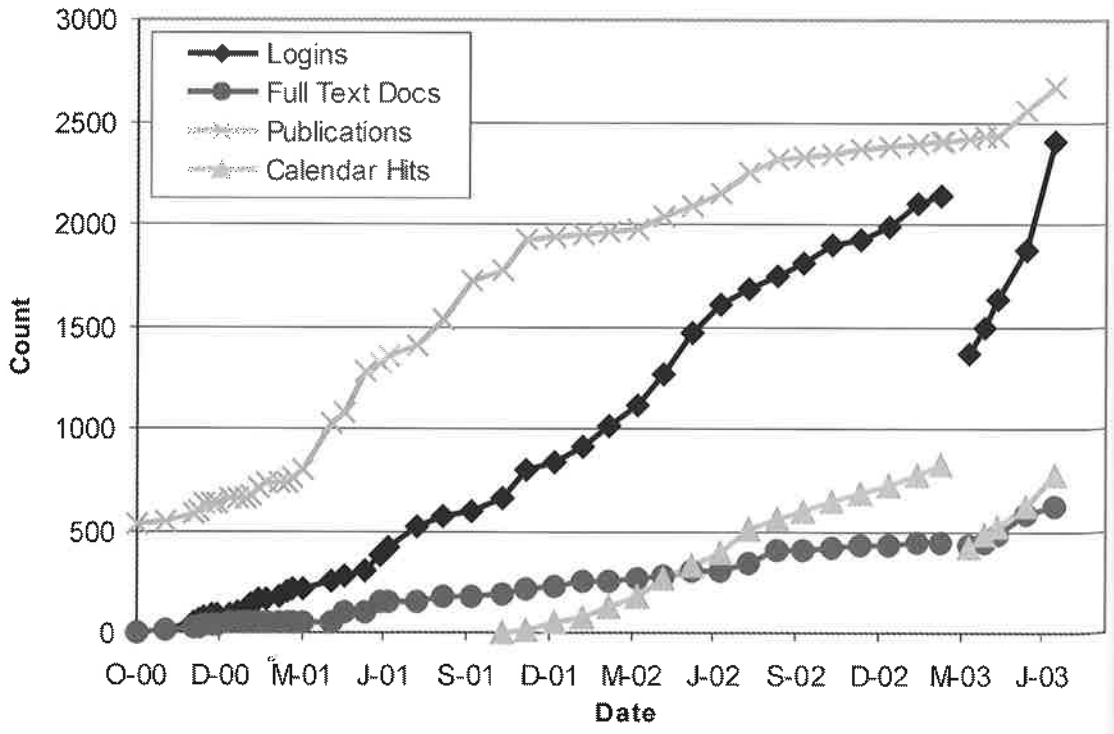


Figure 6: Partner use of the CRC website from October 2000 to June 2003. A break in use occurred at the time the new website was launched.

COOPERATIVE LINKAGES

The CRC SPF has strong international linkages between the:

- Genetic Improvement Program and scientists in the USA, NZ, Chile, Argentina, Portugal, China, France, Denmark and Malaysia;
- Sustainable Management Program and scientists in the USA, Germany, China, Sweden, Portugal, France, NZ and South Africa;
- Resource Protection Program and scientists in the USA, Canada, UK, NZ, 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. The numbers of these links are depicted in the table below.

Table 2: Cooperative Linkages Table showing the number of International (IN), National (N) and Within Centre (W) Linkages

Genetic Improvement

	97/98			98/99			99/00			00/01			01/02			02/03		
	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W
A1	1	1	6	1	1	5	2	3	9	3	3	9	5	3	10	5	3	10
A2	2	4	3	1	3	3	2	5	7	4	4	7	5	4	7	1	4	8
A3	0	0	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	2
A4	1	0	1	3	1	1	4	3	2	1	3	1	2	3	1	3	2	1
A5	0	3	4	0	1	2	0	2	3	0	2	4	0	2	4	0	2	3
A6	1	3	0	1	3	1	3	3	1	2	2	2	4	2	2	4	2	2
A7	0	0	5	1	2	3	1	2	7	2	2	5	2	2	4	2	2	4
Total	5	11	18	7	12	16	12	19	30	12	17	29	18	17	29	15	16	30

Sustainable Management

	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W
B1	1	1	1	1	1	2	0	2	3	2	3	7	2	2	3	4	3	3
B2	1	0	0	1	0	0	3	2	1	6	2	9	8	4	2	8	4	2
B3	0	3	3	0	4	4	0	2	4	0	2	5	0	3	6	0	3	7
B4	4	1	1	3	7	5	4	12	11	4	9	3	3	8	8	5	8	5
Total	6	5	5	5	12	11	7	18	19	12	16	3	13	17	17	17	18	17

Resource Protection

	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W	IN	N	W
C1	2	5	4	4	8	8	5	9	9	4	7	7	4	4	4	4	8	6
C2	0	3	2	0	2	1	1	6	5	2	6	9	2	4	2	2	5	5
C3	1	1	3	1	2	4	2	1	4	2	3	5	2	3	5	1	6	2
C4	1	1	2	0	1	3	0	1	2	1	0	3	1	1	4	1	2	3
C5	1	0	0	1	1	3	5	2	3	4	2	3	3	3	3	3	3	3
Total	5	11	11	6	14	19	13	19	23	13	18	27	12	15	18	11	24	19

Education and Technology Transfer

	4	8	2	3	7	3	3	6	2	4	8	4	4	6	4	1	6	4

RESEARCH

Genetic Improvement Program

Manager
A/Prof Brad Potts

Introduction

A major expansion of the plantation estate of eucalypts and pines is occurring throughout 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 in both the sub-tropical and temperate regions demonstrate the importance of breeding and aim to increase the returns from wood production.

The research undertaken in the Genetic Improvement Program aims to ensure that plantation stock is of the highest possible genetic quality. It aims to improve the efficiency of breeding and ensure the genetic gains are rapidly and efficiently transferred to Australia's increasing plantation estate. In brief, the program aims 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 research outcomes will directly assist breeders of pines, eucalypts, and other native species in our member organisations, as well as organisations multiplying and distributing improved seed.

Project A1

Leader
A/Prof Brad Potts

Staff
Dr Luis Apiolaza
Mr Robert Barbour
Mr Peter Buxton
Mr Peter Gore
Prof Rod Griffin
Dr Andrew Hingston
Dr Greg Jordan
Mr Kelsey Joyce
Ms Marian Lorkin
Dr Briony Patterson
Mr David Pilbeam
Prof Jim Reid
Mr Paul Tilyard
Dr René Vaillancourt
Dr Dean Williams

Genetics and reproductive biology of eucalypts

Background

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

Outcomes

- High heritability (h^2_{op} = 0.44) for 4-year diameter growth has been detected in an *E. globulus* family trial subject to high levels of foliar damage caused by *Mycosphaerella nubilosa*. This appears to be due to large genetic differences in disease susceptibility (h^2_{op} = 0.60) and its strong adverse genetic correlation (r_g = -0.77) with growth at this site.
- Stem coring of the oldest inbreeding trial of *E. globulus* have shown that while inbreeding significantly reduced growth and survival, the selfed progeny that did survive to harvest age (14 years) had higher wood density than outcrosses.
- Observations of bird-pollinators visiting 23 *E. globulus* trees showed that birds spent more time foraging, and commenced foraging more often, in the upper parts of the canopy. This difference in foraging behaviour would explain the significant increase in outcrossing rate and numbers of seeds per capsule previously reported in the upper parts of the *E. globulus* canopy.

Outcomes from external grants

- The effects of canopy aspect, genetics (family) and season on seed production and quality was studied

using 30 trees from 6 families in an *E. nitens* seed orchard in Tasmania. These factors had significant effects on many seed quality and yield traits. For example, greater numbers of seeds per capsule and per kilogram of uncleaned seed were obtained from southern compared with northern aspects of the trees.

- Hybrid seedlings between plantation *E. nitens* and adjacent, native *E. ovata* have now been found established in the wild up to 310m from plantation boundaries. In contrast, *E. nitens* seedlings were not found beyond 30 m from the same boundaries, consistent with *E. nitens* pollen dispersal exceeding seed dispersal.

Goals

To determine:

- the impact of inbreeding depression on growth and wood properties in *E. globulus*;
- genetic and environmental control of reproductive traits including self-sterility in *E. globulus*;
- effects of site, genotype and fertiliser on the efficiency of paclobutrazol to increase flower abundance in *E. globulus*; and
- the later age performance and genetics of F_1 and advanced generation *E. nitens* x *globulus* hybrids compared with the pure species.

Goals for external grants

- To determine the environmental and genetic factors affecting the quantity and quality (e.g. size and density) of seed produced in *E. nitens* and *E. globulus* seed orchards.
- To determine the levels of pollen-mediated gene flow between plantation and native forest eucalypts and factors affecting it.

PhD student Marian Lorkin control pollinating *E. globulus* as part of a study of the genetic control of self-incompatibility

Project A2

Breeding Strategies

Leader
Dr Luis Apiolaza

Staff
Mr Greg Dutkowski
Dr Bruce Greaves
Mr Yongjun Li
Dr Peter Volker
Mr Simon Whittock

Background

The Breeding Strategies project aims to maximise the profit derived from breeding programs of CRC partners. This is achieved through the improvement of breeding value predictions by means of more accurate statistical models, integration of economic and risk information into the prediction of total economic merit, and constant evaluation of tree breeding decision-making and its impact on the results of breeding strategies. Most of this work is channeled through the breeding program of the Southern Tree Breeding Association (STBA), which includes most CRC industrial partners as members. The project integrates information on genetic control and geographic information for growth, risk traits, reproductive traits, and wood properties, and closely interacts with projects A1 (Genetics and reproductive biology of eucalypts) and A5 (Wood quality).

Outcomes

- Analyses of 150 forest tree data sets have now shown that spatial analysis will result in significant improvements in genetic evaluation models wherever trial blocking factors are significant.

- A method has been developed to quantify the degree of connectedness between trials with varying proportions of common families. This index has been integrated into a simulation program to study the effect of connectedness on the accuracy of breeding value estimations.

- The project has supported the initial evaluations of 2nd generation progeny tests in the STBA National Breeding Program of *E. globulus*.

Quantiative geneticist, Yongjun Li studying the effects of connectedness on accuracy of estimating breeding values

Outcomes from external grants

- A review of potential products and markets that may impinge on the development of breeding objectives for *E. globulus* in Australia was completed.

- A model has been developed to determine the economic benefits of coppicing *E. globulus* for the 2nd rotation crop as opposed to replanting with genetically improved seedlings. It was demonstrated that genetic improvement in dry matter production of about 20% would make seedlings economically competitive with coppice crops, if the productivity of a coppice crop is similar to that of the first rotation crop.

Goals

- Improve accuracy of breeding value prediction through better accounting for environmental variation and population structure.

- Enhance the process of selecting elite trees by developing models that integrate economic and risk information into the prediction of total economic merit.

- Evaluate tree breeding decision-making and its impact on the results of breeding strategies.

- Support CRC partners in the prediction of breeding values, estimation of total tree merit, and design and implementation of breeding strategies.

Goal for external grant

- Develop alternative breeding objectives for *E. globulus* and study the genetic variation of new objective traits (e.g. coppicing ability, solid wood properties).

Project A3

Leader
Dr Gavin Moran

Staff
Ms Kylie Groom
Ms Jan Murrell
Dr Reddy Thumma

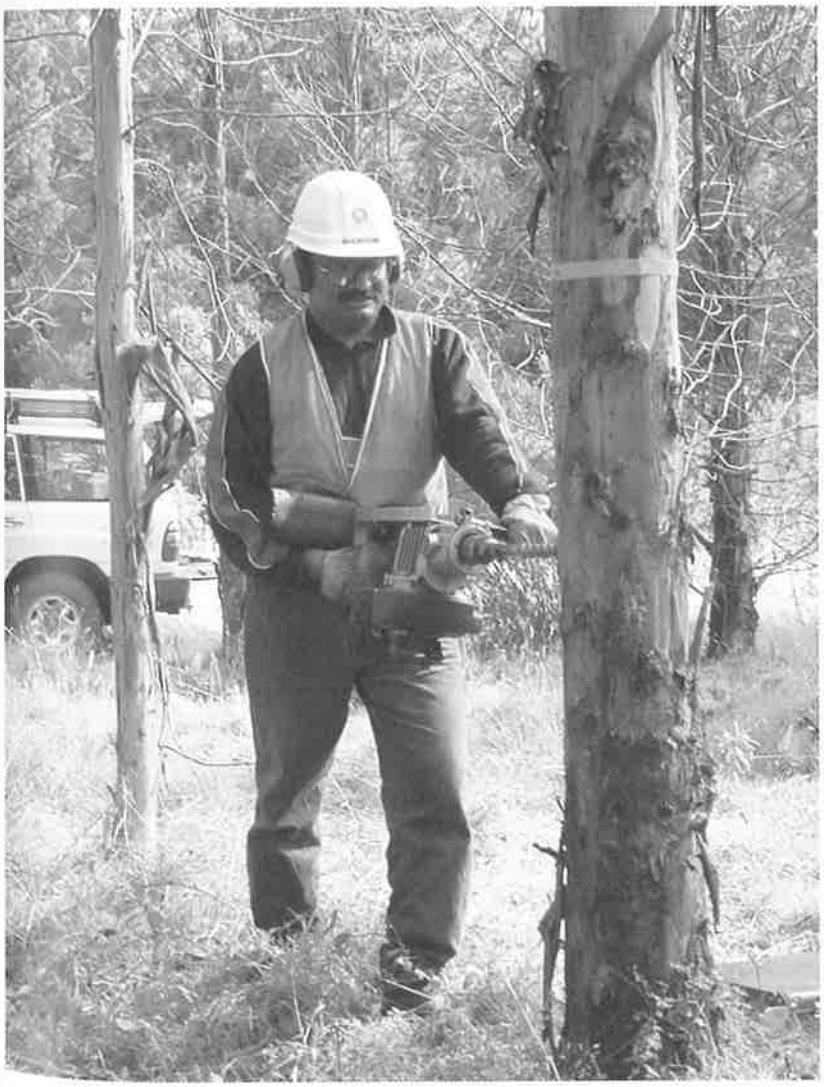
Molecular approaches to tree improvement

Background

The aim of this research is to understand the molecular genetic basis of traits with high commercial value, such as those for wood and fibre, and to use this knowledge to more efficiently develop improved genotypes for deployment in plantations.

Determination of the genes controlling wood fibre traits in eucalypts will enable a better understanding of fibre formation and the development of better selection strategies for these traits. Such outcomes will enable Australian industry to establish high value plantations, especially for pulp and paper products based on planting stock for tailored end uses.

Reddy Thumma sampling wood cores in progeny trial of *E. nitens*



The approach involves characterising quantitative trait loci (QTL) and candidate genes for wood and fibre traits and growth. The traits include wood density, pulp yield, cellulose levels, fibre length and microfibril angle. The candidate genes include those involved in lignin and cell wall polysaccharide biosynthesis.
Current work is focussed on:

- characterising QTL controlling wood and fibre properties in *E. nitens*;
- testing for associations between expression of wood fibre traits and candidate genes;
- developing strategies to utilise QTL and candidate gene data in selection procedures in eucalypt breeding programs.

The project is closely integrated with Project A5 (wood quality) and utilises technologies developed in the CSIRO Forest Products Laboratory in Clayton.

Outcomes

- Mapping and QTL studies are being undertaken in a CSIRO full-sib progeny trial of 300 *E. nitens* trees. Data on 135 DNA markers, wood density and microfibril angle has been collected. Some of these markers will allow the transferability of QTL between *E. globulus* and *E. nitens* to be determined.
- A Forestry Tasmania *E. nitens* progeny trial is being used in association studies to relate candidate gene variation to variation in wood fibre traits. DNA samples and wood cores from sample populations (about 300 trees) have been assayed for 20 SNPs in a critical gene in the biosynthesis of lignin (CCR) assayed for density variation and microfibril angle.

Project Goals

- Develop procedures that utilise QTL information for wood and fibre traits in breeding and deployment programs.
- Test transference of QTL locations between *E. globulus* and *E. nitens*.
- Assess variation in candidate genes co-locating to key QTL for lignin, pulp yield and other wood fibre traits, and determine their relationship to variation in traits.

Project A4

Molecular genetics of eucalypts

Leader
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Staff
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Mr Jules Freeman
Mr Carl Grosser
Mr Timothy Jones
Mr Andrew Milgate
Dr Briony Patterson
Ms Fiona Poke
Dr Brad Potts
Mr Damien Rathbone
Dr Jim Reid
Mr Adam Smolenski
Dr Dorothy Steane
Mr James Worth

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, as well as understanding the genetic control of quantitative traits. However, these applications are probably just the beginning since the rapidly expanding field of genomics is providing unprecedented insights into plant genomes leading to the identification of genes of interest.

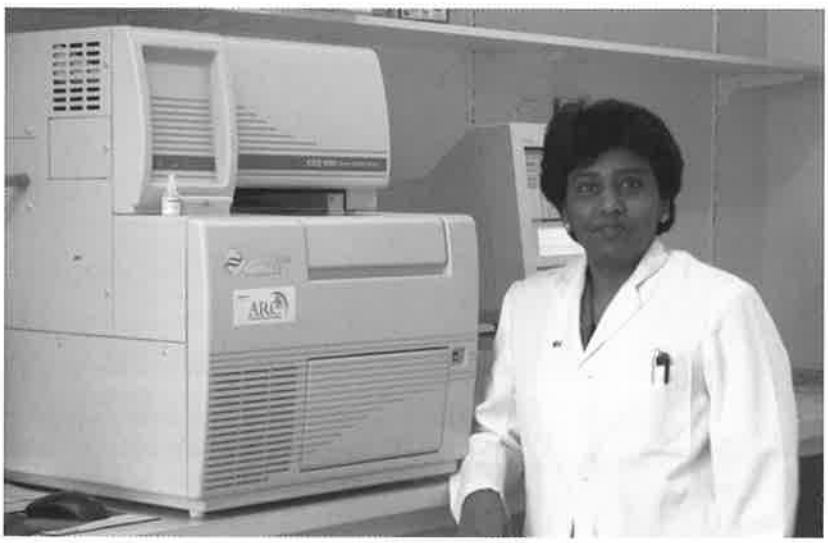
This project focuses on eucalypts and aims to use molecular markers to:

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

Outcomes

- A large study of the genetic diversity in the native base population of *E. globulus* based on microsatellites developed in the CRC has been completed. This data provides unique insights into inbreeding and relationships between races of *E. globulus*.
- A set of *E. globulus* microsatellite loci have been identified that can be run together to reduce the cost of fingerprinting.

Visiting scientist A/Prof Wickneswari Ratham



- Rare isozyme markers were used to i) confirm the advantages of style cutting in the Mass Supplementary Pollination (MSP) system being used for *E. globulus* and ii) verify the operational use of a weekly crossing cycle. Low levels of contamination were found across multiple genotypes. Microsatellites showed that this was mainly due to outcrossing rather than self-pollination.

Outcomes from an external ARC grant

- Variation in an important nuclear gene for lignin biosynthesis (CCR) was studied across the geographic range of *E. globulus*. Large differences in allele frequency between mainland and Tasmanian populations were demonstrated. Sharing of chloroplast DNA and CCR alleles between *E. globulus* and *E. cordata* in south-eastern Tasmania suggests that the *E. globulus* gene pool has been affected by past hybridisation and this may explain the observed variation in CCR alleles.
- Significant differences in the frequency of molecular markers between adjacent dwarf and tall forms of *E. globulus* have been demonstrated. The maintenance of these differences in open-pollinated progenies implies effective barriers to gene flow may occur over a short distance in this species.

Goals

- Study resistance to *Mycosphaerella* infection in *E. globulus* using a QTL approach.
- Investigate the potential for incorporating molecular screening methods in *E. globulus* breeding programs in order to change lignin content and composition.
- Develop a model to predict seed quality in *E. nitens* seed orchards using simple measurements of reproductive parameters and verify it using microsatellite markers and paternity analysis. This model will allow prediction of breeding values of seed lots.

Goals for external grants

- Use microsatellite markers to study genetic diversity and relationships in a breeding population of *E. globulus* in comparison with the base population.
- Study the utility and inheritance of mitochondrial DNA for studying hybridisation in eucalypts.
- Establish the relationship between hybridisation potential and phylogenetic affinity.

Project A5

Leader
Dr Carolyn Raymond (to November 2002)
Dr Chris Harwood (from February 2003)

Staff
Ms Linda Ballard
Mr Peter Kube
Dr Emlyn Williams
Mr Leon Savage
Ms Kirsty Siu

Wood quality

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 is concentrating 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 CSIRO Forest Products Laboratory, with some of the technologies developed there (SilviScan 2, cellulose content analysis and Near Infrared Reflectance Analysis) being implemented and applied to genetic material in member breeding programs for both *E. globulus* and *E. nitens*.

Outcomes

- Changes in key project staff during the year set back the timing of some outcomes, but non-destructive sampling strategies for shrinkage and collapse (e.g. Figure 7) in *E. globulus* and *E. nitens* have been developed, and sample processing for determining sampling strategies for stiffness has been completed.
  Note: Collapse is damage to the structure of wood cells during drying. This causes timber distortion. 'Core collapse' is measured in radial cores taken at a fixed height (1.1m). 'Whole collapse' is calculated from a weighted average of 8 cores taken at various proportions of tree height.
- Near Infrared Reflectance analysis calibrations have been developed for lignin content for *E. globulus* and *E. nitens*.

Goals

- Determine optimum non-destructive sampling strategy for stiffness in *E. nitens*.
- Determine race and provenance effects and genetic parameters for lignin and cellulose content, and shrinkage and collapse, and their genetic relationships with growth traits in *E. nitens* base populations.

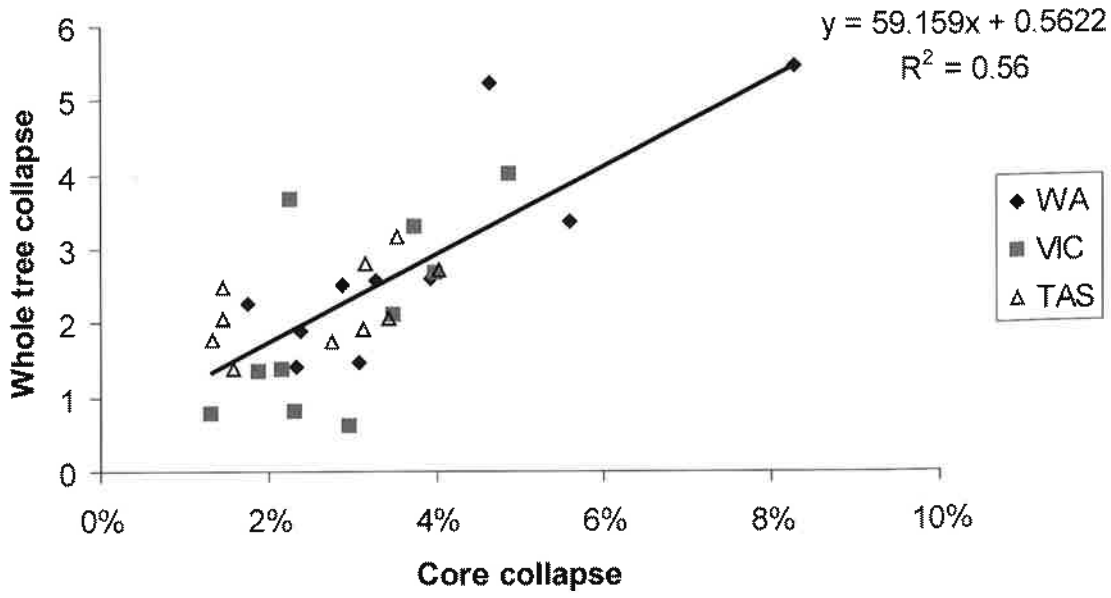


Figure 7: Scatter diagram and regression equation for predicting whole-tree volumetric collapse (%) from the collapse of an air-dried core taken from near breast height for *E. globulus*, together with the degree of fit (R2).

Project A6

Hybrid breeding

Leader
Dr Mark Dieters

Staff
Mr Jeremy Brawner
Mr Dominic Kain
Dr Kevin Harding
Dr Garth Nikles
Mr Paul Toon

Background

The CRC-SPF and its partner organisations, have access to one of the most extensive arrays of artificial forest tree hybrids in the world. The hybrid breeding project has two primary aims:

- understand the genetics of hybrid populations, focusing on growth and wood properties; and
- develop or introduce into Australia the most advanced strategies for breeding hybrids.

This project focuses on the tropical pine species *P. elliottii* and *P. caribaea* var. *hondurensis* and their hybrids which are being deployed commercially by the Department of Primary Industries (Queensland), and interacts closely with project A7 (Molecular genetic improvement for tropical and subtropical production).

Outcomes

- Simulation of hybrid breeding strategies such as synthetic breeding, a modified form of Reciprocal Recurrent Selection (RRS-SF) and standard Reciprocal Recurrent Selection (RRS) showed that the synthetic strategy (SYN) was the most cost effective (greatest gain for fixed resources) under a wide range of genetic structures (Figure 8).
- Genetic modelling of hybrid populations of *Pinus elliottii* and *P. caribaea* var. *hondurensis* indicated that partial dominance gene action contributes to heterosis in stem volume, but the genetic control of wood density is due to additive, and possibly additive-related epistatic gene action.
- Indirect selection for wood density in pure species trials has been shown to be nearly as efficient as direct selection in hybrid trials.
- Studies of *P. elliottii* or *P. caribaea* var. *hondurensis* have shown that the heritability of a trait in pure species combination is a good predictor of the strength of the pure-hybrid correlation in the same trait (ie. high $h^2 \Rightarrow$ high r_{ph}).
- Analysis of mid-rotation data from factorial matings between *Pinus caribaea* var. *hondurensis* and both *P. tecunumanii* and *P. oocarpa* confirm the clear superiority of these hybrids (especially those involving *P. tecunmanii*) over pure *Pinus caribaea* var. *hondurensis*. There was little genotype by environment interaction, and strong correlations between the performance of the *P. caribaea* var. *hondurensis* parents when crossed within species or hybridised with either *P. tecumumanii* or *P. oocarpa*.
- Analysis of clonal tests of *Pinus elliottii* × *P. caribaea* var. *hondurensis* clonal tests, across 12 sites in southeast Queensland demonstrated very little genotype (clone, family or parent) × site interaction. Age-age correlations (1 – 8 years) supported a reduction in the age of clonal selection from 6 years to 4 years.
- Analysis of progeny tests of *P. elliottii* parents mated with *P. elliottii* and *P. caribaea* var. *hondurensis* indicated that the pure-hybrid correlations were poor (close to zero) for growth traits at 10 years of age, but high for stem straightness (0.7).
- Volume equations for *P. elliottii*, *P. caribaea* var. *hondurensis* and their F_1 and F_2 hybrids, and estimates of the MAI (at 15 years of age) on three sites in southeast Queensland have been determined.

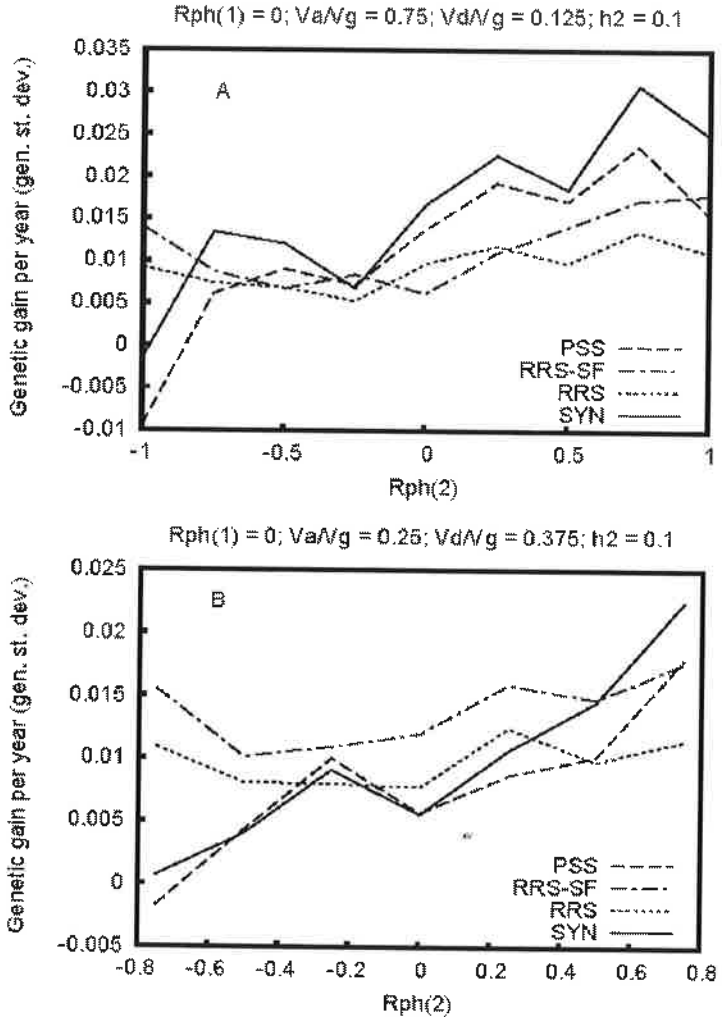


Figure 8: Genetic gain per year expressed in units of the F, genetic standard deviation, under breeding strategies RRS, PSS, RRS-SF and SYN in dependence of the pure-hybrid correlation in species 2 ($r_{ph}(2)$) in selected parameter situations. Case A: a higher proportion of the genetic variance is additive and SYN is the best ranking strategy for all values of $r_{ph}(2)$. Case B: a higher proportion of the genetic variance is dominance and RRS-SF is the best ranking strategy for most values of $r_{ph}(2)$.

Goals

- Document a hybrid breeding strategy for pine hybrids in Queensland.
- Finalise analysis of hybrid pine trials.

Project A7

Leader
Prof Robert Henry

Staff
Mr Mike Cross
Dr Mark Dieters
Mr Peter Eggler
Ms Francis Elliott
Dr Kevin Harding
Prof Jane Hughes
Ms Rachel King
Mr Rohan Mellick
Mr Leon Scott
Dr Mervyn Shepherd
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Mr Paul Toon

Molecular genetic improvement for tropical and subtropical production

Background

Genetic improvement and sustainable management of tropical forest species is supported by the application of molecular tools in this project. The species being studied include *Pinus* hybrids (*P. elliottii* var. *elliottii* (PEE) x *P. caribaea* var. *hondurensis* (PCH)), *Araucaria cunninghamii* (Hoop pine) and *Eucalyptus* species. The project is increasing our understanding of the genetics of complex traits such as wood properties and propagation performance. Techniques for verification of hybridisation in plantations and native populations are being developed and applied in forest management.

Outcomes

- Genetic mapping of genes for adventitious rooting in hybrid pines shows that some genes act broadly in hybrid pine populations and with additive gene action. Several quantitative trait loci (QTL) of moderate effect were found in the same genomic regions both in an outcrossed pine hybrid and in an unrelated, second-generation inbred pine hybrid. This finding indicated the possibility for improving strike rates for cuttings in the clonal forestry program by manipulating one set of genes across families and generations of hybrids.
- The discovery that interspecific pine hybrids have recombination rates similar to their parental taxa has implications for conventional and molecular improvement, and our understanding of speciation mechanisms in the Australes subsection of pines (Figure 9). Together with data on the congruence of genome organisation from comparative mapping in this group, the results indicated Australes is a freely introgressing group, and that it should be considered a species complex rather than a set of species undergoing independent evolution. One implication for the breeding of hybrids in this group is that blocks of linked genes should be rapidly broken up in early generation crosses, and mating designs which enhance recombination, but that involve inbreeding, should not be required for introgression.
- Candidate wood property genes, PAL and CAD have been located on a genetic map for hybrid pines following the development of assays based on pyrosequencing or single strand conformation polymorphism.
- A DNA fingerprinting assay, based on a multi-locus analysis of chloroplast microsatellites, has been developed for the definitive elimination of slash pine contaminants from tropical pine hybrids. The assay distinguished all slash from Caribbean pine trees in a reference population and can be conveniently multiplexed for saving on cost and time of the assay.
- Genetic maps for Hoop pine were completed. These are the first genetic maps in the Araucariaceae and low rate of polymorphism between the parents suggested that the genetic diversity in this species may be lower and inbreeding could be higher than previously thought.

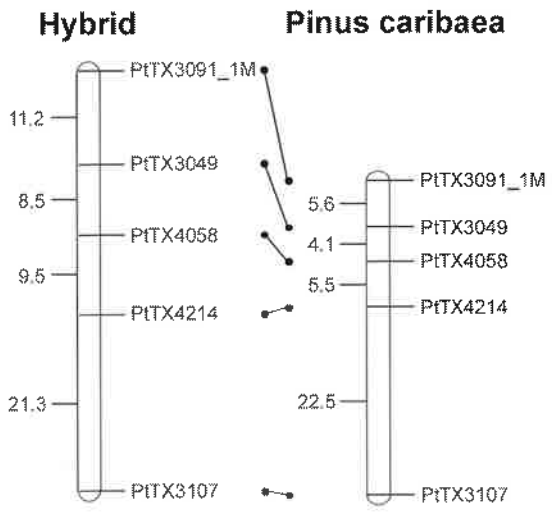

Figure 9: Partial genetic maps for *Pinus caribaea* var. *hondurensis* parent and a hybrid with *Pinus elliottii* var. *elliottii*. Tests for recombination heterogeneity indicate the recombination rates are the same in the hybrid and its parental taxa.

Outcomes from external grants

- Analysis of gene flow and paternity in an *E. grandis* seed orchard indicated that although there was a preference for inter-provenance crossing and a low incidence of nearest-neighbour matings, selfing (range 7-36% AV±SD 14.7±12.7%) and pollen contamination (range 34-57% AV±SD 46.1±8.1%) were high. There appeared to be no directionality to pollen movement and pollen was moved effectively throughout the orchard.

Goals

- Complete the analysis for genes for adventitious rooting in hybrid pines
- Finalise recombination variation studies in hybrid pines
- Finalise QTL studies in Hoop pine
- Finalise gene flow studies in *E. grandis*

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 examines the environmental factors and silvicultural practices that influence forest production and casts these into a quantitative framework with the use of process-based models. We play a critical role in delivering the knowledge needed to ensure that practices implemented by forest managers in Australia are sustainable and subject to ongoing improvement in terms of economic and environmental performance. This provides a valuable adjunct to the work of other research organisations involved in the definition of criteria for sustainability.

Project B1

Leader
Dr Philip Smethurst

Staff
Mr Paul Adams
Mr Richard Appleton
Mr Craig Baillie
Dr Chris Beadle
Ms Maria Cherry
Mr Keith Churchill
Ms Sandra Hetherington
Mr Andrew Knowles
Dr Andrew Mitchell
Mr Bill Neilsen
Mr Chris O'Hara
Ms Carolyn Ringrose
Mr Julian Smith
Ms Diane Spurr
Ms Elizabeth Vinall
Ms Ann Wilkinson

Site productivity

Background

The aims of this project are to:

- determine the extent to which nutrient and water supply can sustain high leaf areas and tree growth rates after canopy closure;
- 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

- Plantation managers were trained in the use of the visual guide for estimating LAI. This visual guide is now included in some operational inventory programs.
- Small-scale variation in soil properties, which leads to considerable variation in tree growth, was demonstrated in a fertiliser experiment at Westfield. This site has relatively fertile soils and rarely experiences water stress. In plots of 6-year-old *E. nitens*, soil P and K concentrations and the rate of N applied together accounted for 83% of the variation between plots in total stem volume.
- The use of foliar N as an indicator of growth was examined under a range of N-supply regimes created by combinations of N fertilisers, weed competition and irrigation. Only on one occasion during the first two years after treatment was foliar N well-correlated with growth in the subsequent year. This result casts considerable doubt on the utility of foliar N concentration as an indicator of N deficiency in *E. globulus*.
- Application of 100 kg N ha^{-1} (as urea) to a 20-year-old eucalypt plantation increased concentrations of mineral N in the soil for only 4-8 weeks, regardless of the season of application (Figure 10). However if this treatment was repeated once annually from age 5 years, it produced a substantial increase in growth rates and nutrient cycling in trees, and on the forest floor there is an increase in litter depth, changed soil moisture availability, reduced variability soil temperature and increased organic matter turnover.
- Soil organic matter can be an important source of nutrients in forest ecosystems. A method was developed for fractionating soil organic matter. When the lighter organic matter fraction was applied to a nutrient-poor sand *E. globulus* seedlings grown in this soil medium showed substantially improved P uptake and growth, relative to controls grown in sand. Both treatments received the same rate of a balanced fertiliser containing no P.

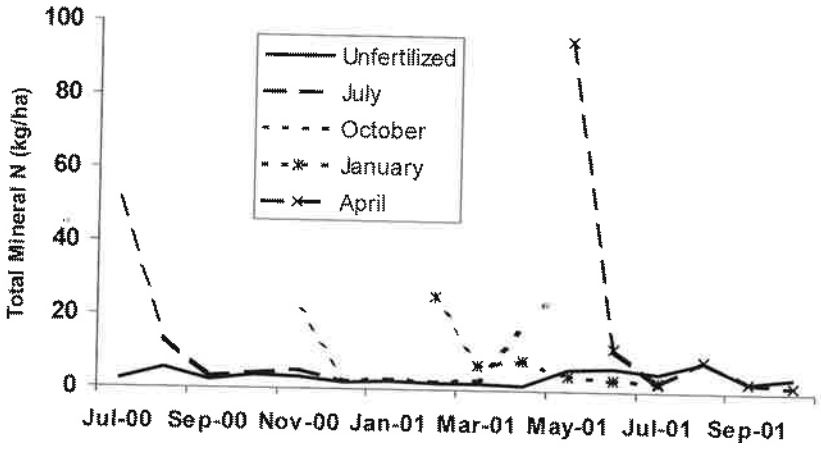

Figure 10: Temporal change in the content of total mineral N of litter plus surface soil in a 19- to 20-year-old *E. regnans* plantation either unfertilized or after 100 kg N ha^{-1} was applied on four separate occasions (July, October, June, April).

Goals

- Summarise management options for P fertilisation of *E. nitens* plantations.
- Develop a mechanistic soil nutrient uptake module for inclusion in productivity models.
- Model short- and long-term responses to N fertilisation.

Project B2

Leader
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Staff
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A/Prof Janet Chaseling
Dr Chengrong Chen
Mr Stuart Fenech
Mr Philip Frayne
Dr Hossein Ghadiri
Mr Jim He
A/Prof Peter Healy
Dr Alan House
Prof Jane Hughes
Mr Paul Keay
Ms Elisha Ladhams
Dr Nicole Mathers
Mr Issa Medraj
Ms Megan Nosovich
Mr David Osborne
Dr Ian Phillips
Dr Nina Prasolova
Prof Calvin Rose
Mr John Simpson
Dr Grant Wardle-Johnson
Dr Michael William
Dr Bofu Yu

Management of tropical soils

Background

The aims of this project are to:

- evaluate the impacts of soil and stand management on both quantity and quality of soil organic matter for sustaining the productivity of subtropical pine plantations in south-east Queensland;
- evaluate the impacts of silvicultural practices on nitrogen (N) pools and dynamics in Hoop pine plantations of south-east Queensland;
- test, develop and apply advanced DNA, stable isotope and nuclear magnetic resonance (NMR) for developing improved biological indicators of soil quality;
- test and identify soil invertebrates as potential indicators of biodiversity in Hoop pine plantations;
- quantify the effects of both silvicultural practices and environmental conditions on soil N availability and on plantation N demands; and
- quantify the effects of harvesting, site preparation practices and seasonal conditions on soil physical processes in subtropical pine plantations.

Outcomes

- Seasonal and spatial variation existed in soil microbial properties among different compaction and cultivation treatments, with soil microbial biomass of carbon (MBC) ranging from 220 to 1089 µg/g, microbial biomass of nitrogen (MBN) from 12 to 328 µg/g, and microbial C:N ratios from 1.6 to 27.5. Fluctuations in soil microbial biomass were mainly driven by the seasonal changes in environmental conditions (including rainfall, temperature and soil moisture). The MBC was less variable with season than the MBN. Soil compaction did not significantly affect MBC, MBN and soil N flux through microbial biomass, while soil cultivation significantly reduced MBC and MBN only in the zero forwarder pass (no compaction) treatment.
- Genetic variation in tree growth and branchlet carbon isotope composition (^{13}C), nitrogen (N) isotope composition (^{15}N) and nutrient (N, P, K, Ca, Mg, Mn, Fe, Cu and Zn) concentration of 11-year-old Hoop pine (*Araucaria cunninghamii* Ait. ex D. Don) half-sib families were examined at two contrasting sites. There was significant genetic variation in measured traits (e.g. in tree growth, branchlet ^{13}C, nutrient and mineral concentration) among the families within and between sites. Significant family variation in branchlet ^{15}N occurred at the dry site ($P = 0.068$), but not at the wet site. Branchlet ^{15}N at the wet site was significantly lower than that at the dry site, suggesting that soil microbial-plant interactions might play a role in discriminating soil available ^{15}N in favour of ^{14}N for tree uptake at the wet site. Branchlet ^{13}C, ^{15}N and nutrient concentration (particularly N) show promise as traits for assisting in the selection of elite Hoop pine families with improved tree water use efficiency, nitrogen use efficiency and growth for the more water- and nutrient-limited environments

Goals

- Further develop and apply ^{13}C, ^{14}N and ^{15}N NMR methodologies to characterise soil organic matter composition and quality in Hoop pine and exotic pine plantations.
- Quantify denitrification, immobilisation and leaching of ^{15}N-labelled fertilisers under different residue management regimes and environmental conditions in the second-rotation Hoop pine plantations.
- Develop and apply soil biological methods, particularly microbial biomass C and N assays, to characterise soil organic C dynamics and N cycling in subtropical pine plantations.
- Develop improved biological indicators of soil quality by testing, developing and applying advanced DNA, stable isotope and NMR techniques.
- Develop potential soil invertebrates as indicators of biodiversity in Hoop pine plantations.
- Assess the suitability of existing data from long-term catchment studies for incorporation into a predictive model of soil loss from subtropical pine plantation catchments.
- Estimate the infiltration parameters using the rainfall-runoff model SRM for site selected storm events.

Tim Blumfield describes studies on nutrition and compaction of soils under a Hoop Pine plantation in Yarraman State Forest, as part of the Hoop Pine Field Day held on the 18th of March 2003

Project B3

Leader
Dr Chris Beadle

Staff
Mr Paul Adams
Dr Philip Brown
Ms Maria Cherry
Mr Keith Churchill
Dr Dugald Close
Dr Neil Davidson
Ms Sandra Hetherington
Dr Greg Holz
Dr Jeanette Hyland
Dr Ryde James
Dr Sarah Jennings
Mr Kelsey Joyce
Prof Peter Kanowski
Mr Sven Ladiges
Dr S Mahendrarajah
Dr Jane Medhurst
Prof Robert Menary
Dr Neville Mendham
Mr Petr Otahal
Dr Libby Pinkard
Dr Digby Race
Ms Jacki Schirmer
Dr Chris Shedley
Dr Philip Smethurst
Mr Tim Tabart
Ms Ingrid van Putten
Prof Frank Vanclay
Mr Grant Westphalen
Ms Ann Wilkinson
Ms Danielle Wiseman
Mr Dale Worledge

Silvicultural systems

Background

The aims of this project are 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 the adoption of commercial forestry on part or all of the farm enterprise, and develop an enhanced understanding of the factors which determine regional timber supply.

Outcomes

- It is estimated that joint ventures (using a variety of mechanisms) underpin about 70% of the current plantation expansion in Australia. Understanding the value of particular joint venture arrangements, and other strategies, for building partnerships in forestry will assist in overcoming community anxiety around plantation forestry.
- The heterogeneous nature of non-industrial private forest owners and the objectives they hold for their forests make policy and program design complex. Examination of this group of forest owners resulted in a typology of landowners with similar objectives. The different landowner groups were easily identified through their socio-economic and motivational differences.
- Information gathering patterns and level of knowledge of forestry- and environment- related issues vary between groups of landowners. However, the main sources for market and price information and management and technical information play a similar role for different types of landowners.
- Exploration of private forest harvesting and forest and conservation management decisions in Tasmania shows that a range of owner and ownership characteristics can explain forest management behaviour.
- Interviews and a workshop with managers within a large forestry company have demonstrated commitment to engaging the public in the company's strategic planning. A process that elicits and examines the perceptions of participants in multi-stakeholder dialogues in order to facilitate constructive dialogue shows potential.
- The use of recommended 'best practices', including cultivation, mounding, long fallow period and good weed control, ensure successful tree seedling establishment in the Midlands of Tasmania.
- Seedling height at planting, within an industry relevant range of 120 to 240 mm, has no affect on growth performance six months after planting in south-west WA and the Green Triangle. Growth performance was inferior in seedlings raised in 45 cm^3, but similar between seedlings raised in 85 and 115 cm^3, containers by six months after planting.

A revegetation planting using best practice at age six months at Sorrell Springs in the Tasmanian Midlands, an area severely affected by tree decline.

Goals

- Publish a 'Farm Forestry Technical and Business Handbook'.
- Develop a process-based model of blackwood height and a decision support system suitable for blackwood being grown in nurse-crop systems.
- Develop a schedule for managing effluent irrigation of plantations managed for solid wood.
- Describe the successful strategies used by industrial companies and governments that strengthen support and cooperation for private forestry amongst individuals and wider communities.
- Examine the determinants of non-industrial private owners' timber harvest and management decisions on the basis of stated forest ownership objectives and socio-economic characteristics.
- Examine aspects of the communication and decision-making processes between forestry companies and the broader community
- Investigate the physiological bases to field observations that there are of no effects of seedling size, but strong effects of seedling container size, on seedling performance after planting.

Project B4

Leader
Dr Peter Sands

Staff
Dr Michael Battaglia
Dr Roger Braddock
Mr Alex Bradley
Dr Kerrie Catchpoole
Dr Kevin Harding
Dr Frieda Henskens
Dr Mark Hunt
Mr Daryl Mummery
Dr Marks Nester
Dr Tony O'Grady
Dr Libby Pinkard
Dr Carolyn Raymond
Mr Paul Ryan
Ms Kirsty Siu
Dr Steven Underhill
Mr Dale Worledge

Modelling production and wood quality

Background

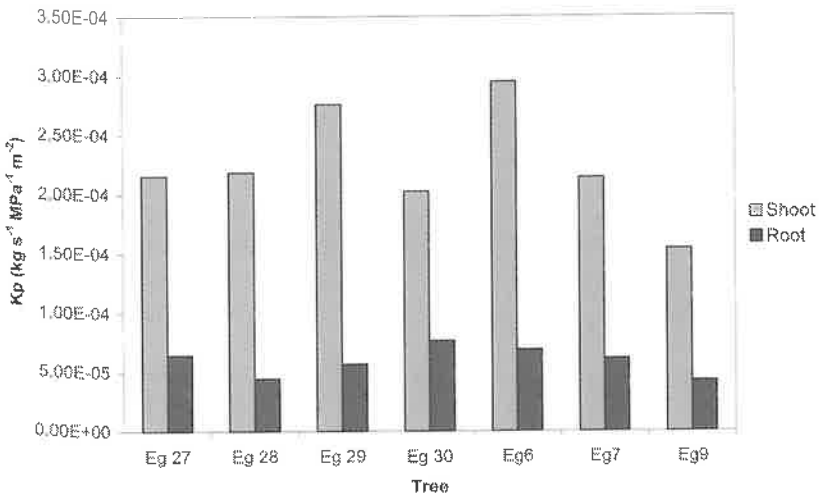
The aims of this project are to:

- produce process-based models which
  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; and
- develop decision support systems for plantation management.

Outcomes

- A site productivity estimation workshop held in Hobart was attended by 31 people and provided hands-on demonstrations of 3-PG, ProMod and Cabala, and detailed background to the models.
- EucProd 2002 was held in Hobart over the period 10-15th November 2002 and attended by 150 delegates from Australia and overseas. It was a very productive, enjoyable, and well-run conference.
- Silvicultural prescriptions to reduce drought death risk in *E. globulus* plantations in south-west Western Australia were developed using Cabala to predict growth, pre-dawn water potential and N uptake and utilisation. A rainfall simulator was developed to generate realistic daily rainfall sequences as biased results are obtained using average data.

Figure 11: Above- and below-ground hydraulic conductance (inverse of resistance) in eight-month-old *E. globulus* (Eg) trees at the Pittwater Experimental Plantation



- A study of stem, coarse root and soil respiration at an *E. nitens* plantation found that coarse root respiration was 0.5 t ha^{-1} yr^{-1}, stem respiration was 0.3 t ha^{-1} yr^{-1}, litterfall was 2.5 t ha^{-1} yr^{-1}, and fine root respiration and turnover was 4.3 t ha^{-1} yr^{-1}. At an *E. globulus* site, there was a strong correlation between soil respiration and below-ground fine root biomass.
- A model developed for farm forestry decision support as part of a JVAP project adequately predicted effects of spatial layout of farm plantings.
- A study of the effect of tree spacing on N distribution and photosynthesis in tree crowns found the variation of N concentration was not as predicted by optimality models. This suggests non-photosynthetic roles of canopy N are important determinants of N distribution.
- By using irrigation to vary the distribution of water around trees it has been found that the biomass of fine roots is higher in areas maintained at higher water content. These data are being used to assess the relationship between fine root biomass and soil water uptake.
- Hydraulic resistance of plantation-grown *E. globulus* trees was found to be greater in the roots than the shoots (Figure 11). This may partially explain why the species is susceptible to drought death. Differences in whole-tree hydraulic conductivity might be related to tree age.
- STEPS V3.0 has been developed and a series of demonstration and training sessions were conducted with CRC industry partners.
- Branch models were developed for Win-EPIFN, the French conversion software that is part of the decision support system for subtropical and tropical softwood species.

Goals

- Edit a special issue of Forest Ecology and Management featuring key papers from EucProd 2002.
- Implement and test a model for the response of blackwood grown under a nurse crop to form pruning.
- Develop and document branching and predictive grading models for sub-tropical pines.
- Develop a prototype decision support system for subtropical softwood species for comment and evaluation.
- Develop spatial applications of process-based growth models and facilitate their use by CRC partners and external clients.
- Develop methods to simulate daily weather sequences and apply these with process-based growth models for risk analysis and management.

Resource Protection Program

Manager
Dr Clare McArthur

Introduction

The Resource Protection Program aims 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, 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; and
- 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

Leaders
Dr Geoff Allen
Dr Rob Floyd
(to December 2002)
Mr John Matthiessen
(from January 2003)

Staff
Dr James Bulinski
Dr Jane Elek
Ms Kate Hoorweg
Dr Mamoru Matsuki
Mr John Matthiessen
Ms Helen Nahrung
Dr Fredrik Östrand
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Mr Luke Rapley
Mr Hilton Redgrove
Mr Anthony Rice
Mr Mark Short
Dr Martin Steinbauer
Mr Rex Sutherland
Ms Trudi Wharton

Biology, ecology and economic impact of insect pests

Background

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

Outcomes

- The number of generations per year in *C. agricola* was found to be a seasonally plastic trait, dependent upon photoperiod at the time of emergence of teneral adults, which in turn was dependent upon the field temperatures experienced by immature stages.
- Population genetic analysis using allozyme electrophoresis of specimens collected in New South Wales, Victoria and Tasmania indicates that gene flow in *C. agricola* is limited between populations and regions, in contrast to *C. bimaculata* which shows high levels of genetic mixing throughout Tasmania.
- *C. agricola* adults mate many times in their reproductive lifetime. Up to 30% of teneral females mate in late summer/autumn before entering reproductive diapause and can produce viable eggs in spring without remating.
- The basic biology and phenology of the Western Australian establishment pest *Heteronyx elongatus* has been documented. Damage is caused to seedlings by larval feeding on roots soon after planting, leading to seedling death. There is a single major generation each year, with a lengthy larval development period autumn-spring and a possible small secondary generation in late summer.
- Populations of *E. californica* in *Pinus radiata* plantations in the ACT are often only locally abundant and peak in summer and autumn when ambient temperatures between 20 to 25°C favour maximum female fecundity.
- A DYMEX population model showed that *M. privata* can have two generations a year (bivoltine), depending upon the timing of commencement of population growth. Areas where bivoltine populations occur may be more susceptible to outbreaks.
- In the field *M. privata* was found to prefer *E. rubida* just as much as *E. globulus* as a host for egg laying. In both species a significant, positive relationship was found between the foliar concentration of terpinol and the numbers of eggs laid on a tree.
- The abundance of parasitoid wasps in the family Braconidae and to a lesser extent Ichneumonidae was found to be lower where the understorey had been killed by herbicide than where it had been left unsprayed.

Goals

- Undertake biological studies of *Heteronyx* spp in Tasmania and determine the identity, phenology and impact of a novel nocturnal foliage-feeding pest, possibly a *Heteronyx* species, causing heavy defoliation in southwestern Australia.
- Provide industry with estimates of the economic impact of the major defoliating insect pests in Western Australia based on early results from exclusion trials.
- Investigate the chemical ecology in relation to mate location in *C. agricola* and laval performance in *M. privata*.
- Determine how the diversity and abundance of wasp natural enemies changes with plantation age and species composition.
- Determine the reproductive strategies used by the parasitoids of *C. agricola*.
- Determine whether *E. californica* is attracted to yellowing *P. radiata* needles or whether the insect is a contributing factor to needle yellowing.

Three pentatomid nymphs (probably *Oechalia schellembergii*) feeding upon a moribund and slowly liquefying *M. privata* larva that they have immobilised with a protease

Project C2

Leaders
Dr Rob Floyd (to December 2002)
Mr John Matthiessen (from January 2003)
Dr Geoff Allen

Staff
Dr James Bulinski
Dr Jane Elek
Dr Grant Farrell
Dr Mamoru Matsuki
Mr John Matthiessen
Ms Helen Nahrung
Dr Fredrik Östrand
Mr Vin Patel
Mr Stephen Paterson
Ms Nita Ramsden
Mr Luke Rapley
Mr Hilton Redgrove
Mr Anthony Rice
Dr Martin Steinbauer
Mr Rex Sutherland

Insect control techniques and IPM

Background

Forest managers are 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 is investigating 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.

Outcomes

- An effective control for *Heteronyx* larval feeding on the roots of newly-planted seedlings is to treat each seedling with a very small amount of insecticide at planting. Inexpensive out-of-patent insecticide can be used and the extremely localised application and small amounts makes the technique entirely consistent with best-practice integrated pest management principles.
- *E. globulus* races were screened for susceptibility to *M. privata* oviposition in an outdoor cage bioassay. Foliage from the Furneaux race was found to be twice as likely to be oviposited on compared to foliage from the Strzelecki Ranges and north-eastern Tasmania race. Foliage from the south-eastern Tasmania race received an intermediate egg lay.
- Increased levels of the foliar wax chemical, benzyl n-tetracosanoate, were found to be consistently associated with decreased *M. privata* field defoliation of *E. globulus* across four field sites in northern Tasmania.
- Host ranking assays with female *M. privata* using families of *E. nitens* have shown that Rubicon and Taronga are equally preferred for egg laying and receive more eggs than trees of a family from the southern NSW provenance. Larval survival was also higher on Rubicon and Taronga than on southern NSW.
- Field trials of a sex pheromone of *M. privata* were conducted in the ACT, Tasmania and Victoria. Unitraps (see image) baited with rubber septa treated with 1mg of triene continued to attract males for 3.5 to 4 months.
- A neem-based insecticide, Nutrineem Gold™, had significant effects on female oviposition and larval development of *C. agricola*. These included reduced fecundity, egg viability, larval survival and increased deformity in newly emerged adults.
- Specific sampling protocols, designed to improve the economic efficiency of field assessment of the pest species *Gonipterus scutellatus*, *Cadmus excrementarius*, *Chrysophtharta* spp (except *C. bimaculata*), and *M. privata* have been developed within the framework of the unified pest and pathogen assessment scheme. The sampling protocols for *G. scutellatus* were implemented by Timbercorp and WAPRES in the spring of 2002, resulting in the regional distribution of *G. scutellatus* being identified.
- In a major replicated field trial in south-western WA, *Chrysophtharta obovata* returned within 1 month and *Gonipterus scutellatus* returned within two months after spraying α-cypermethrin.

Goals

- Investigate the longer-term effects of insecticide spray on recolonisation of plantations by pest and non-pest insect species, comparing plantations sprayed with Dominex® (broad spectrum) and Success® (targeted to specific insect groups) with unsprayed areas.
- Investigate the relationship between sex pheromone trap catches of *M. privata* and the level of defoliation that will subsequently occur.
- Investigate avenues for the commercialisation of the sex pheromone lure of *M. privata*.
- Begin info-chemicals discovery research for compounds that are biologically active in scarabs that are of pest status to new plantations.

Fredrik Östrand and Georgie Brown erecting a Unitrap baited with a sex pheromone lure for *M. privata*

Project C3

Leader
Dr Clare McArthur

Staff
Mr Hugh Fitzgerald
Ms Prue Loney
Ms Julianne O'Reilly
Mr Stephen Paterson
Ms Natasha Wiggins

Resistance of planting stock to vertebrate browsers

Background

A key method for reducing browser damage to eucalypts is to produce more resistant trees. This should be achievable by genetic and phenotypic manipulation of those trees. Our research is directed at identifying resistant genotypes, developing a rapid method for estimating susceptibility as detected by leaf chemistry, and predicting susceptibility of seedlings as a function of their environment. These three aspects can be incorporated into an overall strategy for predicting and reducing browser damage of eucalypts at plantation establishment. Specific aims of this project are to:

- determine the relative damage to and preferences for various plant types by browsing herbivores;
- investigate the genetic basis of resistance of eucalypts, and the effects of environment on this resistance; and
- determine whether resistance can be modelled as a function of leaf chemistry using near-infra-red spectroscopy (NIRS). NIRS provides an indirect measure of leaf chemistry.

Outcomes

- In no choice trials, brushtail possums ate more foliage from *E. globulus* saplings than *E. regnans*. However, when offered both plant species together, possums ate less *E. regnans* foliage than under no-choice conditions, even though the total intake of foliage was greater.
- There is genetic variation between races and localities in essential oils and FPCs (formyl phloroglucinol compounds) in *E globulus* foliage. These are two characteristics that can affect intake by marsupial browsers
- Sideroxylonal was the main variable affecting intake of coppiced *E. globulus* foliage by brushtail possums. It explained 38% of the variation in intake.
- Brushtail possums preferred juvenile to adult foliage of four-year-old phase-change *E. nitens* trees when offered a choice, but were able to consume at least as much adult as juvenile foliage under no-choice conditions.

Goals

- Compare the relative contribution of genetic and environmental (nursery) effects on palatability of *E. globulus* seedlings to brushtail possums.
- Quantify the physical and chemical response of *E. globulus* and *E. nitens* seedlings to various wind and fertiliser levels, and test subsequent relative palatability to browsers.
- Determine the effect of fertiliser on variation in physical and chemical characteristics of leaves within seedlings of *E. nitens* seedlings, and relate this variation to within-seedling preferences by herbivores.

Feeding trial measuring preferences of brushtail possums for two types of foliage.

Project C4

Leader
Dr Clare McArthur

Staff
Mr Hugh Fitzgerald
Ms Alison Miller
Mr Stephen Paterson
Mr Andrew Walsh
Mr Geoff While
Ms Natasha Wiggins

Strategies to reduce vertebrate browsing damage

Background

This project addresses the problem of reducing browsing damage to seedlings using characteristics of the environment (whole plantation and its surrounding habitat) as its framework. 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 are to:

- understand the interaction between browsers and the environment, and the consequences on damage to seedlings;
- investigate the impact of vegetation immediately around a seedling on its risk of being browsed;
- develop methods for monitoring damage and predicting risk; and
- design appropriate options to reduce browsing damage through various planting strategies.

Outcomes

- Distribution of high quality food (grass) on an ex-pasture plantation affected the distribution of pademelons and Bennett's wallabies, measured by a scat survey. Macropod distribution was further constrained by distance from protective shelter, in the form of forest, at the plantation edge.
- On an ex-native forest plantation with windrows and only low quality food (bracken and fireweed), vegetation had a minor effect on the distribution of macropods. However, distribution of macropods was again constrained by distance from protective shelter, windrows in particular.

Goals

- Establish energetic costs of foraging and browsing damage by brushtail possums to *E. globulus* seedlings in monoculture versus mixed-species plantings.
- Survey plantations to determine how vegetation at various scales affects browsing damage to seedlings.
- Summarise strategies for reducing browsing damage.

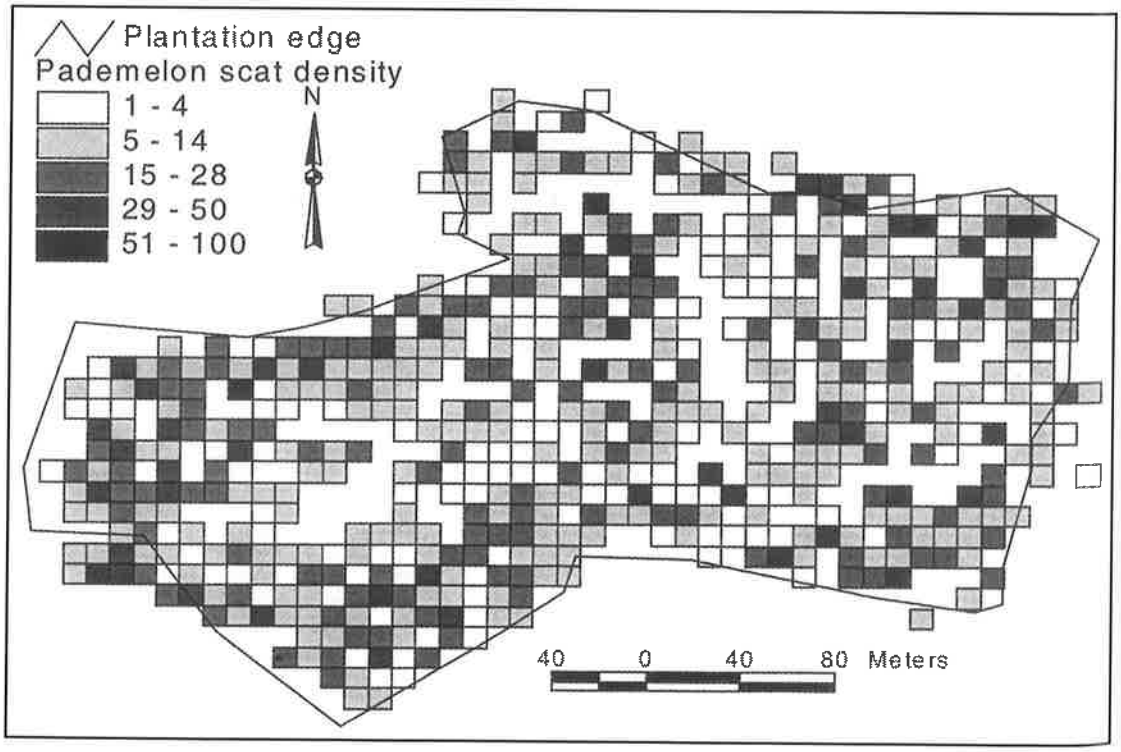


Figure 12: Map showing the distribution of pademelon scats in a plantation established on an ex-pasture site at Dunalley. The distribution of scats is related to the distribution and quantity of grass on the site.

Project C5

Leader
Dr Caroline Mohammed

Staff
Dr Karen Barry
Ms Alieta Eyles
Ms Kate Harrison
Ms Anna Hopkins
Ms Liz Pietrzykowski
Dr. Libby Pinkard
Ms Anna Smith
Ms Danielle Wiseman
Ms Marie Yee
Dr Yuan Zi Qing

Strategies to minimise loss due to fungal attack

Background

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

Prescriptions are being 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 *E. obliqua* wet sclerophyll forests.

Specific objectives are to:

- identify host, pathogen and site parameters influencing a) the risk of stem defect associated with wounding and fungal infection in *E. nitens* and *E. globulus* plantations destined for solid wood production, and b) the risk and impact on productivity of *Mycosphaerella* infections in plantations of *E. globulus* and *E. nitens*;
- For *Mycosphaerella*; a) develop a bioassay to screen for resistance to the pathogen, and b) initiate the use of remote sensing technology in eucalypt plantations to determine disease severity levels; and
- Investigate saproxylic insect and fungal ecology in different age-classes of standing trees and in decomposing coarse woody debris (CWD) of *E. obliqua* wet sclerophyll forests.

Outcomes

- Fertilised plots have a higher number of large diameter branches at pruning and a higher incidence of decay infections. There was little evidence that decay had spread out from the knotty core in plantation *E. nitens* sampled 6 years after pruning, although decay had spread longitudinally through the stem.
- Some of the secondary compounds (tannins, flavonoids and terpenes) involved in the response of *E. nitens* and *E. globulus* to stem injury and infection are also associated with tree resistance to stem damaging fungi and insects. Therefore, these compounds could be used as biochemical indicators for resistance to stem fungi, canker fungi and insects such as borers.
- In collaboration with Sustainable Management, the process-based model CABALA has been used to predict canopy wetness, a factor in spore release and germination of *Mycosphaerella*. Risk maps have been created for plantations in WA, NSW and TAS/VIC based on the climatic factors known to be favourable to *Mycosphaerella* disease.
- A plantation infected with *Mycosphaerella* has been mapped and scored for infection. Certain trees were sampled and reflectance measures taken of infected and uninfected foliage types, and other surfaces in the plantation environment. Matching our ground-based data to a Digital Multi Spectral Videographic Image will allow us to identify the spectra most effective for remotely sensing *Mycosphaerella* severity.
- Studies of *E. obliqua* trees ranging from young regrowth (70 years old), to old-growth (>150 years old) show that saproxylic (dead wood dependent) communities are extremely diverse, and highly heterogenous across the landscape, but highly susceptible to forests practices that result in the removal of large diameter logs. Regrowth forests cater for a different assemblage of beetles than old growth forests. Retaining large logs within regrowth forests will not be sufficient to cater for the fauna specific to the large logs in old growth forests.

PhD student Anna Hopkins taking samples of decayed wood from a 180 year old *E. obliqua* for a study of associated fungal assemblages

Goals

- Quantify the long-term impact of decay infections established at pruning.
- Continue ongoing molecular studies to identify decay. Test the pathogenicity of these fungi to *E. nitens* and *E. globulus*.
- Determine environmental conditions dictating spore release, fluctuations in spore inoculum load and leaf infection for the *Mycosphaerella* species present in a Tasmanian plantation site of *E. globulus*.
- Measure physiological and pathological parameters in trees with different levels of *Mycosphaerella* infection.
- Continue ongoing investigations to identify spectra that are useful for the differentiation of plantation sites with different levels of *Mycosphaerella* infection.

EDUCATION and TECHNOLOGY TRANSFER

Managers
Dr Neil Davidson
Mr Greg Dutkowski

Staff
Dr Jurgen Bauhus
Dr Rebecca Boyle
Dr Philip Brown
Dr Eleanor Bruce
Ms Jill Butterworth
Dr Dugald Close
Prof Rob Clark
Dr David Doley
Mr Richard Doyle
Dr Bill Foley
Prof Robert Henry
Dr Mark Hovenden
Dr Ryde James
Dr Greg Jordan
Prof Peter Kanowski
Prof Jamie Kirkpatrick
Dr Sinniah Mahendrarajah
A/Prof Stuart McLean
Dr Peter McQuillan
Dr Neville Mendham
Dr Libby Pinkard
Mr Digby Race
Prof Jim Reid
Dr Alistair Richardson
Dr Sergey Shabala
Prof Frank Vanclay
Dr Robert Wiltshire

Background

The Education and Technology Transfer Program coordinates:

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

The principal objectives are 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 the 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; and
- raise community awareness of CRC activities and the value to Australia of a sustainably managed forest industry.

Outcomes

Education

- There were 63 PhD, MSc and Honours students enrolled in the CRC in 2002/03. Of the postgraduate students, 11 were attracted from industry, 15 are 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). Sixteen students have CRC top-ups to APA or ARC scholarships. Only 10 were supported solely by CRC-SPF PhD scholarships (see Tables 3 and 4 for details).
- The students who completed their degrees in this financial year (2002/03) were:- in the Genetic Improvement Program: Peter Bundock PhD, Michelle McGranahan PhD, Susan Foster (Hons); in the Sustainable Management Program: Tim Blumfield PhD, Sven Ladiges PhD, Tim Tabart MSc, Tim Watson (Hons), Stuart Fenech (Hons); in the Resource Protection Program: Kirsten le Mar PhD, Tim Wardlaw PhD, Helen Nahrung PhD, Geoff While (Hons), Andea Witt (Hons).
- Students who submitted a thesis for examination in 2002/03 were:- Grant Westphalen PhD, Andrew Gibbons PhD, Dominic Kain PhD, Daryl Mummery PhD and Alieta Eyles PhD.
- New students in 2002/03 were:- Alison Miller PhD, Matthew Hamilton PhD, Katherine Harrison PhD, Damien Rathbone (Hons), Djirilina Burton (Hons), Cameron Shield (Hons), James Worth (Hons)
- One of the CRC's PhD students received a major award this year. Julianne O'Reilly-Wapstra won the Forest and Wood Products Research and Development Corporation sponsored AFFA Science and Innovation Awards for Young People in 2002. The title of the project was 'Breeding for resistance in *Eucalyptus globulus* to mammalian herbivores: the role of genetics and secondary plant chemistry'.
- Mr James Worth received the Genetics Honours Scholarship for his project at the University of Tasmania.
- Supervision of postgraduate and honours students is widely distributed amongst CRC partner institutions such that 41 of the 72 supervisors of Honours, MSc and PhD projects were not staff of Australian university departments (see Table 5 for details).

Julianne O'Reilly-Wapstra holding her AFFA Science and Innovation Award.

Table 3: CRC-SPF Research Students

First Name	Second Name	Degree	Funding	Start	Uni	Project	Supervisors	Program
Paul	ADAMS	PhD	LWRDC	1996	UT	Sources of competition from weeds in plantations	Dr N Mendham, Dr C Beadle, Dr P Smethurst	SM
Sue	BAKER	PhD	APA/CRC	2000	UT	Conservation of beetles in managed forests	A/Prof A Richardson	RP
Robert	BARBOUR	PhD	CRC	2000	UT	Gene flow between plantations and native forest	A/Prof B Potts, Dr R Vaillancourt	GI
Djirlina	BURTON	Hons		2003	UT	Effect of wind and nutrients on seedling characteristics and palatability	Dr C McArthur, Dr D Close	RP
Joanne	BURTON	PhD	GU/CRC	2002	GU	Links between carbon and nitrogen cycling processes in forest ecosystems	Dr Z Xu, Dr H Gharibi, Dr S Boyd, Prof J Hughes	SM
Paul	DARGUSCH	MSc		1997	UT	Physical, social and economic barriers to the adaptation of farm forestry in NE Tasmania	Prof R Clark, Ms A Fulton	SM
Greg	DUTKOWSKI	PhD	Ind staff	1996	UT	Improvement of mixed models for prediction of breeding values in forestry	A/Prof B Potts, Dr A Gilmour	GI
Alieta	EYLES	PhD	APA/CRC	1999	UT	Role of kino in anti microbial defences of *E. globulus*	Dr C Mohammed	RP
Jules	FREEMAN	PhD	UT/CRC	2001	UT	Linkage mapping and QTL analysis of *Mycosphaerella* resistance in *Eucalyptus globulus*	Dr R Vaillancourt, A/Prof B Potts, Dr D Steane	GI
Andrew	GIBBONS	PhD	CSIRO	1998	UT	Effect of intensive forest management on understorey and fauna in *E. delegatensis*	Dr M Battaglia, Dr R Wiltshire	SM
Carl	GROSSER	PhD	SPIRT/ARC	1999	UT	Seed quality and paternity analysis in *E. nitens* in seed orchards	Dr R Vaillancourt, A/Prof B Potts	GI
Matthew	HAMILTON	PhD	UT/CRC	2003	UT	Breeding methodologies for improving *E. nitens*	A/Prof B Potts, Dr L Apiolaza, Dr C Harwood	GI
Katherine	HARRISON	PhD	CRC	2002	UT	Invertebrate assemblages associated with habitat features in *E. obliqua* forests of S Tas	Dr C Mohammed, Dr S Groves	RP
Craig	HAWKINS	MSc	Ind staff	1998	UT	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
Kate	HOORWEG	Hons		2002	ANU	Palatability of tropical and subtropical eucalypts to larvae of autumn gum moth	Dr M Steinbauer, Dr W Foley	RP
Anna	HOPKINS	PHD	APA/CRC	2002	UT	Ecologically sustainable forest management: course woody debris	Dr C Mohammed, Dr S Groves	RP
Megan	JONES	PhD	SFNSW	1999	SCU	Gene flow and genetic diversity of hardwood plantations in NSW	Dr M Shepherd, Prof R Henry, Prof A Delves	GI
Tim	JONES	PhD	SPIRT/ARC	2000	UT	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	UT	K and Mg uptake by eucalypts and pines.	Dr S Shabala, Dr P Smethurst, Dr P Brown	SM
Sharon	KOH	PhD	CRC	2002	UT	Mathematical modelling of tree growth	Dr P Sands, Prof L Forbes, Dr M Battaglia	SM
Peter	KUBE	PhD	Ind staff	1996	UT	Breeding objectives for the production of sawlogs and pulpwood from plantation grown *E. nitens*	Dr C Raymond, Prof J Reid	GI
Sven	LADIGES	PhD	CRC	1996	UT	Micronutrient deficiencies in eucalypts induced by excess application of N & P	Prof R Menary, Dr C Beadle	SM
Andrew	LAIRD	Hons		2002	UT	Differences in photoinhibition, and protective pigments and waxes amongst eucalypts	Dr N Davidson, Dr D Close	SM
Prue	LONEY	PHD	CRC	2002	UT	Plant defences against mammalian browsing	Dr C McArthur, Dr G Jordan	RP
Marian	LORKIN	PhD	APA/CRC	2000	UT	Reproductive biology of *Eucalyptus*	A/Prof B Potts, Dr R Vaillancourt	GI
Gay	McKINNON	PhD	ARC	2000	UT	Molecular evolution of eucalypts	Dr R Vaillancourt, A/Prof B Potts, Dr D Steane	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	UT	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	UT	Foraging by herbivores in relation to vegetation patchiness	Dr C McArthur, Dr P Smethurst	RP/SM
Daryl	MUMMERY	PhD	CSIRO	1999	UT	Using landscape models to enhance plantation yield predictions	Dr E Bruce, Dr M Battaglia, Dr P Ryan	SM
Helen	NAHRUNG	PhD	APA	1999	UT	Biology and phenology of *Chrysophtharta agricola*	Dr G Allen	RP
Mark	NEYLAND	MSc	Ind staff	1996	UT	Alternative silvicultural systems for regenerating native forest	Dr N Davidson, Dr C Beadle, Mr J Hickey	SM
Megan	NOSOVICH	PhD	ARC	2003	GU	Links between carbon and nitrogen cycling processes in forest ecosystems	Dr Z Xu, Dr S Boyd, As/Prof P Healy	SM
Chris	O'HARA	PhD	APA/CRC	1998	ANU	Phosphorus fractions in forest soils	Dr J Bauhus, Dr D Khanna, Dr J Raison, Dr P Smethurst	SM
Julianne	O'REILLY-WAPSTRA	PhD	UT/CRC	2000	UT	Genetic and chemical resistance of *E. globulus* and *E. nitens* to mammalian herbivores	Dr C McArthur, A/Prof B Potts	RP
Ross	PEACOCK	PhD	Ind staff	1994	UT	Regeneration after cable logging	Dr N Davidson, Dr M Brown	SM
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	UT	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	UT	Lignin biosynthesis in *Eucalyptus globulus*	Prof J Reid, Dr R Vaillancourt	GI
Rebecca	PRYOR	MSc	CRC	2002	UT	Waterlogging of *Eucalyptus globulus*	Dr N Davidson, Dr M Battaglia, Dr D Close	SM
Luke	RAPLEY	PhD	UT/CRC	2000	UT	Genetic variation in susceptibility of eucalypts to insect attack	Dr G Allen, A/Prof B Potts	RP/GI
Damien	RATHBONE	Hons		2003	UT	Population genetics of *Eucalyptus perriniana*	A/Prof B Potts, Dr R Vaillancourt, Dr D Steane	GI
Hilton	REDGROVE	PhD	APA-I	2003	UT	The ecology of *Heteronyx spp.* beetles: establishment pests of eucalypt plantations	Dr G Allen, Dr M Hurley, Dr P McQuillan, Dr D deLittle	RP
Anthony	RICE	PhD	APA	1999	UT	The ecology and host interactions of the larval parasitoids of *Chrysophtharta agricola*	Dr G Allen	RP
Carolyn	RINGROSE	MSc		1999	UT	N mineralisation in annually N-fertilised plantations	Mr R Doyle, Mr W Neilsen, Dr P Smethurst	SM
Jackie	SCHIRMER	PhD	APA/CRC	2000	ANU	Evaluating the 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 Dieters, Dr G Nikles	GI
Cameron	SHIELDS	Hons		2003	UT	Effect of frost and photoinhibition on the altitudinal cline in *E. urnigera*	Dr R Wiltshire, Dr N Davidson, Dr D Close	SM
Anna	SMITH	PhD	APA/CSIRO	2002	UT	Risk and impact of *Mycospheaella* in plantations of *E. globulus* and *E. nitens*	Dr C Mohammed, Dr C Beadle, Dr M Battaglia	RP/SM
Diane	SPURR	MSc	CRC	1999	UT	Above-ground nitrogen dynamics in *E. nitens*	Dr P Smethurst, Dr M Hovenden	SM
Tim	TABART	MSc		1998	UT	Achieving sustainable economic development through collaborative community decision-making	Prof R Clark, Ms A Fulton	SM
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
Greg	UNWIN	PhD	Ind staff	2000	UT	Response of tropical rainforest trees to stress	Dr N Davidson, Prof J Reid, Prof J Kirkpatrick, Dr C Beadle	SM
Grant	WESTPHALEN	PhD	CRC	1996	UT	Indicator species for sustainibility in native forest systems	Dr M Brown, Mr J Hickey, Dr N Davidson	SM
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	UT	Breeding for sustainability in *Eucalyptus globulus*	Dr L Apiolaza, A/Prof B Potts	GI
Natasha	WIGGINS	PhD	UT/CRC	2002	UT	Feeding behaviour in brushtail possums	Dr C McArthur, A/Prof S McLean, Dr R Boyle	RP
Danielle	WISEMAN	PhD	APA-I	2001	UT	Pathology and physiology of pruned *E. globulus*	Dr C Mohammed, Dr C Beadle, Dr E Pinkard	RP/SM
James	WORTH	Hons		2003	UT	Population genetic studies of *Nothofagus cunninghammii*	Gr G Jordan, Dr R Vaillancourt	GI
Marie	YEE	PhD	APA/CRC	1999	UT	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

Table 4: Student enrolments and funding source

Number of Students			Funding	
			CRC Scholarship	10
Total number of students		63	APA Scholarship	3
			CRC top-up of APA Scholarship	10
			FFIC top-up of APA Scholarship	1
Full/PartTime:	Full Time	53	CSIRO top-up of APA Scholarship	1
	Part Time	10	ARC	4
			APA-I	3
			SPIRT/ARC	4
Degree	Hons	6	UT/CRC top up	5
	MSc	8	GU/CRC top up	1
	PhD	49	CSIRO	2
			Industry (CRC partners)	1
			Industry staff doing PhD	6
CRC Programs	Genetic Improvement	19	LWRDC	1
	Sustainable Management	27	FWPRDC	1
	Resource Protection	17	SFNSW	1
			unfunded MSc	3
			unfunded Hons	6
			Total	63

Fernando Droppelmann, (3rd right) from the Chilean Eucalypt Breeding Cooperative and Carlos Contardo (2nd left) and Jaime Zapata from Bioforest, Chile visited the CRCSPF in November 2002 to inspect eucalypt hybrid trials and seed production systems. They are seen here with Briony Patterson, Peter Gore (SeedEnergy), Luis Apiolaza, Rene Vaillancourt and Yongjun Li of the CRC-SPF visiting SeedEnergy's E. globulus seed production facility near Hobart.

- Seven CRC scientists, who are not staff of university departments, contributed to 11 university courses in fields allied to their research, involving 481 students: Dr N Davidson in 'Plant Ecology' (UT, 46 students), Dr C McArthur in 'Fisheries and Wildlife Management' (UT, 52 students), 'Zoology II (Animal Form and Function)' (UT, 70 students) and 'Tasmanian Fauna - Ecological and Evolutionary Studies' (UT, 50 students), Dr P Smethurst in 'Soil Fertility' (UT, 18 students), A/Prof B Potts in 'Molecular Evolution' (UT, 25 students) and 'Botany of Tasmania' (UT, 18 students), Dr Z Xu in Land and Water (GU, 80 students), Dr Martin Steinbauer in 'Insect Management for Forestry' (ANU, 12 students), Dr Dorothy Steane in 'Botany 2' (UT, 85 students) and 'Molecular Evolution' (25 students). Dr Neil Davidson coordinates a four-year undergraduate course, 'Forest Ecology', designed for students with an interest in forestry at the University of Tasmania.

- Thirteen postdoctoral fellows worked with the Centre in 2002/03: Dr R Thumma in molecular genetics (CSIRO FFP, Canberra), Dr M Steinbauer in entomology (CSIRO Ento, Canberra), Dr M Shepherd in molecular biology (SCU, Lismore), Dr D Close in tree physiology (UT and CSIRO FFP, Hobart), Dr N Prasolova on soil nutrition (GU, Brisbane), Dr D Steane and Dr B Patterson in molecular genetics (UT, Hobart), Dr F Henskens on canopy nitrogen dynamics (CSIRO FFP, Hobart), Dr A O'Grady in root biomass turnover (CSIRO FFP, Hobart), Dr A Mitchell (CSIRO FFP, Hobart) on availability of base cations, Dr Jane Medhurst (CSIRO FFP, Hobart) on Blackwood silviculture, Dr Karen Barry on tree pathology (CSIRO FFP, Hobart), and Mamoru Matsuki on insect ecology (UT, Hobart).

Table 5: Supervisors and the number of CRC students they supervised

Supervisors					
Dr G Allen UT	5	Prof L Forbes UT	1	Dr A Muneri* QFRI	1
Dr L Apiolaza UT/FT	2	Ms A Fulton* Consultant	2	Mr W Neilsen* FT	1
Dr P Barker* NPWS	1	Dr A Gilmour* NSW Ag	1	Dr G Nikles* QFRI	1
Dr M Battaglia* CSIRO FFP	5	Dr H Gharidi GU	1	Dr E Pinkard* UT	2
Dr H Bauhus ANU	1	Dr S Groves* FT	2	Dr J Phillips GU	1
Dr C Beadle* CSIRO FFP	7	Dr C Harwood* CSIRO FFP	1	A/Prof B Potts* CRC/UT	13
Dr S Boyd GU	2	Dr K Harding* QFRI	2	Dr J Raison* CSIRO FFP	1
Dr R Boyle UT	1	A/Prof P Healy GU	1	Ms C Raymond* CRC/State Forests NSW	1
Dr M Brown* Forestry Tas	2	Prof R Henry SCU	2	Prof J Reid UT	3
Dr P Brown UT	1	Mr J Hickey* FT	2	Dr A Richardson UT	2
Dr E Bruce UT	1	Dr M Hovenden UT	1	Dr H Ross ANU	1
Prof R Clark UT	2	Ass Prof J Hughes GU	4	Dr P Ryan* QFRI	1
Dr D Close* UT	4	Dr M Hurley* U Melb	1	Dr P Sands* CSIRO FFP	1
Dr P Cooper ANU	1	Dr G Jordan UT/CRC	2	Dr S Shabala UT	1
Dr N Davidson* CRC/UT	7	Prof P Kanowski ANU	2	Dr M Shepherd* CRC	2
Prof A Delves SCU	1	Dr P Khanna* CSIRO	1	Dr P Smethurst* CSIRO FFP/CRC	6
Dr M Dieters* QFRI	2	Prof J Kirkpatrick UT	1	Dr F Smith* CSIRO Plant Industry	1
Dr P de Barro* CSIRO Entomology	1	Dr B Li** NCSU (USA)	1	Dr D Steane* CRC	3
Dr D de Little* Forest Health Consultant	2	Dr C McArthur* CRC/UT	5	Dr M Steinbauer* CSIRO ENT/CRC	1
Dr D Doley* UQ retired	1	A/Prof S McLean UT	1	Dr R Taylor* NTPWC	1
Dr S Dovers U Melb (Creswick)	1	Dr P McQuillan UT	1	Dr R Vaillancourt UT	10
Mr R Doyle UT	1	Prof R Menary* UT retired	1	Dr H Wallace USC	1
Dr R Floyd* CSIRO Ento	1	Dr N Mendham UT	1	Dr R Wiltshire UT	3
Dr W Foley ANU	1	Dr C Mohammed UT/CSIRO	8	Dr Z Xu* QFRI	4

* Supervisors who are not university departmental staff	= 37
** International supervisors	= 1
University departmental supervisors	= 34
Total	= 72

- The CRC hosted eight visiting scientists and a group of Chilean foresters during 2002/03.

Genetic Improvement Program

- Prof Wickneswari Ratnam, from the School of Environmental and Natural Resource Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia visited the CRC from April- September 2003 to work with Dr Rene Vaillancourt on 'Analysis of cambial region and developing xylem cDNA libraries for *Acacia mangium* x *Acacia auriculiformis* hybrids and development of molecular markers for lignin genes for selection and manipulation'.
- Dr Dianna Percy, from the UK Leverhulme Trust (visiting CSIRO, Entomology) visited the CRC in January 2003 to work with A/Prof Brad Potts on 'psyllid communities on natural and artificial eucalypt hybrids'. Dianna uses sound recordings to identify psyllid species.
- Foresters from the Chilean Eucalypt Breeding Cooperative (Fernando Droppelmann) and Bioforest, Chile (Carlos Contardo and Jaime Zapata) visited the CRCSPF in November 2002 to inspect eucalypt hybrid trials and seed production systems. In April 2003, two Chilean wood scientists from INFOR, Gonzalo Hernandez and Jorge Cabrera, visited the CRC.

Sustainable Management Program

- Dr Mel Tyree, from US Forest Service, North Eastern Forest Experiment Station, visited the CRC from May 1-15 2003 to work with Dr Mike Battaglia and Dr Tony O'Grady on 'Assessment of tree hydraulic conductance'.
- Prof Richard Fisher, Manager of Forest Research and Productivity, Temple-Inland Forest, Diboll, Texas, USA, visited the CRC from 28/10/02 to 21/11/02 to work with Dr Zhihong Xu at QFRI and attend EucProd 2002 in Hobart. He conducted collaborative research with scientists in B2 project on the management of tropical soils and presented seminars on industrial forestry in the southern US and 'Is forest certification the answer?'
- Prof Ann Hagerman, from Miami University, Oxford, Ohio visited the CRC from 1/5/03 to 31/7/03 to work with Dr Dugald Close and Dr Clare McArthur (RP) at UT on 'Biological antioxidants and the effects of plant phenolics on mammalian feeding'.

Resource Protection Program

- Dr Glenn Iason, from The Macaulay Land Use Research Institute, Aberdeen, Scotland worked with Dr Clare McArthur and Natasha Wiggins at UT on 'Diet diversity and tree selection by vertebrate browsers' for two months from Dec 2002 to Jan 2003.
- Prof Francis Schwarze from Albert-Ludwigs University Freiburg, Germany visited the CRC during the period Sept 22-26 2002 and worked with Dr Caroline Mohammed at CSIRO FFP Hobart on 'Risk assessment and description of decay defects associated with pruning *E. globulus* and *E. nitens* subject to different fertiliser regimes'.
- Dr Fredrik Östrand from Lund University, Lund, Sweden, visited the CRC from July 2002 to August 2003 to work with Martin Steinbauer at CSIRO Entomology Canberra on the improvement and efficacy of the sex pheromone of autumn gum moth.

Technology Transfer

Increased use and uptake of CRC research results by industry partners has been facilitated by the development of the following specific technology transfer packages:

- The first stages of a eucalypt seed orchard manual were completed. Following a review by clients, the project was extended to include medium priority modules due for completion by August 2003.
- Systems developed to enable effective and low cost monitoring of mammal browsing damage are being tested by Forestry Tasmania. The system features site stratification and structured reconnaissance to reduce the cost of assessment where damage is low. It allows low-cost, timely and accurate decisions to be made about the need for control measures.
- A system has been developed for the inventory of basic density in *E. globulus* plantations. The system allows collection of data in a variety of ways and features the estimation of both the mean and accuracy of basic density measurement in large plantations. A pilot project using the system was carried out with three industry partners – WAPRES, Timbercorp and Grand Ridge Plantations.
- The CRC has run a series of development courses for farm forestry professionals using National Heritage Trust funding under contract to Private

Forests Tasmania. Courses have been offered in environmental management systems and soils identification, and further courses are currently being planned.

- A comparative analysis of the nutrition management systems of CRC partners has allowed the identification of technology transfer strategies for this area of research.
- As well as the specific major projects, a technology transfer plan has been developed for each research project. The plans are stored in a calendar of events that is easy to monitor and update.
- To improve communication between industry and scientists a series of small industry projects were initiated. Scientists spent a week with an industry partner working on projects of direct benefit to the industry partner. Projects covered the areas of seed orchard management, racial classification of an *E. nitens* breeding program founder parents, analysis of browsing mammal spotlighting data, evaluation of coppice management options, and development of seedling specifications.
- A new Member's Web Site was launched with the aim of capturing all CRC events and output so that there is a "one-stop-shop" for all CRC information (see 'Major Development').
- The CRC ran a number of major events this year (see Table 6).
- The CRC ran a wide range of technology transfer activities for partners during 2002/03. There were 170 public presentations, which included 77 conference and symposium presentations and 27 seminars. In addition the CRC ran 4 workshops, 5 short course and 2 field days. The CRC produced 39 technical publications, 29 of which were in the CRC Technical Publication series, and 25 flash sheets ('Hot Off the Seed Bed', 'Beyond the Black Stump' and 'Pest Off'), and 7 articles in partner newspapers and news sheets.
- The CRC produced 268 publications in 2002/03. These included 4 book chapters, 122 refereed journal articles (88 published and 34 in press), 129 unrefereed publications (65 in public arena and 64 confidential) and 13 theses.
- In the last year there have been 7 articles in newspapers and industry news sheets, and 17 items in the electronic media, including 5 TV segments relating to Centre activities (see 'Media activities' in Public Presentations).
- Documented visits to individual CRC partners and between nodes of the CRC (Hobart, Canberra, Brisbane, Gympie) total 228 person-days for 2002/03.

Goals

- Maintain rates of completion of PhD projects in 2003/04.
- Raise the profile of the CRC in the media.
- Continue to develop technology transfer packages (CRC technology presented in a readily usable form) as an important method of transferring outcomes of CRC research to industry.
- Continue to package generic technology arising from CRC research in a form that is most useful to other end users of CRC technology (e.g. farmers, farm foresters, nurserymen, forestry consultants).

Table 6: Major events run by the CRC in 2002/3

Event	Program	Dates
'EucProd', an international conference on factors that influence the growth and productivity of eucalypts	Sustainable Management	10-15 November 2002
Midlands Field Day: 'The trick to establishing trees in the Midlands in areas suffering rural tree decline'	Sustainable Management	27 June 2003
'An Introduction to Tasmanian Forest Soils', a short course for farm forestry professionals	Sustainable Management	25 October and 11 December 2002
'Certification and Environmental Management Systems', a short course for farm forestry professionals	Sustainable Management	5 and 6 December 2002
STEPS Training, a course demonstrating use of the STEPS decision support system	Sustainable Management	28 February 2003
'GenResFest', a workshop discussing breeding for pest resistance	Genetic Improvement	25 February 2003
'LossFest', a workshop discussing causes of loss in productivity and wood quality	Resource Protection	26 February 2003
'InFest', a workshop discussing research findings on *Eucalyptus* leaf beetle *Chrysophtharta agricola*	Resource Protection	15 October 2002
'NutFest', a field day demonstrating nutrient studies in southern Tasmanian eucalypt plantations	Sustainable Management	19 June 2003
'Site Productivity Estimation Workshop', a workshop demonstrating use of CRC models ProMod, CABALA and 3 PG	Sustainable Management	9-11 July 2002
LAI Guide Training, a course demonstrating use of the 'Visual Guide to estimating Leaf Area Index of Eucalypt Plantations'	Sustainable Management	various dates
'An Introduction to Quantitative Genetics Analysis', a course demonstrating use of statistical methods and ASREML software	Genetic Improvement	26-28 September 2002
Hoop Pine Field Day, a field day demonstrating fertiliser and compaction trials in plantations	Sustainable Management	18 March 2003

UTILISATION AND APPLICATION OF RESEARCH

Strategy for the technology transfer program

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

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

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

2. *Early transfer of results*

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

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

   A full list of technology transfer activities conducted by the CRC can be found on the CRC-SPF website http://www.forestry.crc.org.au and major activities are outlined in Outcomes in the Education and Technology Transfer section.

Major and ongoing technology transfer projects are:

- Eucalypt seed orchard manual
- Wood quality inventory
- Pest monitoring protocols
- Insect activity database

Numerous smaller projects are negotiated with individual partners, such as training in the use of LAI, or quantitative genetics training.

Technology transfer plans are implemented for each research project. The plans are stored in an on-line database, which allows easy monitoring and updating, as well as feeding an on-line calendar of events.

The technology transfer team has also worked at making existing research information more easily available. A new Member's Web Site was launched with the aim of capturing all CRC events and output so that there is a "one-stop-shop" for all CRC information. The system offers 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 are however only available to groups nominated by the author so that intellectual property rights can be managed (see 'Major Development').

Technology transfer also occurs through training provided by the CRC to its postgraduates. Recent PhD graduates transfer new technology to their employers. There are currently 9 company staff enrolled in PhD and MSc courses while still employed: Peter Kube (Tree Breeder, Forestry Tasmania); Ross Peacock (Research Scientist, Dept. Planning, NSW); Craig Hawkins (Forester, Gunns Limited); Mark Neyland (Research Officer, Forestry Tasmania); Daryl Mummery (Experimental Officer, CSIRO FFP); Andrew Gibbons (Technical Officer, CSIRO FFP); Greg Unwin (Lecturer in Farm Forestry, UT); Paul Adams (Forest Nutritionist, Forestry Tasmania) and Greg Dutkowski (Technology Transfer Officer, CRC-SPF). A further 15 students are conducting research on scholarships supported by industry (APA-I, SPIRT/ARC, CSIRO, CRC Industry partners, LWRDC, FWPRDC, SFNSW).

The employment of students in industry is an important and effective form of Technology Transfer. The success of our students in

obtaining employment in the forest industry was demonstrated by appointments this year: Dr Dean Williams (Tree Breeder, Forestry Tasmania), Dr Peter Volker (Manager, Plantation Program, Forestry Tasmania), Dr Helen Nahrung (Postdoctoral Fellow Qld Uni technology, Qld), Dr Tim Blumfield (Postdoctoral Fellow, GU), Dr Tim Wardlaw (promoted to Manager, Native Forests Branch, Forestry Tasmania), Dr Jane Medhurst (Postdoctoral Fellow, Swedish University of Agricultural Sciences, Upsala, Sweden), Dr Libby Pinkard (Postdoctoral Fellow, CSIRO FFP), Dr Nicole Mathers (Research Fellow, GU).

Industrial Uptake

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

Genetic Improvement Program

- A eucalypt seed orchard manual covering aspects of design and management has been produced for partners. High priority modules were produced and medium priority modules identified for production.
- A marketing standard for *Eucalyptus globulus* seed trees has been developed with WAPRES and seedEnergy. The system is based on STBA breeding values.
- Outcrossing rates have been monitored in an operational *E. globulus* seed orchard by one of our partners (WAPRES) and self-incompatibility screening is continuing following the demonstration that this is one of the major factors affecting outcrossing rates in *E. globulus*.
- The demonstration of hybridisation between exotic *E. nitens* plantations and native forest species has resulted in partners and government agencies (Forest practices) starting to address this issue in their environmental management policies.
- Breeding values for *Mycosphaerella* resistance, calculated while studying the genetic control of the disease resistance in a Gunns Ltd *E. globulus* trial, have been transferred to the industrial partner for breeding purposes.
- CRC representation on the STBA Board (Greg Dutkowski, Sandra Hetherington), and on the Technical Committee, and Research, Quantitative Genetics and Data Management Sub-Committees (Luis Apiolaza and René Vaillancourt), has assisted in the transfer of technology from the program to this partner.
- The CRC has continued to provided specialist support to the STBA in the estimation of genetic parameters for *E. globulus* and *P. radiata*, to be used in the national genetic evaluations of both species. The year has seen the first generational use of TREEPLAN evaluation software, developed with assistance from CRC scientists.
- Training in the use of ASREML software has been provided for industry partners and students. An on-line resource of examples called "ASREML cookbook" has been produced.
- In QDPI, quality control of tropical pine breeding and propagation material continues to utilise DNA fingerprinting methodology developed within the CRC.
- Computer simulation of hybrid breeding strategies indicated that the development of a stable composite (or synthetic) hybrid, by selection within hybrid progeny and subsequent recurrent cycles of mating and selection, will deliver the greatest genetic gain per year when the genetic correlation between pure and hybrid progeny is not negative. Reciprocal recurrent selection schemes delivered less gain, however were more "stable" delivering genetic gain across a wide range of genetic architectures. These results have been used to support a change in the hybrid breeding strategy applied to the genetic improvement of *Pinus elliottii* x *P. caribaea* var. *hondurensis* in Queensland to a composite breeding strategy. The details of this new breeding strategy will be formalised in 2003/04.
- Breeding values were updated for *P. elliottii* x *P. caribaea* var. *hondurensis* hybrids, using data from all F1 and F2 progeny and clonal tests. These breeding values were used to nominate clones for: 1) inclusion in a new seed orchard to produce wind-pollinated F2 hybrid seed; 2) update the crossing program for the production of the hybrid families that will be included in future clonal tests; and 3) nomination of clones that will form the founders of the composite hybrid breeding program in Queensland.
- Experimental results (Dominic Kain's PhD research) have demonstrated that indirect assessment of wood density and spiral grain angle using assessments in bark windows is highly correlated to results obtained from 12mm cores. Therefore, it has been decided to adopt bark window assessments, using a Pilodyn and Spiralite, as a first-stage screening tool for the assessment of wood properties in tests of *P. elliottii*

x *P. caribaea* var. *hondurensis* hybrid clones. This work will commence in early 2004. Core samples will then be collected from the most promising clones for more detailed analysis using Silvascan.

Sustainable Management Program

- Forestry Tasmania is expanding their N fertilisation program across their eucalypt plantation estate.
- Potassium has been included in some fertiliser recommendations used by Private Forests Tasmania for ex-pasture sites.
- Residue retention is being tested on an operational scale by QDPI; they are also exploring the feasibility of applying N fertilisers on very deficient sites.
- Adoption of the LAI Visual Guide for estimating canopy size has been extended to all parts of the Centre.
- New seedling specifications that were developed with Timbercorp have been tested in a range of planting environments.
- Private Forests Tasmania has widely distributed the latest version of the Farm Forestry Toolbox that includes a decision support tool based on ProMod.
- Training in the use of ProMod as a tool for evaluating regional variation in yield was undertaken for WAPRES staff.
- New empirical growth models were developed with WAPRES staff.
- The dynamic site productivity model CABALA is being used to predict options for thinning in pulpwood and solid wood plantations.
- A STEPS roadshow that included workshops for 30 participants in north and south Queensland and Tasmania was undertaken to provide training in the use of this software.
- Queensland's DPI Forestry has been using STEPS throughout the past year to perform economic analyses of exotic pine plantation resources at Byfield, and south-east regions. They will begin reviews in the *Araucaria cunninghamii* resource in the short term. Results from the software have been guiding policy decision-making for the organisation.
- Statistical and modelling advice has been provided to various CRC partners.

Resource Protection Program

- Forestry Tasmania has been testing integrated methods of monitoring and managing browsing damage on plantations.
- Application of fertilizer to increase vigour and resistance to *Mycosphaerella* is being tested by Forestry Tasmania.
- Photos of disease ratings for *Mycosphaerella* leaves have been included into a manual for crown damage assessment for plantation eucalypts.

STAFFING AND ADMINISTRATION

The CRC-SPF underwent its Fifth Year Review during this financial year. A summary of the outcomes is given here.

Fifth Year Review Stage 1 Report

Stage 1 of the 5th year review of CRC-SPF (covering the quality and relevance of the research) was undertaken from 30 July to 3 August 2002 by Prof Roger Sands, Dr Stephen Verryn and Dr Steven Cork, assisted by the CRC Visitor Dr Max Whitten. Visits were made to both major nodes of the CRC - Brisbane and Hobart - and representatives from other locations were present at the discussions. Formal presentations were given by Program Managers followed by open fora with Project Leaders, researchers and students.

The Panel reported very favourably. Among other things, they concluded that:

- '... the quality of research was high across all programmes, and outstanding in some projects. All projects reported substantial publication records and postgraduate students featured prominently in authorship. CRC-SPF researchers have an impressive record of presentation at national and international conferences and the CRC-SPF has organised several successful international conferences. International scientists have been attracted to work in the CRC-SPF. It is clear that the CRC-SPF enjoys an excellent international reputation for quality research.'

- 'The industry partners in the CRC-SPF are highly satisfied with research performance and outcomes. The CRC-SPF has a formal 'signing- off' process for each deliverable by the industry partners and has various mechanisms to ensure that the technologies that are developed are transferred to industry partners. There are many examples of research outputs being successfully delivered to industry. A tangible indication of the degree of industry satisfaction is their willingness to increase their support if the CRC-SPF continues beyond the scheduled termination date of 2004, or should another CRC be initiated for their forestry needs. A recent economic analysis by the Centre for International Economics concluded that research by the CRC-SPF will yield substantial economic benefits for industry. This positive finding supports the Panel's conclusions about quality and relevance of research by the CRC-SPF.'

- 'All research programs planned and documented their achievements against objectives, outcomes and milestones. The Panel is satisfied that the stated performance criteria have been satisfactorily met and, in some cases, considerably exceeded.'

- 'The research by postgraduate students is central to the research performance of the CRC-SPF. The quality and commitment of postgraduates and their research output is excellent. The morale and motivation of the students is very high, and there is a unanimous feeling among the postgraduates that they are privileged to be an integral part of the CRC. They feel they receive quality supervision and superior support and facilities than students who are not part of a CRC.'

Fifth Year Review Stage 2 Report

The CRC Committee's Expert Panel has examined the report of the Stage 1 Review (CRC research program) conducted by Roger Sands, Stephen Verryn and Steven Cork in July - August 2002, and the further documentation provided by the CRC for Stage 2 (overall management of the CRC).

Overall, the Panel found that: 'CRC SPF has demonstrated that it has added considerable value to production forests in Australia and the Stage 1 report and external economic analysis indicate that there is considerable potential strategic value in ensuring a continuation of cooperative research in this area' and 'noted that this CRC has a number of strengths and no apparent weaknesses. It has excellent Education and Training activities and the involvement of industry in virtually all levels of activity provides for good collaboration and communication. SMEs are heavily involved as core and non-core partners and also collaborators.'

On strategic direction: 'The only issue which could be questioned is apparent lack of attention in the development of CRC objectives relating to the impact that plantation development has on issues such as catchment management, runoff, water quality, and other systems wide impact of forestry production on natural resource management. There is some evidence of working with other CRCs in this respect.'

The Panel reiterated the conclusions of Sands, Verryn and Cork about the quality of CRC research, i.e. *high across all programs and outstanding in some projects.* They also noted 'that industry appears to be satisfied with research quality and relevance.' and 'international linkages are strong and the large number of collaborative projects with significant international forestry research centres indicates that much of the

research is in the world's best category and highly relevant to other countries with similar forestry potential and problems.'

Membership

During 2002/03 Serve-Ag ended their membership of the CRC.

Staff

All research staff of the CRC are listed in attachment B under their member organizations.

Staff movements

Professor Robert Henry from Southern Cross University took up duty as Deputy Director in May 2003 to replace Dr Russell Haines. Robert has been Project Leader of the Molecular Genetics Improvement Project at Southern Cross since the beginning of the CRC-SPF and has a long involvement with the Genetic Improvement Program. Jeremy Brawner moved from the USA to commence duty in the Hybrid Breeding Project as a Geneticist at QFRI. Dominic Kain commenced a short-term contract at ANU to assist the hybrid Breeding project. Dr Tim Blumfield completed his PhD and started a contract as Research Fellow at Griffith University in the Management of Tropical Soils Project. Dr Nicole Mathers completed a three-month contract at Griffith University as a Research Fellow. Dr Luis Apiolaza resigned from his position as Quantitative Geneticist to move to Forestry Tasmania. Dr Chris Harwood took over as Project Leader in the Wood Quality Project A5 from Dr Carolyn Raymond, who left to take up a position in State Forests NSW. Leon Savage resigned as a technician in Wood Quality to take up a position with Gunns Ltd. Kylie Groom resigned from her position as a technician in Molecular Genetics in Canberra. Dr John Matthiessen replaced Dr Rob Floyd as the Project Leader in the Resource Protection Project C2 based in Canberra. Julian Smith was appointed as a Technician in Site Productivity in December 2002 to replace Liz Vinall. Jean Richmond, who had been Secretary to the Director and the Board since the start of the first forestry CRC in 1991, retired this year.

Postgraduate students

CRC-SPF students who received their PhD degrees and new students starting with the CRC in 2002/03 are listed under Education Outcomes in the Education and Technology Transfer section.

Administration

The number of meetings held by the Board and other committees during 2002/03 were as follows:

Board of Management	3
Management Committee	11
Advisory Committee	1
Program Coordinating Committees	
Genetic Improvement	2
Sustainable Management	2
Resource Protection	2

SPECIFIED PERSONNEL

Title, Name and Role	Contributing Organisation	% 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 Clare McArthur, Resource Protection	University of Tasmania	100
A/Prof Brad Potts, Genetic Improvement	University of Tasmania	100
Dr Neil Davidson, Education and Technology Transfer	University of Tasmania	100

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Genetic Improvement Program

Books and book chapters

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Barry KM, Davies NW, Irianto R, Mohammed CL (2003). Features of antifungal wood defence in *Acacia mangium* - why is it so susceptible to heartrot? In '8th International Congress of Plant Pathology'. 2-8 February 2003, Christchurch, New Zealand.

Eyles A, Davies NW, Mohammed CL, Mitsunaga T, Mihara R (2002). *Eucalyptus* wound wood extracts show antioxidant and antimicrobial activity. In '8th International Congress of Plant Pathology'. 2-8 February, Christchurch, New Zealand.

Eyles A, Davies NW, Mohammed CL (2002). Traumatic oil glands induced by pruning in the wound-associated phloem of *Eucalyptus globulus*: chemistry and histology. In '7th International Mycological Congress'. 11-17 August, Oslo, Norway.

Eyles A, Davies NW, Yuan ZQ, Mohammed CL (2002). Host response to natural infection by a stem canker (*Cytonaema* sp.) in the aerial bark of *Eucalyptus globulus*: a preliminary report. In '7th International Mycological Congress'. 11-17 August, Oslo, Norway.

Irianto R, Barry KM, Santoso ET, Widyati E, Sitepu I, Mohammed CL (2003). Heartrot and rootrot diseases of *Acacia mangium* plantations in Sumatra, Indonesia. In '8th International Congress of Plant Pathology'. 2-8 February 2003, Christchurch, New Zealand.

Mohammed CL, Battaglia M (2002). Forest health constraints to eucalypt productivity in Australia. In 'EucProd 2002: International Conference on Eucalypt Productivity'. 10-15 November, Hobart, Tasmania.

Mohammed CL, Barry KM, Eyles A, Harrison K, Hall M (2002). An overview of wound response and antimicrobial defence in eucalypts. In '7th International Mycological Congress'. 11-17 August, Oslo, Norway.

Mohammed CL, Wardlaw T, Barry KM, Eyles A, Wiseman D, Beadle CL, Battaglia M, Pinkard EA, Kube PD (2003). An interdisciplinary approach to the study and management of stem defects in eucalypts. In '8th International Congress of Plant Pathology'. 2-8 February, Christchurch, New Zealand.

Mohammed CL, Wardlaw T, Smith A, Pinkard EA, Beadle CL, Battaglia M (2003). *Mycosphaerella* leaf diseases of temperate eucalypts around the southern Pacific rim. In '8th International Congress of Plant Pathology'. 2-8 February, Christchurch, New Zealand.

Nahrung HF (2002). Induction and termination of reproductive diapause in *Chrysoptharta agricola*. In 'Australian Entomological Society 33rd Scientific Conference'. 22-27 September 2002, Fremantle, WA.

O'Reilly-Wapstra J (2003). Brushtail possum preferences for *Eucalyptus globulus*: the role of plant genotype and plant secondary compounds. In '49th Australian Mammal Society Annual Conference'. 7-9 July, Sydney, NSW.

Seeman OD, Nahrung HF (2002). Sexually transmitted parasitic mites (Acari: Podapolipidae) of paropsine beetles (Chrysomelidae). In 'Australian Entomological Society 33rd Scientific Conference'. 22-27 September, Fremantle, WA.

Smith A, Wardlaw T, Pinkard EA, Pietrzykowski E, Mohammed CL, Battaglia M (2003). Is the Crown Damage Index damaged by scorer variation? In '8th International Congress of Plant Pathology'. 2-8 February, Christchurch, New Zealand.

Wiggins N, McArthur C, McLean S, Boyle R (2003). Effects of plant secondary metabolites on feeding behaviour of brushtail possums. In '49th Australian Mammal Society Annual Conference'. 7-9 July, Sydney, NSW.

Wiseman D (2003). Tree nutrition affects the incidence and extent of wood decay. In '8th International Congress of Plant Pathology'. 2-8 February, Christchurch, New Zealand.

Yee M, Yuan ZQ, Mohammed CL (2002). Fungi, beetles and rotted wood: Implications for Native Forest Management in Tasmania. In '7th International Mycological Congress'. 11-17 August, Oslo, Norway.

Confidential reports

Close DC, McArthur C, Pietrzykowski E, Fitzgerald H, Paterson S (2002). Field browsing resistance of Shining Gum and Tasmanian Blue Gum seedlings raised under different nutrient regimes in the nursery. Technical Report No. 96. (CRC-SPF, Hobart, Tasmania)

de Little DW, Dutkowski GW (2003). Browsing Damage Assessment Reconnaissance Field Sheet. (CRC-SPF, Hobart, Tasmania)

Dutkowski GW (2003). Mammal Browsing Damage Assessment. Work Instructions No. 1. (CRC-SPF, Hobart, Tasmania)

Elek JA, Steinbauer MJ (2003) Mimic® (tebufenozide): an environmentally-friendly method for managing autumn gum moth larvae in eucalypt plantations. Pest Off! 19

le Mar K, McArthur C (2002). How do marsupial herbivores use the forestry environment in Tasmania and what does this mean for managing browsing damage? Technical Report No. 95. 37 pp. (CRC-SPF, Hobart, Tasmania)

Matsuki M, Bulinski J (2003) Adult Eucalypt Weevil and *Chrysophtharta obovata* leaf beetles can rapidly recolonise plantations after spraying. Pest Off! 16

McArthur C, Close DC, Beadle CL, Paterson S, Fitzgerald H, Walsh A, Kincade T (2002). Nursery effects on leaf chemistry of *Eucalyptus nitens* seedlings and their resistance to mammal browsing. Technical Report No. 94. 17 pp. (CRC-SPF, Hobart, Tasmania)

McArthur C, Hurley M, Fitzgerald H, Paterson S, Patel VS (2003) Comparing damage by insects and mammals on a *Eucalyptus nitens* plantation at establishment. Pest Off! 17

Mohammed CL, Barry KM, Harrison K, Wiseman D, Yuan ZQ, Yee M, Hopkins A, Wardlaw T, Bougher N, Tommerup I (2003) Decay fungi in eucalypts slowly reveal their true identity! Pest Off! 18

O'Brien K, Throssell A, Matsuki M (2003). Effects of a neem-based insecticide on a leaf beetle species. Technical Report No. 101. 22 pp. (CRC-SPF, Hobart, Tasmania)

O'Brien K, Throssell A, Matsuki M (2003) Neem-based insecticides may be a valuable tool in the IPM of *Chrysophtharta agricola*. Pest Off! 15

Paterson S, Fitzgerald H, Matsuki M (2003) *Chrysophtharta bimaculata* and *C. agricola* have different key predators. Pest Off! 22

Paterson S, Fitzgerald H, Matsuki M (2003) Egg-laying of *Chrysophtharta bimaculata* and *C. agricola* is related to leaf development. Pest Off! 21

Pietrzykowski E, McArthur C, Smethurst PJ, Barnes C (2002). Effectiveness of lupins as a cover crop for reducing damage by browsing mammals. Technical Report No. 89. 22 pp. (CRC-SPF, Hobart, Tasmania)

Witt A, McArthur C, Close DC (2003) Do repellents reduce browsing damage by mammals? Pest Off! 20

Theses

le Mar K (2002) Spatial organization and habitat selection patterns of three marsupial herbivores within a patchy forestry environment. PhD, School of Zoology, University of Tasmania, Hobart, Tasmania.

Nahrung HF (2003) Reproductive ecology of *Chrysophtharta agricola* (Chapuis) (Coleoptera: Chrysomelidae). PhD, School of Agricultural Science, University of Tasmania, Hobart.

Wardlaw TJ (2003) The extent, impact and management of stem decay in young regrowth forests scheduled for thinning in Tasmania. PhD, School of Agricultural Science, University of Tasmania, Hobart, Tasmania.

While G (2002) Factors affecting the distribution of marsupial herbivores in forestry plantations. Honours, School of Zoology, University of Tasmania, Hobart.

Witt A (2002) Effects of Repellents on Seedling Growth and Herbivory. Honours, School of Zoology, University of Tasmania, Hobart, Tasmania.

PUBLIC PRESENTATIONS

Presentations which also appear as conference proceedings or abstracts are cited in the Publications section of this Annual Report.

Genetic Improvement Program

Apiolaza LA (2002) Multivariate analysis. Presentation at 'Introduction to Quantitative Genetics Analysis' 26-27 September. Hobart, Tasmania.

Apiolaza LA (2002) Me, myself, I: a personal view of the analysis of repeated measurements. Presentation at 'StatFest' 26 September. Hobart, Tasmania.

Apiolaza LA (2002) Genetics and linear models. Presentation at 'Introduction to Quantitative Genetics Analysis' 26-27 September. Hobart, Tasmania.

Apiolaza LA (2003) Breeding for risk traits. Presentation at 'GenResFest: Breeding for Pest Resistance' 25 February. Hobart, Tasmania.

Brawner J (2003) Early growth performance of series III hybrid clones planted in southeast Queensland. Workshop at 'Clonal Forestry Update 2003' 6 May, for DPI Forestry. Gympie, Queensland.

Dieters MJ (2002) Genetic Improvement of conifers in Queensland. Seminar for University of Queensland. Brisbane, Queensland.

Dieters MJ (2003) Series V clonal tests and implications of composite breeding. Workshop at 'Clonal Forestry Update 2003' 6 May, for QFRI. Gympie, Queensland.

Dutkowski GW (2002) The constitution is dead, long live the constitution. Presentation at 'STBA General Meeting'. Hobart, Tasmania.

Dutkowski GW (2002) A journey into outer space! Presentation at 'StatFest' 27 September. Hobart, Tasmania.

Dutkowski GW, Pilbeam DJ, Hunter SJ (2002) A certification and marketing standard for *Eucalyptus globulus*. Presentation at 'Deployment Workshop' for STBA. Hobart, Tasmania.

Dutkowski GW (2002) ASREML Primer. Presentation at 'Introduction to Quantitative Genetics Analysis' 26-27 September. Hobart, Tasmania.

Dutkowski GW (2002) How to cope with your relations. Presentation at 'Introduction to Quantitative Genetics Analysis' 26-27 September. Hobart, Tasmania.

Foster SA (2002) Testing the Jordan hypothesis: differentiation in *E. globulus*. Seminar for University of Tasmania. 23 August. Hobart.

Freeman JS (2003) Genome mapping and QTL analysis for disease resistance in *E. globulus*. Presentation at 'GenResFest: Breeding for Pest Resistance' 25 February. Hobart, Tasmania.

Harding KJ (2003) Acoustic testing of series II clones and plans for assessment of series III clones. Workshop at 'Clonal Forestry Update 2003' 6 May, for DPI Forestry. Gympie, Queensland.

Harwood CE (2003) Sampling issues for genetics of solid wood properties. Presentation at 'CRC Quantitative Genetics Discussion Group'. Hobart, Tasmania.

Hingston AB, Mallick SA (2003) Are introduced social bees a threat to the endangered swift parrot? Presentation at 'Birds Australia Member's Day & Annual General Meeting' 31 May. Hobart, Tasmania.

Jones ME (2002) Gene flow and genetic diversity in *Eucalyptus grandis*. Seminar 29 August, for NSW State Forests. Sydney, NSW.

Kerr RJ, Dieters MJ (2002) Simulation of Hybrid Breeding Strategies. Seminar 29 November, for QFRI. Gympie, Queensland.

Li Y (2002) Mate selection to exploit dominant QTL in crosses. Presentation at 'Sixth World Congress on Genetics Applied to Livestock Production' 19-23 August. Montpellier, France.

Li Y (2003) Connectedness and setting common families. Presentation at 'STBA Technical Committee Meeting' 13-15 May, for STBA. Melbourne, Victoria.

Li Y (2003) Estimation of genetic parameters for *E. globulus* full-sib family trials. Presentation at 'STBA Technical Committee Meeting' 13-15 May, for STBA. Melbourne, Victoria.

Lorkin M (2003) Screening *E. globulus* for self-incompatibility. Presentation 20 September, for WAPRES. Manjimup, WA.

McRae TA, Pilbeam DJ (2002) Innovations and new developments in the STBA. Seminar 13 August. Hobart, Tasmania.

Poke FS (2002) Lignin: How to make wood even better! Seminar 6 September, for University of Tasmania. Hobart, Tasmania.

Poke FS, Reid JB, Vaillancourt RE (2003) The effect of an important SNP in CCR on lignin content of *Eucalyptus globulus*. Presentation at 'IUFRO Tree Biotechnology meeting'. Umea, Sweden.

Potts BM, Reid JB (2002) Tasmania's exceptional eucalypts: their place in science. Presentation at 'Going Bush – Understanding the Tasmanian Vegetation.' 16 October. Hobart, Tasmania.

Potts BM, Volker PW, Tilyard P (2003) The Tasmanian experience with *Eucalyptus nitens* x *globulus* hybrids. Invited seminar at 'Biologia reproductive y protocolos de hibridacion de *Eucalyptus*' 2 December. Conception, Chile.

Pound LM (2003) Self-incompatibility in *Eucalyptus nitens* and *E. globulus*. Seminar 28 February, for University of Tasmania. Hobart, Tasmania.

Scott LJ (2002) QTL mapping in Hoop Pine. Seminar for QFRI. Brisbane, Queensland.

Shepherd M (2003) Genetic map based studies of speciation in pines. Seminar for Southern Cross University. Lismore, New South Wales.

Steane DA (2003) Tracing the evolution of xeromorphy in Casuarinaceae. Seminar for University of Tasmania. Hobart, Tasmania.

Vaillancourt RE, McKinnon GE, Whittock SP, Potts BM (2002) Sharing of nuclear and cpDNA variation across eucalypt species. Presentation at 'Genetic Society of Australia Comparative Genetics Meeting' 10 July. Sydney, NSW.

Vaillancourt RE, Barbour RC, Potts BM (2002) Identifying the risks of genetic pollution of native eucalypt gene pools. Presentation at 'Genetic Pollution forum' 18 November, for Farm Forestry Working Group of NSW. Nowra, NSW.

Vaillancourt RE, Milgate AW, Mohammed CL, Potts BM (2003) Genetic control of susceptibility to *Mycosphaerella* resistance. Presentation at 'GenResFest: Breeding for Pest Resistance' 25 February. Hobart, Tasmania.

Volker PW (2002) A mixed marriage leads to shattered dreams - a catholic view of the hybridisation of eucalypts (*E. nitens x globulus*). Seminar 19 August, for CSIRO. Canberra, ACT.

Volker PW (2002) A mixed marriage leads to shattered dreams - a catholic view of the hybridisation of eucalypts (*E. nitens x globulus*). Seminar 9 August, for University of Tasmania. Hobart, Tasmania.

Whittock SP, Greaves BL, Apiolaza LA (2003) 2nd rotation: seedlings and genetic gain, or coppice? Presentation at 'STBA Technical Advisory Meeting' 13-15 May, for STBA. Melbourne, Victoria.

Whittock SP, Greaves BL (2003) 2nd rotation: seedlings and genetic gain, or coppice? Presentation 21 January, for Great Southern Plantations. Albany, WA.

Whittock SP, Greaves BL, Apiolaza LA (2003) 2nd rotation: seedlings and genetic gain, or coppice? Presentation 23 January, for WAPRES. Manjimup, WA.

Williams ER (2003) Pedigree Analysis of Multi-stratum Experiments. Seminar 13 June. Hobart, Tasmania.

Williams ER (2003) Heritability calculation in multi-stratum experiments. Presentation at 'CRC Quantitative Genetics Discussion Group'. Hobart, Tasmania.

Sustainable Management Program

Battaglia M (2003) CABALA: linked carbon, nitrogen and water model for silvicultural decision support. Presentation at 'WA Industry Forum'. Albany, WA.

Beadle CL (2003) Management of pruning and thinning in plantations - a physiological approach. Seminar 19 March. Brisbane, Queensland.

Catchpoole KJ (2002) The PLATIPUS Tale - Analysis of Log Value. Workshop at 'RWG2: Forest Measurement and Information Systems' 25-29 November. Caloundra, Queensland.

Catchpoole KJ (2002) Modelling silvicultural scenarios. Workshop at 'Exotic Pine Industry Forum: Predicting wood flows and wood quality' 22 August. Gympie, Queensland.

Close DC (2003) Seedling and container size - effects on after planting performance. 4 May, for WAPRES. Manjimup, WA.

Close DC (2003) Foran trial - initial seedling specifications. 4 May, for WAPRES. Manjimup, WA.

Close DC (2003) In-nursery nitrogen management and after planting performance. 4 May, for WAPRES. Manjimup, WA.

Mitchell AD (2003) Base cations – Potential for growth limitation in plantation forestry. Seminar 16 May. Hobart, Tasmania.

Pryor R (2003) Waterlogging in Tasmanian eucalypt plantations; the effect of soil and tree nutrition on tree productivity and growth under waterlogged conditions. Seminar 2 May. Hobart, Tasmania.

White DA, Benyon RG, Theiveyanathan T, Marcar N, Battaglia M (2002) Restoring water balance: the role of trees from paddock to catchment scale. at 'CRC-PBMDS' 17 June. Perth, WA.

Resource Protection Program

Adams PR (2003) Loss of productivity due to weeds, soil factors, etc. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Allen GR (2002) Temperature and development of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Allen GR (2002) Spatial and temporal impact of natural enemies of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Allen GR (2002) Egg parasitoids of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Allen GR (2002) Relationship of *Chrysophtharta agricola* to other leaf beetles. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Apiolaza LA (2003) Economic analysis of losses in *Pinus radiata*. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Barry KM (2003) Reduced wood quality due to stem decay. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Battaglia M (2003) Modelling loss in plantations: the flip-side of productivity. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Close DC (2003) How to grow trees in dry environments. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

de Little DW (2003) Loss of productivity due to Autumn Gum Moth in northern Tasmania. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Elek JA (2002) Impact on trees and control of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Elek JA (2003) Loss of productivity due to leaf beetles in Tasmania. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Eyles A (2003) Wound responses of *Eucalyptus globulus* and *E. nitens*: anatomy and chemistry. Seminar 5 July. Hobart, Tasmania.

Jenkin B, Matsuki M (2003) Economic analysis of losses in *Eucalyptus grandis* and *E. globulus* in Victoria. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

le Mar K (2003) Hierarchical scales of selection in three herbivores. Seminar 26 March. Hobart, Tasmania.

le Mar K (2003) Hierarchical scales of selection in three herbivores. Seminar 2 April, for University of Tasmania. Hobart, Tasmania.

Loney P (2003) The relationship between herbivory and plant structure in eucalypts. Seminar 26 June, for University of Tasmania. Hobart, Tasmania.

Loney P (2003) The relationship between leaf structure in plantation eucalypts and herbivory. Seminar 16 May. Hobart, Tasmania.

Matsuki M (2003) Model for studying effects of herbivory on tree growth. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

McArthur C (2003) Managing browsing damage in eucalypt plantations - alternatives to 1080? Invited Presentation for BIOTA (Biology Teachers' Association of Tasmania) 2 May. Hobart, Tasmania.

Nahrung HF (2002) Phenology of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2002) Overwintering of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2002) Mating system and infochemicals of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2002) Comparison of Tasmania and mainland: *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2002) *Chrysophtharta agricola* in relation to adult vs juvenile foliage of *Eucalyptus*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2002) General biology of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Nahrung HF (2003) Reproductive ecology of *Chrysophtharta agricola*, a pest of *Eucalyptus* plantations in south-eastern Australia. Seminar 26 June. Hobart, Tasmania.

O'Reilly-Wapstra J (2003) Genetic based susceptibility to marsupial browsing. Presentation at 'GenResFest: Breeding for Pest Resistance' 25 February. Hobart, Tasmania.

Ostrand F, Steinbauer MJ (2003) Developing a pheromone-based monitoring system for Autumn Gum Moth: how's it going? Seminar 26 June. Hobart, Tasmania.

Pietrzykowski E (2003) Remote sensing to detect forest health problems like *Mycosphaerella* infection. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Pinkard EA (2003) Determining the effects of *Mycosphaerella* on productivity of *Eucalyptus globulus*. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Rapley L (2002) Genetic variation in *Eucalyptus globulus* in relation to host preference of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Rapley L (2003) Verifying that the levels of benzyl esters in the foliar waxes of *E. globulus* influence Autumn Gum Moth defoliation and oviposition. Presentation at 'GenResFest: Breeding for Pest Resistance' 25 February. Hobart, Tasmania.

Rice AD (2002) Larval parasitoids of *Chrysophtharta agricola*. Workshop at 'InFest' 15 October. Hobart, Tasmania.

Schwarze FW (2002) Development and prognosis of decay in the sapwood of living trees. Seminar 25 September. Hobart, Tasmania.

Schwarze FW (2002) Diagnosis of decay in living trees. Seminar 25 September. Hobart, Tasmania.

Smith A (2003) Crown Damage Index: Some results. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Stone C (2003) Crown Damage Index: Concepts. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Walsh A (2003) Vertebrate browsing. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Wardlaw T (2003) Predicting future loss due to stem decay. Presentation at 'LossFest' 26 February. Hobart, Tasmania.

Wiggins N (2003) Effects of plant chemistry on feeding behaviour of marsupial folivores. Seminar 26 June, for University of Tasmania. Hobart, Tasmania.

Media activities

Print

Australian Forest Grower, 2002. D de Little: 'Special Liftout No. 61: FOREST HEALTH - a proactive approach to pest and disease problems in plantations'.

Australian Forest Grower, 2002. P Smethurst: 'Target fertiliser management to your specific site'.

Farming Ahead, 2002. S Cunningham and M Steinbauer: 'Multi-faceted approach controls tree pests'.

The Mercury, 2002. M Yee and S Grove: 'Science finds dead wood more than just waste of space'.

Tasmanian Country, 2003. D Close: 'Field day turns on plant power'.

The Examiner, 2003. D Close: 'Field day to help prevent tree decline'.

The Mercury, 2003. A Hingston: 'New threat to swift parrot is bumblebee'.

Electronic media

ABC Radio 936 Hobart Breakfast Show. C McArthur: interview on 'Alternatives to 1080'. 14 August 2002.

ABC Radio Morning Show, R Vaillancourt: interview on 'Gum trees used sex to beat the Ice Age'. 20 August 2002.

ABC TV News, R Vaillancourt: interview on 'Gum trees used sex to beat the Ice Age'. 24 August 2002.

ABC Radio Country Hour, R Vaillancourt: interview on 'Genetic research to aid farm forestry'. 27 August 2002.

Edge Radio 99.3 FM Take Two Science. M Yee and S Grove: interview on 'Deadwoodology is where it is at'. 16 September 2002.

WIN Television Burke's Backyard. D Close: report on 'Why do plants turn red?' 18 October 2002.

ABC Radio 936 Hobart, D Close: report on 'A forestry research project has found solutions to the reduction of tree cover in Tasmania's midlands'. 28 June 2003.

ABC Radio Northern Tasmania. D Close: report on 'A forestry research project has found solutions to the reduction of tree cover in Tasmania's midlands'. 28 June 2003.

7RN Radio Hobart. D Close: report on 'A forestry research project has found solutions to the reduction of tree cover in Tasmania's midlands'. 28 June 2003.

7BU Radio Burnie. D Close: report on 'The tree decline crisis in the Tasmanian midlands is in the spotlight today'. 28 June 2003.

7LA Radio Launceston. D Close: report on 'The tree decline crisis in the Tasmanian midlands is in the spotlight today'. 28 June 2003.

7SD Radio Scottsdale. D Close: report on 'The tree decline crisis in the Tasmanian midlands is in the spotlight today'. 28 June 2003.

Southern Cross State Television News Tasmania. D Close and N Davidson: interview on 'New research is assisting the reversal of tree decline in Tasmania's midlands'. 28 June 2003.

ABC TV State Television News. D Close and N Davidson: interview on 'A research project has shown specific planting techniques are required to regenerate Tasmanian midlands tree cover'. 28 June 2003.

7AD Radio Devonport. D Close: report on 'The tree decline crisis in the Tasmanian midlands is in the spotlight today'. 28 June 2003.

ABC Television Stateline. D Close: interview on 'Rural tree decline in the Midlands of Tasmania'. 28 June 2003.

GRANTS AND AWARDS

Grant / Award	Awarded for	Duration	Recipients	Amount $
Genetic Improvement Program				
IRGS grant	Phylogeography of the southern beech, *Nothofagus cunninghami*	1 year	Dr R Vaillancourt	$21,000
ARC Discovery Grant	Hybridisation and gene flow in *Eucalyptus*	2 years	A/Prof B Potts Dr R Vaillancourt	$130, 000
ARC Linkage 2002 round II	Wood quality improvement for spotted gum	3 years	Prof RJ Henry Dr A Muneri	$362,000
Southern Tree Breeding Association (STBA)	"Best Franchisee" for assistance in development of the TREEPLAN software used in genetic evaluation		CRC-SPF	
Southern Tree Breeding Association (STBA)	STBA scientist of the Year		Mr G Dutkowski	
School of Plant Science, UT	Honours Scholarship in Genetics		Mr J Worth	$1 500
Sustainable Management Program				
NSW Dept. LWC, CRC PBMDS	Assessing the capacity of discharge site tree plantings to reduce salt export to waterways	2 years	Dr Theiveyanathan Mr R Falkiner Dr N Marcar Dr M Battaglia	$66 650
ARC Linkage	Risk impact on productivity and control of *Mycosphaerella* infections in plantations of *E. nitens* and *E. globulus*	4 years	Dr C Mohammed Dr M Battaglia Dr C Beadle Dr T Wardlaw Dr J Bulinski Dr D de Little	$190 000
ARC Linkage APA plus CSIRO PhD scholarship	*Mycosphaerella* – infection physiology and host defence responses	4 years	Dr C Mohammed Dr M Battaglia Dr C Beadle Ms A Smith	$105 000
CRC-SPF competitive postdoctoral program	Predicting soil water depletion, water uptake and water table use	3 years	Dr M Battaglia	$152 000
CRC-PBMDS	Influence of site factors and stand management on growth and water use of herbaceous and woody perennials	5 years	Dr D White Dr P Ward Dr M Battaglia Dr K Montagu Dr P Taylor Dr J McGrath Prof H Lambers	$522 860
Royal Society of Tasmania	Royal Society of Tasmania Doctoral Award 2002. (Presented by the Governor of Tasmania, Sir Guy Green)		Dr D Close	

Grant / Award	Awarded for	Duration	Recipients	Amount $
Resource Protection Program				
Australian Academy of Science	Scientific visit to France to work with Dr S Derridj (INRA)	3 weeks	Dr M Steinbauer	$4 800
Institutional Research Grants Scheme (Uni Tas)	Sperm utilisation strategies in a multiple mating leaf beetle	1 year	Dr G Allen	$18 000
Agriculture Fisheries and Forestry Australia (AFFA)	2002 AFFA Science and Innovation Awards for Young People, sponsored by Forest and Wood Products Research and Development Corporation		Ms J O'Reilly-Wapstra	$8 000
Total				$1 581 810

CONSULTANCIES

Consultancy with	for	Duration	Recipients	Amount $
FEA Australia	Thinning responses in *E. nitens*		Dr M Battaglia	$4000
RAIZ, Portugal	Modelling *E. globulus* in Portugal		Dr M Battaglia	$7500
Ministry of Agriculture and Forestry, NZ	Advice on the population ecology of *Uraba lugens* in Australia	1 day	Dr M Steinbauer	$1800
Environmental Health Project Team, Private Forestry Council of Victoria.	The risk of genetic pollution of native eucalypts from plantations and farm forestry in Victoria: a scoping study.		A/Prof B Potts Dr R Vaillancourt Dr A Hingston	$10,000

PERFORMANCE INDICATORS

Cooperative arrangements

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

Most CRC research is conducted using company trials, or trials established on company land, so companies are involved at the outset with the planning and implementation of research projects and have ownership of them. Plans for these experiments are lodged with the companies, and these include an agreed protocol for the research. The company partners allocate staff time (in-kind contributions) to CRC research projects so effective interaction can occur. The Program Coordinating Committees (PCCs) of the CRC retain an overview of these research projects. They prioritise research and set 'deliverables' (research outcomes that can be directly used by industry). The PCCs are chaired by industry representatives and consist largely of the partners' staff to ensure that they are 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 231 person-days for 2002/03

- *Proportion of joint publications with other research groups*

  Eighty three (31%) of the 268 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 a large number of visitors to the CRC, and to CRC-arranged seminars. Those who took part in the CRC Visitor Program and had extended visits to the CRC are listed under Outcomes in the Education and Technology Transfer section.

- *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, the northern node projects A6 and A7 closely interact on work on tropical hybrid pines, A1 and A4 work closely together on the molecular genetics of temperate eucalypts, and A3 and A5 interact in studying the genetic control and mapping of wood property genes in *Eucalyptus globulus* and *E. nitens*. 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. Project A2 works with scientists from QFRI, GL, STBA, CSIRO and FT on the use of ASREML software for the analysis of their data. Project A1 links with projects A6 and A7 on problems associated with eucalypt genetics and hybridisation, which are common to temperate and sub-tropical eucalypts. Project A1 is conducting research projects on the genetics of *E. globulus* across Australia in southern Tasmania (UT and FT) and northern Tasmania (GL), in Western Australia (WACAP), and in Victoria (GRP). 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.

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. There are also strong links with FT and GL.

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 and the Resource Protection Program (RP) on the genetics of pest and disease resistance.

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

Project A2 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), and on the Technical Committee, and Research, Quantitative Genetics and Data Management Sub-Committees (Greg Dutkowski, Dr Luis Apiolaza 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 its spin-off company 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. The project A6 is based within and closely interacts with DPIQ and QFRI, the organisation responsible for the breeding and deployment of sub-tropic pines in Queensland.

- *pruning and thinning*

Dr Chris Beadle (CSIRO) and Andy Warner (PFT) organised a blackwood workshop and study tour with Forest Research New Zealand. There were ten Australian delegates, including from CRC partners Forestry Tasmania and Private Forests Tasmania. A report is being published by the Joint Venture Agroforestry Program. A web page is being developed to serve the needs of the Blackwood Industry Group in Australia.

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

There has been close interaction between projects B1 and B2 concerning organic matter and nutrient cycling. Two major activities: (i) the inclusion of Queensland soils in the base cation research of Dr Andrew Mitchell, and (ii) SIF-funded collaboration between these two projects to investigate foliar C, N and water use by *E. nitens* are in place.

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

Dr Digby Race (ANU) in cooperatrion with CSIRO Sustainable Ecosystems organised a workshop on Farm Forestry: Australian experiences of linking biodiversity to commercial forestry that was held at La Trobe University - Beechworth campus in September 2002. The CRC-SPF was a sponsor of this meeting.

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

In association with PFT and FT, the CRC has developed version 4 of the Farm Forestry Toolbox CD. This incorporates a version of ProMod for *E. nitens*. A dynamic version of ProMod called CABALA has been developed that can examine the consequences of silviculture on productivity in the current and subsequent rotations. Project B4 staff led a training course on the use of these models.

- *measurement of leaf area index in the field*

Ms Maria Cherry has trained partners in the use of the 'Visual Guide for Measuring Leaf Area Index' in Tasmania for Tasmanian partners, in Hamilton, Victoria for Timbercorp staff and in Western Australia for WACAP and Timbercorp staff.

- *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 has been a high degree of collaboration between locations in research on insect herbivores. Dr M Matsuki (CRC, Tas) and M Short (CSIRO, Canberra) have collaborated in research on parasitoids of autumn gum moth. M Matsuki and Dr J Bulinksi (Timbercorp, W.A.) have been studying the spatial variation of eucalypt weevil and *Cadmus excremantarius* in south-west W.A., *Mnesampela privata* and *Chrysophtharta m-fuscum* in the Green Triangle. M Matsuki and J. Elek (FT/CRC, Tas) studied spatial variation of *Chrysophtharta agricola* in Tasmania and also effects of neem extracts on *C. agricola*. M Matsuki and Dr A Loch (CSIRO, W.A.) have collaborated on developing efficient insect monitoring schemes for major insect pests in plantations. Research on autumn gum moth continues with interactions between Dr M Steinbauer (CSIRO/CRC, Canberra), A Loch and Dr G Allen's group (CRC, Tas). Research on key insect pests in W.A. forestry involves Timbercorp and WAPRES with Dr R Floyd (CSIRO, Canberra), J Matthiessen (CSIRO/CRC, W.A.) and A Loch. Recolonisation of insect pests

after chemical control has been studied by M. Matsuki and J. Bulinski in WA and M. Matsuki, J. Elek, and G. Allen in Tasmania. M Matsuki has established an e-group (email group) between all researchers in the Resource Protection Program and interested forestry companies for rapid communication of information relating to insect pests and other factors affecting tree health.

- *impact of insect pests at plantation establishment*

H Redgrove and Dr G Allen (UT) have been investigating the biology of *Heteronyx* beetles and their effect on establishment of *E. nitens* plantations with Dr D de Little (Forest Health Consultant). John Matthiessen carried out a SIF project during 2002/03 to document the biology of *Heteronyx elongatus*, which is damaging in the larval stage to newly-planted seedlings in WA, and to investigate control options. Localised application of very small quantities of insecticide to seedlings, with inexpensive generic insecticide performing about as well as expensive newer proprietary materials offered a highly effective control.

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

Dr C McArthur has completed a project with Mr R Appleton at GRP in Victoria on provenance variability of *E. globulus* to browsing. Collaboration continues between Dr C McArthur, Ms J O'Reilly-Wapstra with A/Prof B Potts (Genetic Improvement Program) on genetic variation of resistance of *E. globulus* and *E. nitens* to browsing. The RP projects in Hobart closely interact with the GI program in research related to resistance breeding and several PhD students are jointly supervised. A collaborative project between Dr C McArthur, Ms J O'Reilly-Wapstra, A/Prof B Potts and Dr D Close is investigating the interaction of genetics and environment on seedling chemistry and palatability.

- *investigation of pathogens of plantation trees*

Research on stem decay, mechanisms of tree defence and wound tissue formation has continued between Dr C Mohammed (CSIRO, UT), and W Neilsen, Dr E Pinkard and T Wardlaw (FT). *Mycosphaerella* research has also progressed with collaboration between C Mohammed and several companies in Tasmania (Dr D de Little; T Wardlaw, FT) and Western Australia (Dr J Bulinksi, Timbercorp).

Research and researchers

- *Papers in refereed journals*

The CRC produced 268 publications in 2002/03. These included 4 book chapters, 122 refereed journal articles (88 published and 34 in press), 129 unrefereed publications (65 in public arena and 64 confidential) and 13 theses.

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

Four book chapters were written in 2002/03. These were:-

Potts BM (2003). Improvement and culture of eucalypts. In 'Encyclopedia of Forest Science'. (Elsevier Science: Oxford) (In press)

Raymond CA, Apiolaza LA (2002). New directions in selection of eucalypts. In 'Plantation Forest Biotechnology for the 21st Century'. (Eds C Walter and M Carson) (Forest Research New Zealand: Rotorua, New Zealand) (In press)

Eds. D Race, D Freudenberger (2003) Farm forestry for green and gold: Australian experiences of linking biodiversity to commercial forestry. 63 pp. (Canberra, ACT) (In press)

Ed. KM Barry (2002). Heartrot in Plantation Hardwoods in Indonesia and Australia. 34 pp. (ACIAR, Canberra, ACT)

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

There were a number of invited presentations in 2002/03:

Poke FS, Reid JB, Vaillancourt RE (2003) The effect of an important SNP in CCR on lignin content of *Eucalyptus globulus*. Presentation at 'IUFRO Tree Biotechnology meeting'. Umea, Sweden.

Potts BM, Volker PW, Tilyard P (2003) The Tasmanian experience with *Eucalyptus nitens* x *globulus* hybrids. Invited seminar at 'Biologia reproductive y protocolos de hibridacion de *Eucalyptus*' 2 December. Conception, Chile.

Makälä A, Sands PJ (2002). Integrating our understanding of physiological, environmental, genetic and silvicultural determinants of growth into predictive

management systems - requirements, challenges and prospects. In 'EucProd 2002: International Conference on Eucalypt Productivity'. 10-15 November, Hobart, Tasmania.

Whitehead D, Beadle CL (2002). Physiological regulation of productivity and water use in *Eucalyptus*. In 'EucProd 2002: International Conference on Eucalypt Productivity'. 10-15 November, Hobart, Tasmania.

McArthur C (2003) Managing browsing damage in eucalypt plantations - alternatives to 1080? Invited Presentation for BIOTA (Biology Teachers' Association of Tasmania) 2 May. Hobart, Tasmania.

- *Number and value of competitive grants awarded*

Fifteen competitive grants were awarded to CRC staff during the last financial year, totalling $1 581 811.

- *Honours and awards*

Dr Dugald Close was awarded the Royal Society of Tasmania Doctoral Award for 2002, presented by the Governor of Tasmania, Sir Guy Green.

Dr Greg Dutkowski was recognised by the Southern Tree Breeding Association (STBA) by presentation of the 'STBA scientist of the Year' award.

The CRC-SPF was recognised by the STBA through an award of "Best Franchisee" for its collaboration in development of the TREEPLAN software used in genetic evaluation.

Two awards were presented to students of the CRC-SPF in 2002/03:

Ms Julianne O'Reilly-Wapstra won the Forest and Wood Products Research and Development Corporation sponsored AFFA Science and Innovation Awards for Young People in 2002. The title of the project was 'Breeding for resistance in *Eucalyptus globulus* to mammalian herbivores: the role of genetics and secondary plant chemistry'.

Mr James Worth received the Genetics Honours Scholarship for his project at UT.

Education and training

- *Time spent by researchers on research training*

There are 49 PhD, 8 MSc and 6 Honours students enrolled with CRC-SPF. It is recognised that each student takes 5–10% of a researcher's time to supervise. This is equivalent to 3.15–6.3 person-years on research training.

- *Number of postgraduate students working in the Centre*

The Centre has 57 postgraduate students and 6 Honours students (see Table 4).

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

Genetic Improvement	19
Sustainable Management	27
Resource Protection	17

- *Number of enrolments in special courses*

Forest Ecology, a special undergraduate course in Plant Science at the University of Tasmania, had seven students enrolled. In addition there were a wide range of workshops and field days organised to train industrial staff, including four special training workshops or 'fests' (listed under Outcomes in the Education and Technology Transfer section).

The total number of enrolments for all these courses was 218.

- *Quality and number of postdoctoral fellows attracted*

Thirteen postdoctoral fellows worked with the Centre in 2002/03: Dr R Thumma in molecular genetics (CSIRO FFP, Canberra), Dr M Steinbauer in entomology (CSIRO Ento, Canberra), Dr M Shepherd in molecular biology (SCU, Lismore), Dr D Close in tree physiology (UT, Hobart), Dr N Prasolova on soil nutrition (GU, Brisbane), Dr D Steane and Dr B Patterson in molecular genetics (UT, Hobart), Dr F Henskens on canopy nitrogen dynamics (UT, Hobart), Dr A O'Grady in root biomass turnover (UT, Hobart), Dr A Mitchell (CSIRO FFP/UT, Hobart) on availability of base cations, Dr J Medhurst (UT, Hobart) on Blackwood silviculture, Dr K Barry on tree pathology (UT, Hobart), and Dr M Matsuki on insect ecology (UT, Hobart).

- *Rate and percentage of completion of higher degrees*

Thirteen students completed this year; 7 PhD, 1 MSc and 5 Honours:

Peter Bundock PhD, Michelle McGranahan PhD, Tim Blumfield PhD, Sven Ladiges PhD, Kirsten le Mar PhD, Tim Wardlaw PhD, Helen Nahrung PhD, Tim Tabart MSc, Tim Watson (Hons), Stuart Fenech (Hons), Geoffrey While (Hons), Andrea Witt (Hons) and Susan Foster (Hons).

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

The success of our students in obtaining employment in the forest industry was demonstrated by appointments this year: Dr Dean Williams (Tree Breeder, Forestry Tasmania), Dr Peter Volker (Manager, Plantation Program, Forestry Tasmania), Dr Tim Blumfield (Postdoctoral Fellow, GU), Dr Tim Wardlaw (promoted to Manager, Native Forests Branch, Forestry Tasmania), Dr Jane Medhurst (Postdoctoral Fellow, UT/Swedish University of Agricultural Sciences, Upsala, Sweden), Dr Libby Pinkard (Postdoctoral Fellow, UT), Dr Nicole Mathers (Research Fellow, GU).

Application of research

- *Degree of adoption of research results by industry*

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

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

Thirty-nine technical reports were produced by the Centre, 29 of which were in the CRC Technical Report series. In addition, 25 technical news sheets were released ('Hot off the Seed Bed', 'Beyond the Black Stump' and 'Pest Off'), and four articles appeared in newsletters of member organisations.

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

Four consultancies were conducted during 2002/03 (see Grants and Awards and Consultancies). Advice was also provided through participation on national committees. For example, Greg Dutkowski (GI) is a member of the STBA Board, and is a member of Research Working Group 1 (RWG1, Forest Genetics). Dr Luis Apiolaza, Dr Yongjun Li and Dr Rene Vaillancourt are on the STBA Technical Committee. Dr Brad Potts (GI) is a member of RGW1, as well as being on the subcommittee for Forest Genetic Resources, on the Biodiversity Advisory Panel for the Tasmanian Government 'State of the Environment Report'. Dr Clare McArthur (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) and Dr Dugald Close (SM) have had close interaction with organisations advising farm foresters through collaborative work on plantation establishment to combat 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 2002/03. These included 170 public presentations including 77 conference or symposia presentations and 27 seminars as well as four CRC-run workshops, five short courses and two field days.

- *Number and financial contribution of potential users*

The CRC-SPF has nineteen members, including most of the major wood producing companies in Australia. Each partner commits 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 in running technology transfer exercises to farmer groups.

- *Number of visitors from user groups*

As the partners in the Centre represent our main user group, many of the 231 person-days involved within-CRC visits (see Performance Indicator 2 under Cooperative Arrangements) and users of the technology we are developing.

- *Number of media or trade journal presentations*

In the last year, seven articles relating to Centre activities appeared in newspapers and industry newsletters, and 17 segments in the electronic media (12 radio and 5 television).

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

In 2002/03 CRC-SPF gave 170 public presentations and ran four workshops, five short courses and two field days to transfer results to industry and the public. An estimated 2004 people attended these activities.

Management and budget

- *Establish procedures to report on progress and achievements*

Plans in place include 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 is monitored and reviewed, and its value to industry assessed through Program Coordinating Committees, the Advisory Panel, the Board, and the Annual Report.

- *Timely and accurate reporting of progress*

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

- *Extent of staff turnover*

There were 12 changes to staffing, including a change of CRC Deputy Director, during 2002/03 (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 2002/2003

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.

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 2002/03 Serve-Ag resigned its membership of the CRC. Receivers for Australian Plantation Timber Limited made an interim dividend following its expulsion from the CRC. Private Forests Tasmania downgraded its membership to Associate from 2002/03 until the end of the Commonwealth Agreement .

(f) Allocation from Commonwealth Grant
During 2002/2003 the CRC received the usual four quarterly grant payments.

Audit Report

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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 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 2003. 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 third parties 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 grant 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.

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 third parties 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):

Third Party	*Amount Committed* $ '000	*Amount Contributed* $ '000
Australian Plantation Timber	250	10
Gunns Ltd	341	182.7
Norske Skog Paper Mills	209	156.9
Private Forests Tasmania	27.4	6.9
University of Queensland	72	40

Total yearly expenditure on the activities of the Centre under each Head of Expenditure differed by more than 20% or $100,000 from the allocation in the budget as follows:

Head of Expenditure	*Total Expenditure* $ '000	*Amount Budgeted* $ '000
Salary	2,488	1,702
Capital	89	nil

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 2003, in all material respects:

1. Researcher contributions and contributions from third parties 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 grant 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));
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, 5 September 2003

Budget Tables

ATTACHMENT A

Co-operative Research Centre for Sustainable Production Forestry
Summary of Base Grant Funds 2002/2003

Opening Balance at 1/7/02	1,788,713
Add Income	2,989,354
Outstanding debtors at 1/7/02	56,250
Less Expenditure	
Salaries, scholarships and associated costs	2,488,021
Consumables	1,062,521
Equipment	89,025
Total Expenditure	3,639,567
Balance at 30/6/03	1,194,750
Less outstanding debtors at 30/6/03	46,503
Closing Balance at 30/6/03	**1,148,247**

RESEARCH STAFF RESOURCES (2002/2003)

ATTACHMENT B

Organisation	Main Activity	Total % Time	% Spent on Research Program GI	SM	RP	Total on Research	% Spent on Eduen	% Spent on Commln Program	% Spent on CRC Admin
Australian Forest Growers									
M Speedy	E	1					1		
Total		1	0	0	0	0	1	0	0
CSIRO Entomology									
T Wharton	R	100			100	100			
J Matthiessen	R	30			30	30			
J La Salle	R	15			15	15			
R Vickers	R	10			10	10			
R Floyd	R	7.5			7.5	7.5			
P De Barro	R	3			3	3			
Total		165.5	0	0	165.5	165.5	0	0	0
CSIRO Forestry & Forest Products									
D Mummery	R	90		90		90			
M Battaglia	R	90		90		90			
C Beadle	R	80		80		80			
P Sands	R	80		80		80			
P Smethurst	R	72		72		72			
C Raymond (end Nov 02)	R	64	32	32		64			
C Harwood(from Dec 02)	R	25	12.5	12.5		25			
G Moran	R	30	30			30			
B McCormack	R	10		10		10			
E Williams	R	10	10			10			
C Mohammed	R	10			10	10			
R Evans	R	5	5			5			
P Cotterill	A	5							5
S Nambiar	A	5							5
G Kile	A	5							5
S Midgley	A	2							2
R Lockwood	A	1							1
Total		584	89.5	466.5	10	566	0	0	18
Department Primary Industries Qld									
M Dieters	R	76	76			76			
Z Xu	R	68		68		68			
K Bubb	R	66		66		66			
J Simpson	R	51		51		51			
P Ryan	R	38		38		38			
D Osborne	R	36		36		36			
M Nester	R	33		33		33			
M Hunt	R	28		28		28			
M Lewty	R	28		28		28			
I Last	R	12	5	7		12			
A House	R	9		9		9			
K Harding	R	7	7			7			
Total		452	88	364	0	452	0	0	0
Forest Enterprises Australia									
R Jacobson	R	2					2		
D Barker	R	1					1		
T Cannon	A	1							1
Total		4	0	0	0	0	3	0	1

RESEARCH STAFF RESOURCES (2002/2003)

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
Forestry Tasmania									
J Elek	R	40			40	40			
A Walsh	R	40			40	40			
P Kube	R	30	29			29			2
L Pinkard	R	20		20		20			
L Apiolaza	R	16			16	16			
P Adams	R	10		10		10			
P Volker	R	5	5			5			
B Neilsen	R	3				0			3
S Candy	R	3			3	3			
M Brown	R/A	5				0			5
N McCormick	R/A	5				0			5
S Grove	R/A	5				0			5
T Wardlaw	R/A	5				0			5
J Hickey	R/A	3				0			3
H Driefsma	R/A	3				0			3
Total		193	34	30	99	163	0	0	31
Grand Ridge Plantations									
P Buxton	R	25	25			25			
B McGennisken	R	20	5	10	5	20			
R Appleton	R	15	5	5	5	15			
S Elms	A	5	3	2		5			
S Penfold	A	5							5
Total		70	38	17	10	65	0	0	5
Griffith University									
J Chaseling	R	30		30		30			
P Healy	R	20		20		20			
J Hughes	R	10		10		10			
S Boyd	R	10		10		10			
I Phillips	R	5		5		5			
H Ghadiri	R	5		5		5			
R Kitching	A	5							5
Total		85	0	80	0	80	0	0	5
Gunns Limited									
C Barnes	R/A	5		2	2	4			1
I Ravenwood	R/A	5	3			3			2
Total		10	3	2	2	7	0	0	3
Norske Skog Paper Mills									
S Hetherington	R	6		3	1	4	1		1
C Berry	R	4		3		3			1
A Willems	A	2							2
Total		12	0	6	1	7	1	0	4
Private Forests Tasmania									
A Lyons	R	1		1		1			
A Warner	R	4		4		4			
G Clark	R	1		1		1			
G Campbell	R	1		1		1			
Total		7	0	7	0	7	0	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			
P Baverstock	A	5							5
Total		55	40	0	0	40	5	0	10
Southern Tree Breeding Association									
T McRae	R	13	13			13			
D Pilbeam	R	10	10			10			
M Powell	R	2	2			2			
Total		25	25	0	0	25	0	0	0

RESEARCH STAFF RESOURCES (2002/2003) 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
The Australian National University									
P Kanowski	R	30				0	30		
D Race	R	25		25		25			
J Bauhus	R	15				0	15		
W Foley	R	12.5				0	12.5		
S Mahendrarajah	R	10				0	10		
R James	R	10				0	10		
Total		102.5	0	25	0	25	77.5	0	0
The University of Queensland									
D Doley	R	25		25		25			
Total		25	0	25	0	25	0	0	0
Timbercorp									
J Bulinski	R	55			55	55			
I Bail	R/A	13		3		3			10
H O'Sullivan	R	10	10			10			
G Samsa	R	5		5		5			
M Worthington	R	2				0			2
Q Clasen	R	1		1		1			
Total		86	10	9	55	74	0	0	12
University of Tasmania									
B Potts	R	50	50			50			
C McArthur	R	50			50	50			
G Allen	R	50			50	50			
N Davidson	R/E	50				0	50		
R Vaillancourt	R	45	45			45			
R Wiltshire	R	20	5			5	15		
S Jennings	R	15		15		15			
C Mohammed	R	15			15	15			
G Jordan	R	15				0	15		
K Barry	R	5			5	5			
J Reid	A	5	3			3	3		
M Hovenden	E	15					15		
A Richardson	E	5					5		
P Brown	E	5					5		
D Close	E	5				0	5		
P McQuillan	E	5					5		
S Shabala	E	5					5		
E Bruce	E	5					5		
J Kirkpatrick	E	5					5		
R Doyle	E	5					5		
N Mendham	E	5					5		
S McLean	E	5					5		
R Boyle	E	5					5		
F Vanclay	E	5					5		
L Pinkard	E	5					5		
R Griffin	R/A	40	10			10			30
P Lane	A	5							5
R Clark	A	5							5
G Hallegraeff	A	5							5
R Swain	A	5							5
A Glenn	A	2							2
Total		462	113	15	120	248	163	0	52
WACAP Treefarms									
C Shedley	R	60	2	58		60			
M Barness	R	25		2	23	25			
S Hunter	R	25	5	3	7	15			10
D Pilbeam	R	5	5			5			
R Breidahl	R	5	0	1		1			4
I Telfer	R	2	1			1			1
B Humble	R	2	2			2			
P Durrell	R	2	2			2			
C Palmer	A	2							2
N Itakura/K Oshima	A	2							2
Total		130	17	63	30	111	0	0	19

RESEARCH STAFF RESOURCES (2002/2003)

ATTACHMENT B

Organisation		Main Activity	Total % Time	% Spent on Research Program			Total on Research	% Spent on Educn	% Spent on Commln Program	% Spent on CRC Admin
				GI	*SM*	*RP*				
CRC Funded										
L Apiolaza(till April 03)	Utas	R	100	100			100			
J Brawner(from Oct 02)	DPI Qld	R	100	100			100			
K Catchpoole	QFRI	R	100		100		100			
C Chen	QFRI	R	100		100		100			
Y Li	Utas	R	100	100			100			
M Matsuki	Utas	R	100			100	100			
A Mitchell	CSIRO FFP/Utas	R	100		100		100			
A O'Grady	Utas	R	100		100		100			
M Shepherd	SCU	R	100	100			100			
M Steinbauer	CSIRO Ento	R	100			100	100			
R Thumma	CSIRO FFP	R	100	100			100			
T Blumfield	GU	R	100		100		100			
D Steane	Utas	R	80	80			80			
B Patterson	Utas	R	55	55			55			
I Andrew	QFRI	R	52		52		52			
B Potts	Utas	R	50	50			50			
C McArthur	Utas	R	50			50	50			
F Henskens	Utas	R	40		40		40			
J Van Putten	Utas	R	40		40		40			
N Mathers	GU	R	25		25		25			
D Kain	ANU	R	25	25			25			
P Smethurst	CSIRO FFP	R	28		28		28			
T Tabart/J Hyland	Utas	R	25		25		25			
D Race	ANU	R	25		25		25			
G Jordan	Utas	R	16	16			16			
G Dutkowski	Utas	E	100					100		
N Davidson	Utas	E	50		25		25	25		
R Griffin	Utas	A	40				0			40
Total			1901	726	760	250	1736	125	0	40

SUMMARY OF CONTRIBUTIONS IN PERSON YEARS

	Total Person Years	Person Years Spent on Research Program				Person Yrs Spent on Educn Program	Person Yrs Spent on Commln Program	Person Yrs Spent on CRC Admin
		GI	*SM*	*RP*	Total on Research			
Total Contributed	24.8	4.7	11.1	4.9	20.7	2.5	0.0	1.6
Total funded by CRC	19.0	7.3	7.6	2.5	17.4	1.3	0.0	0.4
Grand total	43.8	11.9	18.7	7.4	38.1	3.7	0.0	2.0
Proportion of total professional (%) staff resources in each activity	100.0	27.3	42.7	16.9	86.9	8.5	0.0	4.6

SUPPORT STAFF 2002/03

Contributed	
Organisation	Number of Staff (Person Years)
CSIRO (FFP & Ento)	6.30
Department of Primary Industries Qld	2.58
Forestry Tasmania	1.75
Gunns Limited	1.00
University of Tasmania	0.80
Southern Cross University	0.30
Timbercorp	0.11
WACAP Treefarms	0.15
Grand Ridge Plantations	0.05
Norske Skog Paper Mills	0.02
Total	13.06

CRC Funded (by Employing Organisation)	
Organisation	Number of Staff (Person Years)
University of Tasmania	12.5
CSIRO (FFP & Ento)	2.2
Southern Cross University	0.8
Department of Primary Industries Qld	0.5
Total	16.0

IN-KIND CONTRIBUTIONS FROM PARTNERS ($'000)

ATTACHMENT C TABLE 1

PARTNER		EXPENDITURE							CUMULATIVE		PROJECTED		GRAND TOTAL		
		1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2002/03	Total to Date		2003/04	2003/04	Total	Agreement	Difference
		Actual	Actual	Actual	Actual	Actual	Actual	Agr'mt	Actual	Agr'mt	Budget	Agr'mt	7 Years	7 years	7 years
AUSTRALIAN FOREST GROWERS															
	SALARIES	1.1	1.1	1.3	1.2	1.3	**1.1**	**0.0**	7.1	0.0	1.1	0.0	8.2	0.0	8.2
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	0.3	0.3	0.3	0.3	0.3	**0.3**	**1.0**	1.8	6.0	0.3	1.0	2.1	7.0	-4.9
	TOTAL	1.4	1.4	1.6	1.5	1.6	**1.4**	**1.0**	8.9	6.0	1.4	1.0	10.3	7.0	3.3
AUSTRALIAN PLANTATION TIMBER															
	SALARIES	0.0	0.0	0.0	83.0	0.0	**0.0**	**83.0**	83.0	249.0	0.0	83.0	83.0	332.0	-249.0
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	0.0	0.0	0.0	117.7	0.0	**0.0**	**117.0**	117.7	351.0	0.0	117.0	117.7	468.0	-350.3
	TOTAL	0.0	0.0	0.0	200.7	0.0	**0.0**	**200.0**	200.7	600.0	0.0	200.0	200.7	800.0	-599.3
CSIRO ENTOMOLOGY															
	SALARIES	163.2	148.6	216.4	212.6	226.2	**186.7**	**152.0**	1,153.7	912.0	111.4	152.0	1,265.1	1,064.0	201.1
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	239.7	254.1	260.9	250.7	238.0	**313.0**	**273.0**	1,556.4	1,638.0	186.4	273.0	1,742.8	1,911.0	-168.2
	TOTAL	402.9	402.7	477.3	463.3	464.2	**499.7**	**425.0**	2,710.1	2,550.0	297.8	425.0	3,007.9	2,975.0	32.9
CSIRO FORESTRY and FOREST PRODUCTS															
	SALARIES	652.6	691.1	679.8	722.3	763.1	**801.5**	**618.0**	4,310.4	3,796.0	748.2	618.0	5,058.6	4,414.0	644.6
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	1,410.0	1,495.8	1,460.4	1,291.5	1,616.9	**1,485.9**	**1,345.0**	8,760.5	8,235.0	1,594.7	1,345.0	10,355.2	9,580.0	775.2
	TOTAL	2,062.6	2,186.9	2,140.2	2,013.8	2,380.0	**2,287.4**	**1,963.0**	13,070.9	12,031.0	2,342.9	1,963.0	15,413.8	13,994.0	1,419.8
DEPARTMENT OF PRIMARY INDUSTRIES QLD															
	SALARIES	449.8	421.7	416.9	460.2	487.3	**509.7**	**322.0**	2,745.6	1,932.0	390.2	322.0	3,135.8	2,254.0	881.8
	CAPITAL	28.4	0.0	0.0	0.0	0.0	**0.0**	**0.0**	28.4	0.0	0.0	0.0	28.4	0.0	28.4
	OTHER	526.0	384.2	426.8	382.5	379.7	**363.4**	**380.0**	2,462.6	2,280.0	381.0	380.0	2,843.6	2,660.0	183.6
	TOTAL	1,004.2	805.9	843.7	842.7	867.0	**873.1**	**702.0**	5,236.6	4,212.0	771.2	702.0	6,007.8	4,914.0	1,093.8
FOREST ENTERPRISES AUSTRALIA															
	SALARIES	0.0	0.0	0.0	5.0	4.0	**2.3**	**0.0**	11.3	0.0	0.0	0.0	11.3	0.0	11.3
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	0.0	0.0	0.0	1.0	0.0	**0.0**	**2.0**	1.0	7.0	2.0	2.0	3.0	9.0	-6.0
	TOTAL	0.0	0.0	0.0	6.0	4.0	**2.3**	**2.0**	12.3	7.0	2.0	2.0	14.3	9.0	5.3
FORESTRY TASMANIA															
	SALARIES	137.0	157.0	188.0	156.2	158.0	**151.0**	**149.0**	947.2	716.0	191.1	164.0	1,138.3	880.0	258.3
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	179.1	168.6	239.7	199.2	185.1	**183.3**	**185.0**	1,155.0	885.0	224.1	203.0	1,379.1	1,088.0	291.1
	TOTAL	316.1	325.6	427.7	355.4	343.1	**334.3**	**334.0**	2,102.2	1,601.0	415.2	367.0	2,517.4	1,968.0	549.4
GRAND RIDGE PLANTATIONS															
	SALARIES	65.8	83.2	58.3	66.6	34.4	**61.3**	**85.0**	369.6	510.0	98.6	85.0	468.2	595.0	-126.8
	CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OTHER	135.5	124.9	108.4	120.0	12.9	**286.7**	**121.0**	788.4	726.0	140.3	121.0	928.7	847.0	81.7
	TOTAL	201.3	208.1	166.7	186.6	47.3	**348.0**	**206.0**	1,158.0	1,236.0	238.9	206.0	1,396.9	1,442.0	-45.1

IN-KIND CONTRIBUTIONS FROM PARTNERS ($'000)

ATTACHMENT C TABLE 1

PARTNER	EXPENDITURE							CUMULATIVE		PROJECTED		GRAND TOTAL		
	1997/98 Actual	1998/99 Actual	1999/00 Actual	2000/01 Actual	2001/02 Actual	**2002/03 Actual**	**2002/03 Agr'mt**	Total to Date Actual	Agr'mt	2003/04 Budget	2003/04 Agr'mt	Total 7 Years	Agreement 7 years	Difference 7 years
GRIFFITH UNIVERSITY														
SALARIES	163.7	108.8	109.8	83.2	89.0	**126.7**	**126.5**	681.2	769.0	106.7	126.5	787.9	895.5	-107.6
CAPITAL	0.0	20.0	20.0	20.0	20.0	**20.0**	**0.0**	100.0	0.0	20.0	0.0	120.0	0.0	120.0
OTHER	150.6	116.5	117.5	89.1	95.2	**135.6**	**116.4**	704.5	698.4	114.1	116.4	818.6	814.8	3.8
TOTAL	314.3	245.3	247.4	192.3	204.2	**282.3**	**242.9**	1,485.8	1,467.4	240.8	242.9	1,726.6	1,710.3	16.3
GUNNS LTD(Formerly GFP)														
SALARIES	263.0	252.2	154.7	217.7	209.5	**66.0**	**100.0**	1,163.1	600.0	67.5	100.0	1,230.6	700.0	530.6
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	369.0	312.6	158.3	127.7	99.8	**91.7**	**216.0**	1,159.1	1,296.0	94.0	216.0	1,253.1	1,512.0	-258.9
TOTAL	632.0	564.8	313.0	345.4	309.3	**157.7**	**316.0**	2,322.2	1,896.0	161.5	316.0	2,483.7	2,212.0	271.7
GUNNS LIMITED														
SALARIES	6.4	24.5	28.4	15.1	0.0	**0.0**	**0.0**	74.4	25.0	0.0	0.0	74.4	25.0	49.4
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	34.8	42.0	13.3	11.0	0.0	**0.0**	**0.0**	101.1	175.0	0.0	0.0	101.1	175.0	-73.9
TOTAL	41.2	66.5	41.7	26.1	0.0	**0.0**	**0.0**	175.5	200.0	0.0	0.0	175.5	200.0	-24.5
NORSKE SKOG PAPER MILLS														
SALARIES	34.0	21.1	23.7	29.7	23.9	**15.2**	**28.0**	147.6	165.0	25.1	28.0	172.7	193.0	-20.3
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	186.0	171.0	199.0	188.0	143.0	**121.7**	**161.0**	1,008.7	976.0	180.0	161.0	1,188.7	1,137.0	51.7
TOTAL	220.0	192.1	222.7	217.7	166.9	**136.9**	**189.0**	1,156.3	1,141.0	205.1	189.0	1,361.4	1,330.0	31.4
PRIVATE FORESTS TASMANIA														
SALARIES	0.0	0.0	10.2	5.5	11.2	**3.5**	**8.1**	30.4	28.4	1.6	8.1	32.0	36.5	-4.5
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	0.0	0.0	17.2	0.0	4.0	**0.4**	**16.3**	21.6	57.0	0.0	16.3	21.6	73.3	-51.7
TOTAL	0.0	0.0	27.4	5.5	15.2	**3.9**	**24.4**	52.0	85.4	1.6	24.4	53.6	109.8	-56.2
SEEDENERGY PTY LTD														
SALARIES	0.0	0.0	0.0	0.0	11.4	**19.4**	**9.4**	30.8	18.8	9.4	9.4	40.2	28.2	12.0
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	0.0	0.0	0.0	0.0	1.5	**2.5**	**1.5**	4.0	3.0	1.5	1.5	5.5	4.5	1.0
TOTAL	0.0	0.0	0.0	0.0	12.9	**21.9**	**10.9**	34.8	21.8	10.9	10.9	45.7	32.7	13.0
SERVE-AG														
SALARIES	0.0	0.0	10.5	8.5	0.0	**0.0**	**0.0**	19.0	18.7	0.0	0.0	19.0	18.7	0.3
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	0.0	0.0	21.5	12.0	0.0	**0.0**	**0.0**	33.5	28.1	0.0	0.0	33.5	28.1	5.4
TOTAL	0.0	0.0	32.0	20.5	0.0	**0.0**	**0.0**	52.5	46.8	0.0	0.0	52.5	46.8	5.7
SOUTHERN CROSS UNIVERSITY														
SALARIES	62.9	68.0	70.2	71.0	75.2	**87.7**	**60.0**	435.0	360.0	73.8	60.0	508.8	420.0	88.8
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	189.7	287.8	300.5	306.8	361.3	**467.6**	**249.0**	1,913.7	1,494.0	336.9	249.0	2,250.6	1,743.0	507.6
TOTAL	252.6	355.8	370.7	377.8	436.5	**555.3**	**309.0**	2,348.7	1,854.0	410.7	309.0	2,759.4	2,163.0	596.4

IN-KIND CONTRIBUTIONS FROM PARTNERS ($'000)

ATTACHMENT C TABLE 1

PARTNER	EXPENDITURE							CUMULATIVE		PROJECTED		GRAND TOTAL		
	1997/98 Actual	1998/99 Actual	1999/00 Actual	2000/01 Actual	2001/02 Actual	**2002/03 Actual**	**2002/03 Agr'mt**	Total to Date Actual	Agr'mt	2003/04 Budget	2003/04 Agr'mt	Total 7 Years	Agreement 7 years	Difference 7 years
SOUTHERN TREE BREEDING ASS'N														
SALARIES	6.0	6.0	14.8	25.7	26.8	**28.0**	**0.0**	107.3	0.0	23.8	0.0	131.1	0.0	131.1
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	0.0	37.0	0.0	0.0	0.0	**0.0**	**5.0**	37.0	30.0	0.0	5.0	37.0	35.0	2.0
TOTAL	6.0	43.0	14.8	25.7	26.8	**28.0**	**5.0**	144.3	30.0	23.8	5.0	168.1	35.0	133.1
THE AUSTRALIAN NATIONAL UNIVERSITY														
SALARIES	59.2	59.2	62.6	67.4	71.6	**105.7**	**63.8**	425.7	382.8	67.4	63.8	493.1	446.6	46.5
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	177.7	177.7	187.8	202.2	214.8	**317.1**	**112.0**	1,277.3	672.0	202.2	112.0	1,479.5	784.0	695.5
TOTAL	236.9	236.9	250.4	269.6	286.4	**422.8**	**175.8**	1,703.0	1,054.8	269.6	175.8	1,972.6	1,230.6	742.0
THE UNIVERSITY OF QUEENSLAND														
SALARIES	8.6	23.6	24.3	24.6	24.8	**14.0**	**25.0**	119.9	150.0	25.0	25.0	144.9	175.0	-30.1
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	10.0	47.0	47.0	47.0	47.0	**26.0**	**47.0**	224.0	282.0	47.0	47.0	271.0	329.0	-58.0
TOTAL	18.6	70.6	71.3	71.6	71.8	**40.0**	**72.0**	343.9	432.0	72.0	72.0	415.9	504.0	-88.1
TIMBERCORP														
SALARIES	0.0	0.0	20.6	114.8	89.1	**92.1**	**93.8**	316.6	304.9	93.8	93.8	410.4	398.7	11.7
CAPITAL	0.0	0.0	2.0	0.0	0.0	**0.0**	**0.0**	2.0	0.0	0.0	0.0	2.0	0.0	2.0
OTHER	5.0	5.0	5.0	272.8	195.8	**223.2**	**198.9**	706.8	716.5	220.5	198.9	927.3	915.4	11.9
TOTAL	5.0	5.0	27.6	387.6	284.9	**315.3**	**292.7**	1,025.4	1,021.4	314.3	292.7	1,339.7	1,314.1	25.6
UNIVERSITY OF TASMANIA														
SALARIES	385.4	402.7	410.5	455.3	472.2	**506.1**	**386.7**	2,632.2	2,320.2	492.0	386.7	3,124.2	2,706.9	417.3
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	703.1	825.3	792.4	828.8	845.3	**875.3**	**763.0**	4,870.2	4,516.0	866.3	763.0	5,736.5	5,279.0	457.5
TOTAL	1,088.5	1,228.0	1,202.9	1,284.1	1,317.5	**1,381.4**	**1,149.7**	7,502.4	6,836.2	1,358.3	1,149.7	8,860.7	7,985.9	874.8
WACAP TREEFARMS														
SALARIES	65.9	71.4	62.8	55.7	61.0	**64.0**	**55.0**	380.8	330.0	63.8	55.0	444.6	385.0	59.6
CAPITAL	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	106.0	113.1	113.4	116.0	116.0	**115.4**	**115.0**	679.9	690.0	112.5	115.0	792.4	805.0	-12.6
TOTAL	171.9	184.5	176.2	171.7	177.0	**179.4**	**170.0**	1,060.7	1,020.0	176.3	170.0	1,237.0	1,190.0	47.0
TOTAL IN-KIND CONTRIBUTIONS														
SALARIES	2,524.6	2,540.2	2,563.8	2,881.3	2,840.0	**2,842.0**	**2,365.3**	16,191.9	13,587.8	2,590.5	2,380.3	18,782.4	15,968.1	2,814.3
CAPITAL	28.4	20.0	22.0	20.0	20.0	**20.0**	**0.0**	130.4	0.0	20.0	0.0	150.4	0.0	150.4
OTHER	4,422.5	4,562.9	4,469.4	4,564.3	4,556.6	**5,009.1**	**4,425.1**	27,584.8	25,762.0	4,703.8	4,443.1	32,288.6	30,205.1	2,083.5
GRAND TOTAL IN-KIND	**6,975.5**	**7,123.1**	**7,055.2**	**7,465.6**	**7,416.6**	**7,871.1**	**6,790.4**	**43,907.1**	**39,349.8**	**7,314.3**	**6,823.4**	**51,221.4**	**46,173.2**	**5,048.3**

ATTACHMENT C TABLE 2

CASH CONTRIBUTIONS ($'000)

PARTNERS	ACTUAL 1997/98 Actual	1998/99 Actual	1999/2000 Actual	2000/01 Actual	2001/02 Actual	**2002/03 Actual**	**2002/03 Agr'mt**	CUMULATIVE Total to Date Actual	Agr'mt	PROJECTED 2003/04 Budget	2003/04 Agr'mt	GRAND TOTAL Total 7 yrs	Agr'mt 7 yrs	Diff 7 yrs
Australian Forest Growers	1.0	1.0	1.0	1.0	1.0	**1.0**	**1.0**	6.0	6.0	1.0	1.0	7.0	7.0	0.0
Australian Plantation Timber (i)	0.0	0.0	0.0	50.0	0.0	**10.0**	**50.0**	60.0	150.0	0.0	50.0	60.0	200.0	-140.0
Department Primary Industries Qld	25.0	50.3	0.0	25.0	25.0	**50.0**	**25.0**	175.3	150.0	0.0	25.0	175.3	175.0	0.3
Forest Enterprises Australia	0.0	0.0	0.0	2.3	3.7	**3.0**	**3.0**	9.0	10.5	3.0	3.0	12.0	13.5	-1.5
Forestry Tasmania	22.5	19.3	15.0	11.6	18.4	**15.0**	**15.0**	101.8	90.0	15.0	15.0	116.8	105.0	11.8
Grand Ridge Plantations	35.0	35.6	35.0	35.0	35.0	**35.0**	**35.0**	210.6	210.0	35.0	35.0	245.6	245.0	0.6
Griffith University	25.0	26.2	25.0	18.7	25.0	**31.3**	**25.0**	151.2	150.0	25.0	25.0	176.2	175.0	1.2
Gunns Ltd (formerly Gunns Forest Products)	65.1	50.0	30.0	20.0	25.0	**25.0**	**25.0**	215.1	212.5	25.0	25.0	240.1	237.5	2.6
Gunns Limited (former supporting membership)	0.0	2.2	0.0	0.0	0.0	**0.0**	**0.0**	2.2	0.0	0.0	0.0	2.2	0.0	2.2
Norske Skog Paper Mills	22.4	20.8	20.0	20.0	20.0	**20.0**	**20.0**	123.2	120.0	20.0	20.0	143.2	140.0	3.2
Private Forests Tasmania (i)	0.0	0.0	0.0	17.5	3.0	**3.0**	**3.0**	23.5	36.0	3.0	3.0	26.5	39.0	-12.5
Serve-Ag (i)	0.0	0.0	0.0	1.2	0.8	**0.0**	**0.0**	2.0	2.5	0.0	0.0	2.0	2.5	-0.5
Southern Cross University	100.0	100.3	100.0	100.0	100.0	**100.0**	**100.0**	600.3	600.0	100.0	100.0	700.3	700.0	0.3
Timbercorp	0.0	0.0	0.0	50.0	62.5	**50.0**	**50.0**	162.5	162.5	50.0	50.0	212.5	212.5	0.0
University of Tasmania	0.0	0.3	0.0	0.0	0.0	**0.0**	**0.0**	0.3	0.0	0.0	0.0	0.3	0.0	0.3
WACAP Treefarms	35.0	36.2	35.0	35.0	35.0	**35.0**	**35.0**	211.2	210.0	35.0	35.0	246.2	245.0	1.2
TOTAL CASH FROM PARTICIPANTS	331.0	342.2	261.0	387.3	354.4	**378.3**	**387.0**	2,054.2	2,110.0	312.0	387.0	2,366.2	2,497.0	-130.8
OTHER CASH														
Interest	20.4	67.5	67.9	121.9	92.7	**89.8**	**0.0**	460.2	0.0	40.0	0.0	500.2	0.0	500.2
Non-participants	7.8	23.4	11.0	3.2	0.0	**0.0**	**0.0**	45.4	0.0	0.0	0.0	45.4	0.0	45.4
Other external funds	0.0	0.0	214.6	17.9	42.5	**91.2**	**0.0**	366.2	0.0	0.0	0.0	366.2	0.0	366.2
CRC Grant	1,718.1	2,313.0	2,328.4	2,346.9	2,384.5	**2,429.8**	**2,300.0**	13,520.7	13,180.0	2,476.0	2,300.0	15,996.7	15,480.0	516.7
TOTAL CRC CASH CONTRIBUTIONS	2,077.3	2,746.1	2,882.9	2,877.2	2,874.1	**2,989.1**	**2,687.0**	16,446.7	15,290.0	2,828.0	2,687.0	19,274.7	17,977.0	1,297.7
Cash carried over from previous year	741.0	1,002.6	1,338.1	1,743.2	1,923.4	**1,813.6**				1,163.2				
Less unspent balance	1,002.6	1,338.1	1,743.2	1,923.4	1,813.6	**1,163.2**				754.8				
TOTAL CASH EXPENDITURE	1,815.7	2,410.7	2,477.8	2,697.0	2,983.9	**3,639.5**	**2,607.0**	16,024.6	15,568.0	3,236.4	2,603.0	19,261.0	18,171.0	1,090.0
ALLOCATION OF CASH EXPENDITURE BETWEEN HEADS OF EXPENDITURE														
SALARIES	1,288.9	1,686.4	1,503.4	1,757.3	1,899.3	**2,488.0**	**1,702.0**	10,623.3	10,238.0	2,043.4	1,703.0	12,666.7	11,941.0	725.7
CAPITAL(ii)	0.0	0.0	0.0	0.0	0.0	**89.0**	**0.0**	89.0	0.0	0.0	0.0	89.0	0.0	89.0
OTHER	526.8	724.3	974.3	939.7	1,084.6	**1,062.5**	**905.0**	5,312.2	5,330.0	1,193.0	900.0	6,505.2	6,230.0	275.2

(i) During 2002/03 Serve-AG membership ended; PPT membership was reduced to Associate Party; APT expelled from Joint Venture

(ii) Purchase 3 motor vehicles in 2002/03

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

ATTACHMENT C TABLE 3

ALL PROGRAMS

	ACTUAL							CUMULATIVE Total to Date		PROJECTED		GRAND TOTAL		
	1997/98 Actual	1998/99 Actual	1999/00 Actual	2000/01 Actual	2001/02 Actual	2002/03 Actual	2002/03 Agr'mt	Actual	Agr'mt	2003/04 Budget	2003/04 Agr'mt	Total 7 yrs	Agr'mt 7 yrs	Diff 7 yrs
GRAND TOTAL (IN-KIND)	6,975.5	7,123.1	7,055.1	7,465.7	7,416.6	**7,871.1**	**6,790.4**	43,907.1	39,349.8	7,314.3	6,823.4	51,221.4	46,173.2	5,048.2
GRAND TOTAL (CASH EXPENDITURE)	1,816.7	2,410.7	2,477.8	2,697.0	2,983.9	**3,639.5**	**2,607.0**	16,024.6	15,568.0	3,236.4	2,603.0	19,261.0	18,171.0	1,090.0
TOTAL RESOURCES APPLIED TO ACTIVITIES OF CENTRE	8,791.2	9,533.8	9,532.9	10,162.6	10,400.5	**11,510.6**	**9,397.4**	59,931.6	54,917.8	10,550.7	9,426.4	70,482.3	64,344.2	6,138.1

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

TOTAL SALARIES (CASH AND IN-KIND)	3,813.5	4,226.6	4,067.2	4,638.6	4,739.3	**5,330.0**	**4,067.3**	26,815.2	23,825.8	4,633.9	4,083.3	31,449.1	27,909.1	3,540.0
TOTAL CAPITAL (CASH AND IN-KIND)	28.4	20.0	22.0	20.0	20.0	**109.0**	**0.0**	219.4	0.0	20.0	0.0	239.4	0.0	239.4
TOTAL OTHER (CASH AND IN-KIND)	4,949.3	5,287.2	5,443.6	5,504.0	5,641.2	**6,071.6**	**5,330.1**	32,896.9	31,092.0	5,896.8	5,343.1	38,793.7	36,435.1	2,358.7

ATTACHMENT C TABLE 4

ALLOCATION OF RESOURCES BETWEEN CATEGORIES OF ACTIVITIES 2002/2003

PROGRAM	RESOURCE USAGE			
	Cash (1) $'000	In-kind $'000	Contributed Staff (2)	Cash Funded Staff (CRC) (2)
Research	3,162.8	6,840.0	20.7	17.4
Education (3)	309.4	669.0	2.5	1.3
Administration	167.4	362.1	1.6	0.4
TOTAL	3,639.6	7,871.1	24.8	19.0

(1) Cash from all sources, including CRC Program
(2) Professional staff in person years
(3) Includes External Communications & Tech Transfer

ABBREVIATIONS

A/Prof	Associate Professor
AFFA	Commonwealth Department of Agriculture, Fisheries and Forestry Australia
AFG	Australian Forest Growers
AGBU	Animal Genetics and Breeding Unit, University of New England
AGRF	Australian Genome Research Facility
AIDAB	Australian International Development Assistance Bureau
ANIC	Australian National Insect Collection
ANU	Australian National University
APA-I	Australian Postgraduate Award - Industry
ARC	Australian Research Council
ASREML	Quantitative genetics computer program
CALM	Department of Conservation and Land Management
CFFT	Centre for Forest Tree Technology
CRC-SPF	Cooperative Research Centre for Sustainable Production Forestry
CSIRO SE	CSIRO Sustainable Ecosystems
CSIRO Ento	CSIRO Entomology
CSIRO FFP	CSIRO Forestry and Forest Products
CSIRO PI	CSIRO Plant Industry
DELM	Department of Environment and Land Management
DPIQ	Department of Primary Industries Queensland
DPIWE	Department of Primary Industries, Water and Environment
ETT	Education and Technology Transfer Program
FEA	Forest Enterprises Australia Pty Ltd
FFIC	Forests and Forest Industry Council
FFPRDC	Forestry and Forest Products Research and Development Corporation
FNCRDC	Forest and Nature Conservation Research and Development Center, Indonesia
ForSA	Forestry South Australia
FR	Forest Research, New Zealand
FRIM	Forest Research Institute Malaysia
FT	Forestry Tasmania
FWPRDC	Forest & Wood Products R&D Corporation
GI	Genetic Improvement Program
GL	Gunns Limited
GMU	Gadjah Mada University, Indonesia
GRP	Grand Ridge Plantations Pty Ltd
GU	Griffith University
HVP	Hancocks Victoria Plantation
ICFR	Institute for Commercial Forestry Research
INRA	Institut National de la Recherche Agronomique, France
INTA	Instituto Nacional de Tecnologia Agropecuaria, Argentina
IUFRO	International Union of Forest Research Organisations
JVAP	Joint Venture Agroforestry Project
LWRDC	Land and Water Research and Development Corporation
NCSU	North Carolina State University, USA
NHT	Natural Heritage Trust
NS	Norske Skog Paper Mills (Australia) Limited
NZ	New Zealand
PFT	Private Forests Tasmania
QFRI	Queensland Forestry Research Institute
RAIZ	Instituto de Investigação de Floresta e Papel, Portugal
RIRDC	Rural Industries Research and Development Corporation
RP	Resource Protection Program

SCu	Southern Cross University
sE	*seedEnergy* Pty Ltd
SF NSW	State Forests of New South Wales
Sm	Sustainable Management Program
SPIRT	Strategic Partnership with Industry - Research and Training, ARC
STBA	Southern Tree Breeding Association Incorporated
TC	Timbercorp Limited
TFGA	Tasmanian Farmers and Graziers Association
UA	University of Adelaide
UF	University of Florida
UL	University of Louisiana, USA
UM	University of Melbourne
UNA	University of North Arizona, USA
UNE	University of New England
UQ	The University of Queensland
USC	University of the Sunshine Coast
USDA	United States Department of Agriculture
UT	University of Tasmania
UWA	University of Western Australia
UWS	University of Western Sydney
UZ	University of Zimbabwe
WACAP	WACAP Treefarms Pty Ltd
WAPRES	WA Plantation Resources

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