



Researching sustainable forest landscapes

ANNUAL REPORT 2010–11

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Australian Government's Cooperative Research Centres Program

Annual Report 2010–11

www.crcforestry.com.au



About this report

The annual report of the Cooperative Research Centre for Forestry has been prepared in accordance with the *Guidelines for annual reporting for the Cooperative Research Centres program* issued in February 2011.

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1 Executive summary

1.1 Achievements

The year under review was the sixth year of operation for the Cooperative Research Centre for Forestry (CRC). A number of CRC projects were completed during this year, and many others reached a stage at which research delivery and adoption resulted in demonstrable changes in policy and practice by our industry and government participants.

Along with emerging outcomes from program activities that have been operating for six years, the CRC also has recently delivered on a number of shorter term activities addressing areas of significant and growing industry priority and national interest, including competition for water resources, carbon sequestration outcomes of different forest management options, second rotation productivity in the hardwood plantation estate and an array of management responses to concerns around forest biodiversity.

Achievements for the 2010–11 financial year include:

- the release of the BPOS (Blue gum Productivity Optimisation System) decision-support tool in June 2011 to industry partners, which has substantially improved their capacity to forecast productivity and evaluate risk across the Australian plantation blue gum estate
- the release of remote sensing tools ForestSensing4 (inventory) and BFAST (forest health) to industry partners
- completion of a major report on the role of forests in greenhouse gas abatement, making a significant contribution to an important public policy debate
- completion of a world-first demonstration that molecular information can be integrated into breeding value predictions in established tree breeding programs, opening up the opportunity to greatly improve outcomes and cost-effectiveness of tree breeding programs
- significant advances in the commercial evaluation of sawn timber production from plantation grown hardwoods
- further deployment and industry uptake of hand-held near-infrared (NIR) scanning to evaluate pulp yield and other commercially important parameters quickly, reducing costs more than ten-fold, without resorting to destructive sampling
- demonstration of the utility of ground-based LiDAR systems and optimisation technology for improving value recovery in softwood plantation harvesting
- deployment of *Enhancing forest machine efficiency: Onboard computer selection and implementation guide* for harvesting equipment, and operational validation of the ALPACA and FastTRUCK decision-support tools
- completion of a number of studies relating forest management practices to catchment water quality and yield outcomes
- ongoing input into forest practices policy and management of biodiversity conservation in native forests and plantations
- publication of the *Community engagement handbook* in May 2011
- substantial input into public policy and negotiations relating to socioeconomic change in the forest and wood products sector throughout Australia.

1.2 Risks and impediments

The CRC is largely on track with milestones and deliverables identified in the Commonwealth Agreement. An external Research Advisory Panel (RAP) regularly benchmarks our progress and the quality of our research. The RAP is comprised of five Australian and international experts who together cover the breadth of the CRC's research, development, innovation and education portfolio. Despite the tumultuous nature of the year for the forest industry—with the ongoing impacts of the

global financial crisis, the high Australian dollar, the impact of the Japanese tsunami on global demand for woodchips and other market forces on the CRC's industry participants—there were no notable impediments to the achievement of our overall objectives.

Uptake of some technologies (e.g. use of molecular genetics in tree breeding, wood processing for sawn timber from plantations) has been slower than anticipated owing to the general downturn in the forest and wood products sector. The unprecedented volume of plantation assets that have changed ownership over the past year has also had some impact, although the CRC was quick to establish working relationships with the new owners in most instances.

1.3 End-user involvement

During the second half of our current funding term, the CRC's strategy has been to progressively increase the level of emphasis and resourcing to end-user engagement, implementation of adoption strategies and communication with stakeholders. The CRC currently employs a full-time Industry Engagement Manager, Industry Liaison Officer and Communications Manager, and a part-time Communications Officer and Communications and Administration Assistant.

Our program coordinating committees are chaired by industry representatives, and each project steering committee includes representatives of stakeholder organisations and research end users. Research adoption is assisted by a steady stream of specialist workshops, field days, research bulletins and technical reports, but it is the personal contact between scientists and practitioners and the close involvement of industry people in all stages of a project that ensures CRC research can be translated to policy and practice.

End users are systemically involved in all CRC projects involving field or operational trials, through involvement of personnel in research and development activities or project oversight, provision of field trial sites and logistic support, or participation in operational trials. At an organisational level, some organisations (e.g. state agencies) participate both as research providers and research users.

1.4 Outcomes

Improved ability to select planting sites and manage for increased profitability of plantation investments, through higher yields and lower costs of production.

There is now widespread industry use of CRC-developed decision tools in site selection, plantation management and performance forecasting. These tools, including ForestSensing4, CABALA V3 and BPOS, support appropriate decisions about plantation establishment and management, taking account of risk, climate variability and the diverse array of outcomes being sought by end users.

An additional decision tool, FPOS (Forest Productivity Optimisation System), is in an advanced stage of development, and will enable industry partners to substantially reduce the risks inherent in establishing different species in previously untested environments. End users of these tools include a substantial majority of the companies and state owned business enterprises that establish and manage plantations around Australia.

Uptake of these decision tools has been facilitated through the CRC's investment in technology transfer and industry support. In addition, the Industry Pest Management Group continues to provide direct technology transfer services relating to management of potentially economically significant plantation pests.

Increased use of planting stock with improved genetic potential, managed to optimise production of high-value wood for fibre and solid-wood markets.

Eucalyptus globulus makes up 65% of the hardwood plantation estate in Australia, and is an important plantation species worldwide. Findings on genetic control of key commercial traits such as

wood density and pulp yield in *E. globulus* have been incorporated into the pulpwood breeding programs of industry partners. Other genetic and silvicultural work on this species is nearing completion and results will be made available to industry participants in the final year of the CRC.

Processing studies on *E. nitens* have been completed and the CRC has developed processing techniques that substantially reduce value-limiting defects in sawn boards from eucalypt plantations. Processing studies on two subtropical species have also been completed. Investment in plantations in recent years has slowed for a variety of reasons, and market opportunities are only now emerging for much of this material, but we anticipate expanded use of research results in breeding programs in future years.

Adoption of harvesting and logistical practices that reduce delivered wood costs, contributing to industry profitability, while maintaining conformity with codes of practice and certification standards.

CRC developed decision tools such as ALPACA, FastTRUCK and the Machine Evaluation Toolbox have been further refined, and uptake by industry participants is increasing. Early implementation trials are yielding positive results, including documented cost-savings to industry participants of the order of 10%. The CRC continues to deliver these decision tools to industry via a series of targeted regional workshops and information sessions. As well, the guide *Enhancing forest machine efficiency: Onboard computer selection and implementation guide* has been deployed to industry partners, with trials to date showing improved productivity and cost savings can be made.

Improved security of access to land and forest resources for the forest industry, sustaining levels of investment in the establishment of new plantations, through demonstrated ability to manage in an environmentally and socially sustainable manner.

The CRC has been an active participant in evidence-based public debate on forestry issues, and has continued to provide information for Commonwealth and state policy formulation with respect to forestry, land use and water resource management. Widespread industry adoption of community engagement strategies, including deployment of the CRC's *Community engagement handbook*, is considered by many industry participants to be an important component of their social licence strategy.

CRC work on management of key pests and pathogens has contributed to risk reduction in plantation management, while a range of work on plantation and native forest silviculture has underpinned strategies for biodiversity conservation in a range of settings.

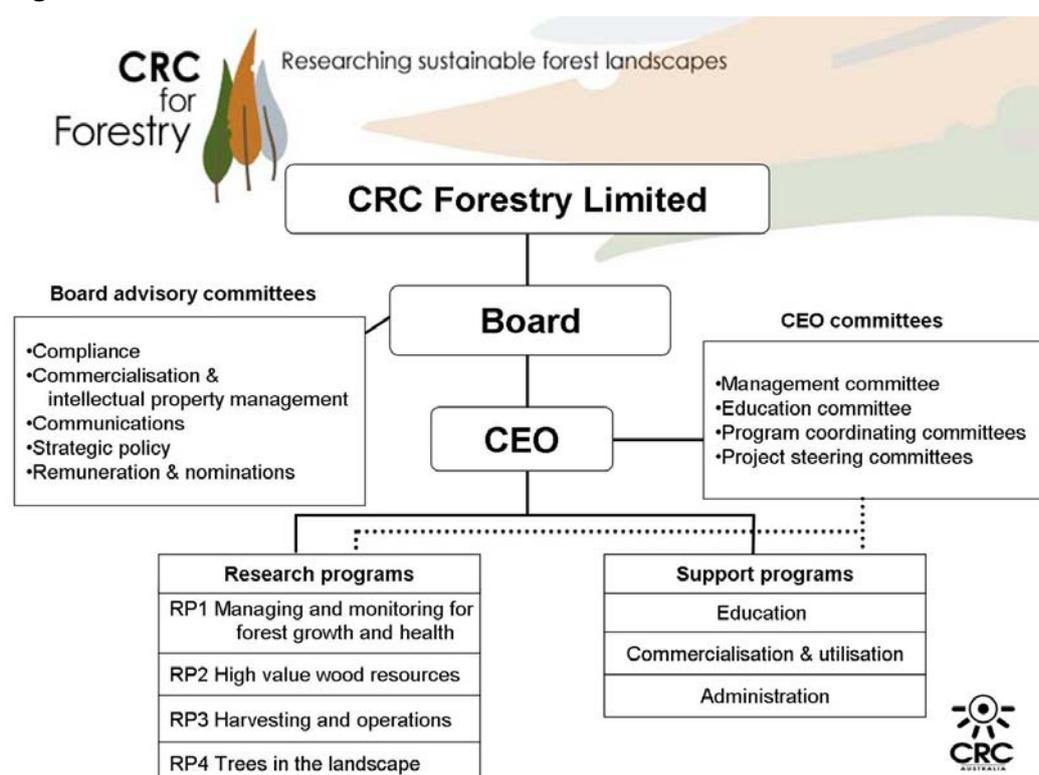
2 Governance and management

2.1 Governance—Board, committees and key staff

The CRC for Forestry operates through a company limited by guarantee (CRC Forestry Limited) and is administered through a Board of Directors. The company was registered in June 2005 and began formal CRC operations the following month.

CRC Forestry Limited has a private ruling from the Australian Taxation Office (Authorisation number 62282) that states installments paid to the company under the contract (i.e. the Commonwealth Agreement) are not assessable income until applied toward the conduct of the activities as specified in the contract.

Organisational chart



Governing Board

CRC Forestry Limited's Board of Directors has eight members, including an independent Chair. Six of the seven Directors are from the private sector. There were no changes to the membership of the Board during 2010–11. The table below outlines the membership of the Board and key skills of Board members.

Name	Role	Key skills	Independent/organisation
Anne Katherine (Kate) Carnell AO BPharm, FAIM, FAIPM, MAICD	Chair of the Board Chair, Remuneration and Nomination Committee Member, Compliance Committee Member, Communications Committee	Chief Executive Officer, Australian Food and Grocery Council Joined the Board at incorporation of the company on 30 June 2005 in a non-executive capacity	Independent

Lyndall Bull BForSci(Hons), BSc, PhD, MAICD	Member, Compliance Committee	Lecturer and National Convenor, National Forestry Masters Program, Australian National University Joined Board on 5 November 2008 in a non-executive capacity	Australian National University
Johannes (Hans) Hendrick Drielsma BScFor(Hons), MForSci, PhD	Chair, Communications Committee Member, Remuneration and Nomination Committee	Executive General Manager, Forestry Tasmania Joined the Board at incorporation of the company on 30 June 2005 in a non-executive capacity	Forestry Tasmania
Gary Brian Inions BSc(Hons), PhD	Member, Remuneration and Nomination Committee Member, Commercialisation and IP Committee	Managing Director, Plantation International Pty Ltd and Hansol PI Pty Ltd Joined the Board on 13 December 2005 in a non- executive capacity	Hansol PI Pty Ltd
Robert (Bob) John Pearce BA, DipEd, JP	Member, Communications Committee	Executive Director, Forest Industries Federation of WA and Chair of the National Association of Forest Industries (NAFI) Joined the Board on 31 October 2006 in a non-executive capacity	Independent
James (Jim) Balfour Reid BSc(Hons), PhD, DSc, FTSE David Syme Research Medal (1989), Royal Society of Tasmania Medal (2000)	Member, Remuneration and Nomination Committee Chair, Commercialisation and IP Committee	Distinguished Professor, University of Tasmania Joined the Board at incorporation of the company on 30 June 2005 in a non-executive capacity	University of Tasmania
Geoff Wilson AM BSc, MSc, DSc, PhD, FTSE, FAIP, FAIM, MAICD	No committee membership at present	Member, Board of the Australian Maritime College (University of Tasmania) and Chairman of the Board of AMC Search Joined the Board on 28 April 2009 in a non-executive capacity	Independent
Robert Geoffrey Woolley BEC, FCA	Chair, Compliance Committee	Chairman of the Forests and Forest Industry Council of Tasmania (FFIC), Chairman of Tasmanian Pure Foods Ltd and Tandou Ltd Joined the Board on 12 December 2005 in a non- executive capacity	Independent

Chief Executive Officer and Company Secretary

Gordon Anthony Duff BSc(Hons), PhD, FAICD	Chief Executive Officer, CRC Forestry Ltd	Member of the Board of the Northern Territory Environment Protection Authority and Chairman of the Forest Practices Authority Tasmania (FPA) Previously CEO of the CRC for Tropical Savannas Management; joined the CRC for Forestry on 2 October 2006	CRC Forestry Ltd
Corinne Elizabeth Hamilton BSc(Hons), PhD, MPA, ASA	Company Secretary, CRC Forestry Ltd	Previously an accountant at BDO; joined the CRC for Forestry on 21 December 2009	CRC Forestry Ltd

Program managers

Name	Organisation	Role	Time committed
Dr Mark Hunt	Queensland Department of Employment, Economic Development and Innovation/ University of the Sunshine Coast	Manager, Research Program One	0.5
Dr Chris Harwood	CSIRO	Manager, Research Program Two	0.5
Mr Mark Brown	University of Melbourne	Manager, Research Program Three Industry Engagement Manager	1.0
Professor Brad Potts	University of Tasmania	Manager, Research Program Four	0.5
Professor Peter Kanowski	Australian National University	Chair, Education Committee	0.2

Committee membership and meetings

During 2010–11 there were four Board meetings, four Compliance Committee meetings, four Communications Committee meetings, and two meetings of the Commercialisation and Intellectual Property Management Committee. The Remuneration and Nomination Committee did not meet this year.

The following table shows the total number of Board and committee meetings held during the year and the number attended by each Director while they were a Director or committee member.

	Board of Directors	Compliance Committee	Communications Committee	Commercialisation Committee
Directors	n = 4	n = 4	n = 4	n = 2
Kate Carnell	4	3	4	
Lyndall Bull	3	4		
Hans Drielsma	4		4	
Gary Inions	3			1
Bob Pearce	4		3	
Jim Reid	3			2
Geoffrey Wilson	4			
Robert Woolley	3	4		

Board advisory committees

Compliance Committee

The Compliance Committee meets quarterly, in advance of the Board meetings, to receive the draft financial statements, budget and participants' report package; oversee risk management monitoring and reporting; receive and review reports from the auditors; and address any other major financial impacts of the company's business.

Member	Position
Robert Woolley (Chair)	Board member
Kate Carnell	Chair of the Board
Lyndall Bull	Board member
Gordon Duff	CEO
Corinne Hamilton (Secretary)	Business Manager and Company Secretary

Commercialisation and Intellectual Property (IP) Management Committee

The Commercialisation and IP Management Committee met twice during the year to review any IP developed. The committee's purpose is to review company strategies for determining the appropriate 'path to adoption' for each CRC research output. This includes use of external and in-house expertise; developing commercialisation plans for those outputs identified as having potential beyond own use by industry participants; and policies and associated training and documentation activities for management of IP generated by CRC for Forestry research.

Member	Position
Jim Reid (Chair)	Board member
Gary Inions	Board member
Charlie Day	University of Melbourne, UM Commercialisation Pty Ltd
Mark Brown (Secretary)	Industry Engagement Manager
Gordon Duff	CEO
Corinne Hamilton	Business Manager and Company Secretary

Communications Committee

The Communications Committee meets quarterly, in advance of Board meetings, to review the communications strategy in consultation with the CEO and the Communications Manager. The committee also receives quarterly progress reports against the communications plan, together with the forward program, and provides advice to the Board on communications issues.

Member	Position
Hans Drielsma (Chair)	Board member
Kate Carnell	Chair of the Board
Bob Pearce	Board member
Gordon Duff	CEO
Samantha Meyer (Secretary)	Communications Manager

Strategic Policy Committee

The Strategic Policy Committee is responsible for strategic planning and is convened as required. No meetings were held during 2010–11.

Remuneration and Nominations Committee

The Remuneration and Nominations Committee did not meet during 2010–11. Committee membership is dependent on the type of business that needs to be transacted. The Chair will normally be the Chair of the CRC Board unless the matter to be addressed relates to the Chair's appointment, performance appraisal or remuneration. The committee's purpose is to address matters in relation to nominations for vacant Board positions and determination of job specifications, advertising, selection, performance appraisal and remuneration of senior company executives.

Member	Position
Kate Carnell (Chair)	Chair of the Board
Hans Drielsma	Board member
Gary Inions	Board Member
Jim Reid	Board Member

CEO committees

The CEO, with the approval of the Board, has established the following committees with relevant interests and expertise to advise on the management of the CRC for Forestry:

Management Committee

The Management Committee assists the CEO in managing the day-to-day activities of the CRC. The committee meets at least six times per year.

Member	Position
Gordon Duff (Chair)	CEO
Mark Hunt	Program Manager, Program One
Chris Harwood	Program Manager, Program Two
Mark Brown	Program Manager, Program Three Industry Engagement Manager
Brad Potts	Program Manager, Program Four
Peter Kanowski	Chair, Education Committee
Corinne Hamilton (Secretary)	Business Manager
Samantha Meyer	Communications Manager

Education Committee

The Education Committee includes a representative from each of the CRC's participating universities. Meetings are held as necessary to address issues of student recruitment, management and leadership development and development of short courses for industry. The Education Committee did not meet during 2010–11.

Member	Position
Peter Kanowski (Chair)	Australian National University
Neil Davidson (Secretary)	University of Tasmania
Chris Weston	University of Melbourne
Mervyn Shepherd	Southern Cross University
Treena Burgess	Murdoch University

Program Coordinating Committees (PCCs)

PCCs are chaired by an industry representative, and include representatives of each participant that is active in the relevant program, plus the research program manager (who also acts as secretary). Core participants and multi-core participants (acting as a group) can elect to be on each committee. The PCCs meet at least twice-yearly to address any major issues arising from research conducted within the relevant research program. In general the role of the PCCs is to assist the CEO in carrying out the CRC program as broadly defined in sections 16–21 of the Participants Agreement, in the best interests of all participants.

Project Steering Committees (PSCs)

PSCs are chaired by industry representatives, and include representatives of each participant active in the relevant project, plus the project leader (who also acts as secretary). The role of each PSC is to oversee implementation of the project as defined in the project agreement, and to ensure that the requirements of clause 18 of the Participants Agreement are met. Meetings are normally held at least quarterly.

Private sector representation on the Board and committees

Under the Participants Agreement, the composition of the Board must include a majority of members who have a background in the forest industry. All other committees (except the CEO's management and education committees) have at least one industry representative. Six of the eight Board members are from the private sector, including one from a government business enterprise.

2.2 Participants

During 2010–11 the CRC had 31 signed-up participants from both the public and private sector representing a large portion of the forest industry in Australia.

Name	Type	ABN or ACN	Organisation type (or individual)
CSIRO	Essential	41 687 119 230	Australian Government Agency
Department of Sustainability and Environment (Victoria)	Essential	90 719 052 204	State Government
Forest and Wood Products Australia Ltd	Essential	34 214 096 882	Private Sector
Forestry Tasmania	Essential	91 628 769 359	Government Trading Enterprise
Forests and Forest Industry Council of Tasmania	Essential	14 313 481 217	Industry body
Gunns Limited	Essential	29 009 478 148	Private Sector
Hansol PI Pty Ltd	Essential	58 100 967 762	Private Sector/SME
Murdoch University	Essential	61 616 369 313	University
Oji Paper Company Ltd	Essential	97 615 796 464	Private Sector
Southern Cross University	Essential	41 995 651 524	University
The University of Melbourne	Essential	81 002 705 224	University
University of Tasmania	Essential	30 764 374 782	University
WA Plantation Resources Pty Ltd	Essential	98 094 151 792	Private Sector/SME
Australian Forest Contractors Association	Supporting	35 102 865 430	Private Sector
Australian National University	Supporting	52 234 063 906	University
Department of Economic Development (Tasmania)	Supporting	84 531 577 304	State Government
Department of Employment, Economic Development and Innovation (Queensland)	Supporting	78 342 684 030	State Government
Department of Primary Industries (New South Wales)	Supporting	51 734 124 190	State Government
Elders Forestry (T/A Integrated Tree Cropping Limited)	Supporting	79 069 762 634	Private Sector/SME
Forest Enterprises Australia Ltd (under external administration)	Supporting	47 009 553 548	Private Sector/SME
Forest Practices Authority	Supporting	42 443 536 412	State Government
Forest Products Commission	Supporting	69 101 683 074	Government Trading Enterprise
Hancock Victorian Plantations Pty Ltd	Supporting	20 084 801 132	Private Sector/SME
Midway Ltd	Supporting	44 005 616 044	Private Sector/SME
Norske Skog Paper Mills (Australia) Ltd	Supporting	84 009 477 132	Private Sector/SME
South Australia Forestry Corporation	Supporting	57 969 474 679	Government Trading Enterprise
South East Fibre Exports Pty Ltd	Supporting	85 000 604 795	Private Sector/SME
Southern Tree Breeding Association Incorporated	Supporting	87 043 835 298	Private Sector/SME
Timberlands Pacific Pty Ltd	Supporting	58 074 313 401	Private Sector/SME
University of the Sunshine Coast	Supporting	28 441 859 157	University
VicForests	Supporting	76 846 538 543	Private Sector/SME

Changes to participants

There were no changes to CRC participants during 2010–11. Forest Enterprises Australia remains under administration and the CRC continues to monitor developments and work with all parties to ensure research and participant contributions are maximised.

2.3 Financial management

The financial statements were audited by Deloitte Touche Tohmatsu and were found to accurately reflect the financial position of CRC Forestry Limited as well as comply with the Australian Accounting Standards. The CRC continually monitors internal controls through the Compliance Committee and Board's governing practices to manage financial risk.

Given CRC Forestry Limited's tax ruling (see page 4) no profit/loss was declared for the 2010–11 financial year. The entirety of income received from the Commonwealth and participants was offset against expenditure, which remained consistent compared to the 2009–10 financial year. Participant involvement remained strong in 2010–11 with \$2.2 million of the total \$6.4 million income received coming from participant contributions.

Expenditure remained research focused in 2010–11 with 78 per cent of expenditure (\$5.0 million) going towards research activities and the remaining 22 per cent (\$1.4 million) spent on commercialisation and utilisation, industry engagement, communications and administration activities. Expenditure is expected to increase in the 2011–12 year as technology transfer activities increase.

Even with an increase in expenditure and a further reduction in Commonwealth funds (per the Commonwealth Agreement) in the final year of the current agreement, cash reserves will ensure that the CRC will remain in a strong financial position and will be able to fulfill all of its current commitments.

2.4 Communications

Effective communication is integral to all areas of the CRC's activities and responsibilities. All CRC participants have a role in the CRC's communications functions, which include:

- sharing information among research partners to enhance collaboration and synergy
- exchanging knowledge between research providers and research users to enable uptake of relevant knowledge by various sectors of the industry
- ensuring the CRC's research, education and communication activities are relevant and responsive to stakeholder needs
- making science-based knowledge relating to forests and forestry accessible to the wider community.

An important aspect of CRC communications is developing links with industry. The CRC employs an Industry Engagement Manager and an Industry Liaison Officer who work closely with the Communications Manager to disseminate information to end users and foster uptake of research findings (see more in 'SME engagement' on page 32).

Communications strategy

A new communications manager was appointed at the start of this reporting period. One of the first tasks was a review of the existing communications plan, ensuring a strategic focus for the remaining period of funding for the CRC. The new Communications Strategy identified clear objectives and stakeholders and set out strategies, timeframes and resources needed to meet those objectives. Following endorsement by the CRC Board, the strategy was implemented as a work plan, and is subject to rolling review, allowing it to adapt to changing circumstances.

Newsletters

The CRC for Forestry has historically published a group of electronic newsletters, reporting on the activities of various research groups. A review of the Communications Strategy in late 2010 recommended focusing effort on a single newsletter—*CRC for Forestry News*. This publication is now the primary source of up-to-date information for both internal and external stakeholders and has a regular, quarterly publication schedule. The newsletter includes an editorial from the CEO on strategic or topical issues, updates on research activities and information on how to access and use the outputs of research. The newsletter is distributed to around one thousand recipients, including government, industry, research, media and international stakeholders. *CRC for Forestry News* is also available on the CRC's website.

The CRC's Biodiversity project continues to publish a bulletin to a selected group of stakeholders.

Publications

CRC researchers produced 111 formal publications during 2010–11, as well as 88 publications targeting end users. Publications included book chapters, journal articles, technical reports, industry bulletins, technical notes and multimedia products. CRC researchers also presented papers at conferences within Australia and internationally.

The CRC for Forestry publicly released a modified version of the 2009–10 Annual Report to assist in raising the profile of the CRC.

See Appendix A for a full list of CRC publications.

Website and members' website

The CRC maintains two websites: a public website; and a members-only, password-protected website. The public website is frequently updated with new information and features and all the CRC's public outputs are available on this site. The members-only website is a critical internal communication tool, which allows simple interaction and engagement within and among research groups. Documents can be made available and downloaded securely, and members can connect with other CRC partners for research and other purposes.

During 2010–11, a project began to bring both websites onto a common platform using a common, and upgraded, content management system. This will result in reduced costs and administration efficiencies, provide a more stable public site, and a members' area with greater interactivity.

Media

The CRC aims to gain media coverage (both mainstream and industry-specific) to ensure that the broader public is able to access science-based knowledge relating to forests and forestry and understand the role of the CRC.

Subjects of particular interest in 2010–11 included a socioeconomic study on the impact on Tasmanian forest jobs of the downturn in the forest industry; research into the challenges of conversion from processing native forest timber to plantation-grown eucalypts; the potential of forest harvest residues for energy generation; and a study on landholder perceptions of tree planting for carbon sequestration. The CRC has cultivated particularly strong relationships with rural and regional press, and with ABC radio, particularly rural radio.

The CRC prepares a contribution for each edition of *Australian Forest and Timber News*, the primary national industry magazine. Outreach through industry media also includes regular contributions to the e-bulletin *Daily Timber News*, contributions to *Australian Forest Grower*, and promotion of CRC initiatives through the newsletters and promotional activities of the CRC's industry partners.

The CRC has made effective use of an arrangement brokered with Get Media by the CRC Association. Many of the CRC's newsletter articles, media releases and event listings are promoted through multiple portals on the Get Media website.

Events

One important way for CRC for Forestry researchers to present the results of their research to industry stakeholders and others is through events. In the past year, researchers have made presentations at dozens of events, including:

- the Forest and Wood Products Australia 'R&D Works' roadshow
- a series of 'Ideas to Impact' workshops designed to expose research outputs to a small group, and apply tools and products to real-world scenarios
- industry and public seminars on a range of research outputs
- stakeholder forum—discussing future research priorities
- briefings for politicians, policy-makers, conservation groups
- workshops.

2.5 Intellectual property management

The CRC manages its intellectual property (IP) through a set of formal processes, policies and registers and scrutinises all areas of activity for commercialisation opportunities. IP management within the CRC consists of:

- IP principles and management policies and procedures
- a detailed IP register (updated annually)
- Commercialisation and IP Management Committee.

As part of the IP procedures, all research is screened prior to project start-up and during the research phase for the type of IP to be generated; for example, for confidential information/trade secrets, copyrights, tangible research property, and patents. Where IP is identified as potentially able to be commercialised, specific commercialisation assessments are undertaken.

As a general rule, the CRC creates IP for use by our participants who represent a very large majority of users of the information. Therefore, outside the CRC's membership there is a very small potential market for licensing or commercialisation. Because the CRC's research priorities are largely determined by our participants, licences or patents are likely to be incidental to the main thrust of the majority of our research programs. There were no developments of this type made during the 2010–11 year.

The CRC for Forestry Board believes that the greatest impact of the CRC will rarely be achieved through direct commercialisation or licensing, but rather through widespread uptake of CRC research outputs leading to innovation by CRC participants. This method of using IP provides maximum benefits to the participants and, at the same time, legal and contractual arrangements ensure that this IP can only be used by the participants and will not be licensed on or used outside their operations without the express permission of the CRC management. The CRC is unaware of any breaches by any participants in regard to IP in 2010–11.

3 Performance against activities

3.1 Progress against the key challenge / outcomes

Outcome 1: Improved ability to select planting sites and manage for increased profitability of plantation investments, through higher yields and lower costs of production.

There is now widespread industry use of CRC-developed decision tools in site selection, plantation management and performance forecasting. These tools, including ForestSensing4, CABALA V3 and BPOS, support appropriate decisions about plantation establishment and management, taking account of risk, climate variability and the diverse array of outcomes sought by end users.

An additional decision tool, FPOS, is in an advanced stage of development, and will enable industry partners to substantially reduce the risks inherent in establishing different species in previously untested environments. End users of these tools include a substantial majority of the companies and state-owned business enterprises that establish and manage plantations around Australia.

Uptake of these decision tools has been facilitated through the CRC's investment in technology transfer and industry support. In addition, the Industry Pest Management Group continues to provide direct technology transfer services relating to management of potentially economically significant plantation pests.

Outcome 2: Increased use of planting stock with improved genetic potential, managed to optimise production of high-value wood for fibre and solid-wood markets.

Eucalyptus globulus makes up 65 per cent of the hardwood plantation estate in Australia and is an important plantation species worldwide. Findings on genetic control of key commercial traits such as wood density and pulp yield in *E. globulus* have been incorporated into the pulpwood breeding programs of industry partners. Other genetic and silvicultural work on this species is nearing completion and results will be made available to industry participants in the final year of the CRC, as planned.

Processing studies on *E. nitens* have been completed and the CRC has developed processing techniques that substantially reduce value-limiting defects in sawn boards from eucalypt plantations. Processing studies on two subtropical species have also been completed. Investment in plantations in recent years has slowed for a variety of reasons, and market opportunities are only now emerging for much of this material, but we anticipate expanded use of research results in breeding programs in future years.

Outcome 3: Adoption of harvesting and logistical practices that reduce delivered wood costs, contributing to industry profitability, while maintaining conformity with codes of practice and certification standards.

CRC-developed decision tools such as ALPACA, FastTRUCK and the Machine Evaluation Toolbox have been further refined; uptake amongst industry participants is increasing. Early implementation trials are yielding positive results, including documented cost savings to industry participants of the order of 10 per cent.

The CRC continues to deliver these decision tools to industry via a series of targeted regional workshops and information sessions.

Outcome 4: Improved security of access to land and forest resources for the forest industry, sustaining levels of investment in the establishment of new plantations, through demonstrated ability to manage in an environmentally and socially sustainable manner.

The CRC has been an active participant in evidence-based public debate on forestry issues, and has continued to provide information for formulation of Commonwealth and state policies on forestry, land use and water resource management. Widespread industry adoption of community engagement

strategies, including the CRC's *Community engagement handbook*, is considered by many industry participants to be an important component of their social licence strategy.

CRC work on management of key pests and pathogens has contributed to risk reduction in plantation management, while a range of work on plantation and native forest silviculture has underpinned strategies for biodiversity conservation in various settings.

Program One
Managing and monitoring for growth and health

Manager: Dr Mark Hunt

Summary

Australia's forest industries are facing increased pressure to optimise production in the existing forest estate at the same time as embracing new species planted in new environments where experience is limited. Additionally, forests are increasingly managed for a range of products and purposes, not only traditional extracted products such as wood fibre and timber but also environmental services including water and carbon. Against the background of increased climate variability, this makes for a complex and challenging operating environment.

One of the key challenges for forest managers today is harnessing the increasing amounts of data and new technologies to improve forest value (physical, social and/or economic). Implicit in this challenge is the need to develop a sophisticated understanding of risk and uncertainty and be able to apply this knowledge to make appropriate decisions that in many cases will have impacts well into the future.

Program One seeks to provide tools and products that inform the management of forests using two approaches. The first is the analysis of complex spatial data to deliver useable information about a forest, including physical aspects of the landscape, and metrics describing the biotic components of the forest, including the trees themselves. The second focuses on forest processes and responses to environment and management. This understanding is captured in process-based models and derived tools. Together the knowledge and tools are the basis for forest and natural resource managers to optimise their practices and predict outcomes of interest.

Program One is organised into seven projects. Three of these are large, multi-focused projects that address important thematic areas of investigation. These three and their subprojects are:

Project 1.1 Monitoring and measuring

Subproject 1.1.1 Site evaluation

Subproject 1.1.2 Monitoring of forest condition with remote sensing

Subproject 1.1.3 Improved forest inventory through high-resolution remote sensing

Project 1.2 Managing and sustaining

Subproject 1.2.1 Sustaining site resources

Subproject 1.2.2 Forest health

Project 1.3 Modelling and information integration

Four smaller, targeted projects have been developed in response to widening stakeholder and participant need, a broadening in the capability of the program team and encouragement through the external review process. These additional projects are:

Project 1.4 Growth modelling and risk assessment for new environments

Project 1.5 Parameters for describing sustainable landscape carbon stocks

Project 1.6 Evaluation of models for the estimation of forest carbon

Project 1.7 The forest productivity optimisation system

Key research achievements

The past twelve months has seen a range of products and tools released by the CRC that capture the research outcomes from Program One. These include ForestSensing4, CABALA V3 (incorporating new forest health and tree level modules) and BPOS. In addition, modelling capacity has been increased through expansion of the application range of CABALA and preliminary progress towards FPOS.

Measuring estate condition using remote sensing

ForestSensing4, software that extracts tree metrics (such as height) from LiDAR¹ data, is now being used by CRC partners. Further training and workshops are planned to expand adoption. LiDAR is increasingly used in forestry to gather information about estate condition. The data capture cost is decreasing but is still significant and it is important to make as much use of the data as possible. As more operational uses for LiDAR data are developed, the cost effectiveness of the technology will improve. For this reason, the operational release of ForestSensing4 has benefits well beyond the processing algorithm itself. As well as being used by CRC partners, the software has been approved for release on the 'Comprehensive R Archive Network'—CRAN—the same platform on which the 'BFAST' algorithms were released in 2010. This means that the outputs will continue to be available for improvement and application well beyond the life of the current CRC. We anticipate that additional program outputs associated with regional soil models will also be delivered to partners and released to the CRAN platform over the next twelve months.

A satellite remote sensing product based on data acquired from MODIS (MODerate-resolution Imaging Spectroradiometer) has also been released for industry use. This is a web-based tool that detects both short-term disturbance events and long-term trends in plantation condition. Forest managers can access the tool online and use it to get information about where changes to forest condition have occurred in their estate, facilitating further, more detailed investigation and, if warranted, an appropriate management response. Validation and improvement to the product is ongoing but initial industry feedback has been positive and supportive.

Forest productivity models for forest management

Most of the predictive modelling in Program One is done using the CABALA (CArbon BALANCE) process-based forest productivity model. CABALA can be used to test 'what-if' scenarios about forest management, performance of new species and potential productivity on new sites and under future climates. During the past year, Version 3 of CABALA was released to project participants. This version underpins the release of a number of other products, including:

- a sub-model that distributes stand productivity amongst individual trees. This work is part of a larger research effort to better understand intra-stand competition for light, water and nutrients including competition amongst crop trees and between crop trees and weeds
- a forest health module that includes the latest understanding of the impacts of plantation pests on productivity, and predicts reductions in growth associated with various patterns of defoliation
- the decision-support tool BPOS (Blue gum Productivity Optimisation System), released to partners in June 2011. BPOS combines CABALA outputs generated by an expert user/developer with site-specific information from the forest grower including soils, climate and nutrition. As well as being easy to use and allowing the user to replace modeled values with real data, BPOS has functions that are not available in CABALA. These include estimation of the amount of key nutrients exported in biomass under different harvesting models, fertiliser response curves and net benefit calculations, and a simple economic model. The development of FPOS has already begun under the auspices of the CRC for Forestry. This tool will expand BPOS to include additional species and management regimes.

¹ LiDAR (Light Detection and Ranging) is an optical remote-sensing technology in which a LiDAR instrument attached underneath an aircraft uses high-speed laser pulses to generate three-dimensional data about terrain or landscape features as light bounces back from the ground, understorey and canopy. The equipment also takes into account the orientation and precise location of the aircraft.

Physiological and empirical studies of weed competition are being used to further develop CABALA's capability to predict the impact of weeds on productivity. This will be included in the next version of CABALA that is scheduled for release in the CRC's final year.

Forest carbon models

CRC researchers have been considering the relative merits of different forest carbon models and how they vary across forest types and climate zones. Specifically, researchers are investigating differences between wet and dry eucalypt forests in temperate Tasmania and subtropical Queensland. As well as understanding the differences in carbon storage and turnover in these different forest types, the work will consider which circumstances and applications are best served by the use of broad scale process models (such as FullCAM²) compared to more site-specific inventory models (such as CFS-CBM 3³). The answers to these questions will be important for forest managers to maximise opportunities arising from a future carbon price. An initial report on the role of forests in greenhouse gas abatement and climate change mitigation/adaptation has been completed by CRC researchers and published under the auspices of Forest and Wood Products Australia. This document provides an important basis for considering the role of commercial forestry in the national forestry and climate change dialogue.

² FullCAM (Full Carbon Accounting Model) is part of the National Carbon Accounting Toolkit and accounts for carbon stock changes associated with land use and management.

³ The CFS-CBM 3 (Canadian Forest Sector Carbon Budget Model) is a stand- and landscape-level modelling framework to simulate the dynamics of all forest carbon stocks required under the Kyoto Protocol (above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon).

Program Two
High-value wood resources

Manager: Dr Chris Harwood

Summary

This program aims to improve the profitability of Australian eucalypt plantations by integrating improvements in genetics, silviculture and wood value through accurate assessment and prediction of wood-quality traits in standing trees, to produce high-value logs fit for specified processing purposes.

The majority of Australian eucalypt plantations are grown solely for pulpwood. This section of the industry is primarily interested in improving volume production, and increasing wood density and pulp yield. However, approximately 15 per cent of plantations are being developed to service solid- and engineered-wood markets with different log and wood quality criteria. The relationships between log and wood traits and performance in processing systems (for example, sawing and drying performance) are critical in defining and improving value. The CRC for Forestry is studying processing and liaising closely with other processing research groups to better understand the wood properties that drive value for different end uses.

Program Two aims to:

- develop tools and methods to improve the quantitative and molecular breeding of eucalypts used for both pulpwood and solid-wood products
- develop empirical models of growth and size-class distribution in managed stands that will link to the process-based models (such as CABALA) being developed within the CRC's Program One
- increase understanding of how the scheduling of pruning and thinning affect log and wood traits, processing performance and consequent value
- improve the assessment methods for key wood traits
- develop decision-support systems that integrate information on germplasm, site, silviculture and stand assessment to enable plantation managers to maximise profitability for defined end uses.

The program is structured around research projects addressing five themes:

- Project 2.1 Breeding for high-value wood products**
- Project 2.2 Silviculture for high-value solid and engineered wood products**
- Project 2.3 Impact of silvicultural interventions on wood quality**
- Project 2.4 Incorporating wood quality into plantation estate management**
- Project 2.5 High-value wood products from subtropical plantations**

Key research achievements

Integrating quantitative and molecular information in tree breeding

The first reports of associations between candidate gene variants (single nucleotide polymorphisms, or SNPs) and wood traits were published for *Eucalyptus globulus* (Thavanikumar *et al.* 2011) and *E. pilularis* (Sexton *et al.* 2010). The CRC for Forestry commissioned PlantPlan Genetics to develop a method for integration of molecular and quantitative information into breeding value prediction in STBA's⁴ TREEPLAN[®] software, for *E. nitens*. This work, done in collaboration with CSIRO Plant Industry (external to the CRC for Forestry) and Project 2.1 industry partners, was documented in CRC Technical Report 210. The results showed that if screening candidates for selection as deployment clones in a seed orchard on the basis of estimated breeding value for an economic index, the use of molecular-based selection traits (DNA polymorphism states) can substantially improve the genetic mean of the elite selected group, and hence the performance and value of plantations raised from the

⁴ Southern Tree Breeding Association

seed orchard. To our knowledge, this is the first integration of molecular information into breeding value prediction in an established conventional tree breeding program. The method will be refined and applied in the coming year to breeding value prediction in *E. globulus*, using the results of genetics studies on this species being undertaken in the program.

Reviewing the viability of sawn timber production from plantation-grown logs of Eucalyptus globulus and E. nitens

A comprehensive review of CRC and other research into sawing and drying of plantation-grown logs of *E. globulus* and *E. nitens* (CRC Technical Report 209) was considered at a workshop attended by scientists and industry partners in December 2010. The review confirmed that pruning and thinning of plantations of these species are essential to produce the large-diameter and relatively defect-free logs required for production of appearance-grade sawn boards and veneers. Even if a pruned sawlog resource is available, existing sawmills optimised for native forest logs will struggle to profitably process plantation logs, which have different sawing and drying characteristics. The review identified the modifications to sawing equipment (multi-saw systems enabling symmetrical release of growth stresses during sawing) and drying methods (carefully monitored drying to 15 per cent moisture content followed by steam reconditioning to minimise drying degrade) that will be needed to optimise processing of plantation sawlogs.

Detailed financial modelling of sawmill operation (CRC Technical Report 211), based on empirical cost and operating data, subsequently established that appropriately designed sawmills should be able to operate profitably on plantation-grown sawlogs while paying an acceptable log price to plantation growers. Access to large volumes of plantation sawlogs would be required to justify the required investment to retrofit existing sawmills or construct new ones. This research has particular application in Tasmania where a significant resource of pruned plantations of *E. nitens* and *E. globulus* will start to yield sawlogs within the next 10–15 years, and sawmills face declining access to native forest logs.

Predicting growth response following thinning, pruning and fertilising

Studies of thinning response in trials established in subtropical plantations of spotted gum (*Corymbia citriodora* subsp. *variegata*) and Dunn's white gum (*E. dunnii*) in northern New South Wales and south-east Queensland found that thinning at ages 6–8 years resulted in large increases in post-thinning diameter growth rate of the retained trees relative to trees in unthinned treatments. This was a surprising result for the south-east Queensland sites, where unthinned plantations were growing slowly and had been exposed to severe drought prior to thinning.

An *E. nitens* silvicultural trial at Carrajung (Victoria) included the application of two levels each of thinning (ca. 900 or 300 trees/ha), pruning (unpruned or 50 per cent of the live crown length pruned of the largest 300 potential sawlog crop trees/ha), and fertilising (nil or 300 kg/ha N fertiliser) at age 3.2 years. Five years after applications of these treatments, the above-ground biomass of the largest 200 potential sawlog crop trees/ha was 40 and 12 per cent greater due to thinning and fertiliser application, respectively, and 6 per cent lower due to pruning.

Results of these studies will be published late in 2011.

Non-destructive evaluation of wood stiffness and pulp yield

Research on the prediction of wood stiffness established very strong correlations between standing tree acoustic wave velocity and that of processed sawn boards and veneer sheets in *E. nitens*, confirming acoustic tools as attractive options for tree breeding and resource assessment.

Portable near-infrared (NIR) scanning is an affordable way for forest managers to obtain fast, non-destructive measures of pulp yield in plantation eucalypts. CRC Technical Report 212 describes the application of the Phazir™ portable hand-held NIR spectrometer to the prediction of wood properties in air-dried eucalypt woodmeal. The Phazir™ is a low-cost NIR instrument that can be used by individual forest companies in-house. Effective calibrations were developed for prediction of Kraft pulp yield and cellulose content of wood samples.

Program Three Harvesting and operations

Manager: Mr Mark Brown

Summary

The primary objective of Program Three is to significantly improve the efficiency, effectiveness and safety of the forest harvesting and transport operations of the CRC's industry partners by applying the findings of quality studies in harvesting and transport operations across a range of Australian industrial forest conditions. This research and application achieves a secondary objective: to build capacity in technical expertise in forest harvesting and transport operations in Australia.

Program Three is structured around five themes:

- | | |
|----------------|--|
| Theme 1 | Developing a better understanding of the performance of different harvesting equipment in different conditions to make harvesting more efficient and cost-effective |
| Theme 2 | Improving productivity and reducing the cost of applying different harvesting systems across sites and operations in Australia |
| Theme 3 | Improving value recovery and use of the forest resource |
| Theme 4 | Testing the application of technology in transportation for improved efficiency |
| Theme 5 | Developing and testing improved logistics techniques for improved transportation efficiency |

Key research achievements

Capacity building

The CRC for Forestry has maintained the focus of Program Three on field-based research in collaboration with industry partners. The early and ongoing success of industry-based projects has allowed the CRC to consolidate support within the Australian industry and to grow valuable international collaborations that will help meet and exceed the research milestones.

Capacity in harvesting and transport research continues to strengthen: at the start of this program, Australia had no capacity in this area. The CRC now has a team of six researchers generating results now being implemented across the industry, and two PhD candidates. There is strong interest from industry and research providers in sustaining this capacity over the long term.

Optimisation and value recovery

Optimising forest operations helps ensure the maximum value can be recovered. Optimisation can be applied across the entire supply chain, including quality of measurement, system calibration and defining relative product values for the required product mix.

Anecdotal evidence, following early trials of optimisation technology, has indicated that industry can meet customer demand for a given product using up to 10 per cent less resource. This suggests there is a benefit to be achieved even in a restricted market.

Though early trials and industry interaction four key issues influencing potential value recovery have been identified:

- improved pre-harvest measurement of value of products
- improved inclusion in harvesting decisions of internal characteristics that affect value (such as stiffness)

- optimised merchandising for value within market-defined product specifications and relative value
- creating market value for portions of the resource currently seen as a by-product of harvesting operations.

Some milestones have been delayed because we have adopted a coordinated research approach that will take more time but deliver better outcomes.

Using ground-based optical remote sensing to assess the potential value of plantations

Trials by the CRC for Forestry, in collaboration with Treemetrics in Ireland, have shown that using ground-based LiDAR was effective in identifying and optimising wood product value before harvest in pine plantations. Recent advances in LiDAR technology have lowered its cost, making it viable for use by individual companies. One of the CRC partners has taken up the technology in a large-scale operational trial based on the CRC research. Over the next year the CRC for Forestry will complete some small-scale trials with Treemetrics to test the new measurement directly against current best practice as well as doing initial tests with the LiDAR technology in *Eucalyptus globulus* and *E. nitens* as part of harvesting research trials.

Acoustic sensing in harvest decision-support

Until recently value recovery at the time of harvest has been focused on the external characteristics of the tree (size and shape). With the growth rates and relatively short rotation lengths achieved in Australian pine plantations, internal characteristics (defects and stiffness) can often have as much or more impact on the value of the forest products harvested from the tree. The interest in measuring and managing these internal characteristics has driven research in technology such as NIR (the subject of trials in the CRC's Program Two) and acoustic measurements. These technologies allow measurement and identification of commercially-important characteristics (such as pulp yield, stiffness and cellulose content) at a stand or genetic group level, using manual measurements. The acoustic technology, which has been demonstrated to effectively predict wood stiffness of logs in standing trees and logs with manual measurements, is now available as a prototype to be attached to a harvester head to allow real time prediction of stiffness while harvesting and allowing the identification of higher value products in the stand. Further field trials of the prototype will take place with New Zealand company Fibregen in October 2011 and will be incorporated in the overall best practice for product merchandising.

Optimisation technology to maximise potential value from a tree

Field trials were completed early in 2011 that compare the value achieved from harvest operations using optimisation technology with those that do not. Use of optimisation technology maximises the potential value that can be gained from a tree by cutting the most valuable products available, based on a tree's external dimensions and assessment of current relative product values that can be cut from those dimensions.

Using harvest residue for bioenergy

The CRC has found that three to seven per cent more wood volume can be recovered from harvest sites while still leaving a significant amount of biomass (nutrients) on the site. In some cases this material is suitable for use in existing markets (pulp and panel production) and in others new markets for energy production are emerging to provide value for this harvest residue material. A PhD student is exploring the energy production potential of harvest residues by studying efficient and sustainable bioenergy supply chains for the Australian contexts.

Onboard computers for effective operations management

The CRC has concluded case studies in the operational use of onboard computer systems with a particular focus on observing accurate long-term performance. A selection and implementation guide was delivered to more than 100 industry practitioners through regional workshops where further applications were identified.

The CRC for Forestry is working with industry partners to test novel adaptation of current onboard systems to address the Australian issues. For example we will test an algorithm to automatically manage primary transport distances with low-cost GPS and basic desktop computers. In a more complex example, new onboard technology developed by the research organisation FPInnovations in Canada is being adapted to help manage supply chain inventories for improved logistics management.

Harvest system productivity and management

The program has continued to build and strengthen data for machine productivity and performance predictions with a number of field studies that address specific industry questions and, when combined, produce a suite of productivity models. In 2010–11 the program focused on biomass harvesting technology in addition to traditional forest harvesting systems. Industry partners have provided extensive feedback on the prototype operational decision-support tool for predicting machine performance, Australian Logging Productivity and Cost Assessment tool (ALPACA). This feedback, combined with recent study results, will be used to produce a final version of ALPACA that will include the emerging forest harvesting activity of biomass collection and transport.

The machine evaluation toolbox developed in 2009–10 has been refined based on industry feedback. The final version has been delivered to frontline managers and forest contractors through workshops. Workshops will continue to be offered on demand and industry partners with specific challenges in machine evaluation will be supported as part of the program's ongoing machine performance research work.

Truck scheduling and logistics management

Use of FastTRUCK, a logistics optimisation planning tool for forest transportation, has continued to expand to include both in-field chipping operations and log producing operations. The tool was completed in 2010–11 and is now being tested with three partners, with a full operational trial to be held by the end of 2011. The CRC for Forestry research has attracted interest in both Australia and Europe. As a result of its early success, in-kind resources have been contributed by the School of Computing and Information Systems at the University of Tasmania to participate in the testing and operational trials, and collaborative support is being provided late in 2011 in Germany and Finland to help adapt the tool to effectively include biomass as one of the products in the transport optimisation.

Program Four
Trees in the landscape

Manager: Professor Brad Potts

Summary

Program Four focuses on developing forestry practices that meet and improve upon agreed environmental certification requirements and foster constructive community engagement. These practices are important as they contribute to security for the forest industry's long-term 'licence to operate' in the Australian landscape, and build international recognition of sustainable forest practices for product marketing.

The program is structured around research projects addressing six themes:

Project 4.1 Water quantity and quality

Changes to forest cover have the potential to alter catchment water balance, and there are community concerns that forestry operations such as harvesting and fertilisation can affect water quality, stream morphology and aquatic habitat. The aim of this project is to improve prediction of water quantity and quality responses to a range of forestry practices.

Project 4.2 Biodiversity

This project provides research to inform the development of strategies, protocols and policies to ensure that biodiversity values are sustained and enhanced in the forest environment and landscapes.

Project 4.3 Communities

It is important to understand the social and economic implications of ongoing change within the forest industry, as well as the impact of changes in rural and regional areas on the forest industry. The CRC is conducting research into the social dimensions of Australia's forest industries to ensure forest and plantation management is socially as well as environmentally sustainable.

Project 4.4 Industry pest management group (IPMG)

This project coordinates regular monitoring of natural enemy and insect herbivore activity in blue gum (*Eucalyptus globulus*) plantations, develops protocols for assessment of insect pests and provides regular technology and knowledge transfer through field days and training of staff in forest management operations.

Project 4.5 Land-use change

This project concluded at the end of 2008.

Project 4.6 Water use and water-use efficiency of eucalypt plantations: from stand to catchment scale

This project aims to improve understanding of the effects of plantation establishment and management on water use and water-use efficiency from stand to catchment scales. This project will draw on outputs from Program One and Project 4.1.

Key research achievements

Projects 4.1 and 4.6—Forests and water (Project leader: Dr Don White)

Projects 4.1 and 4.6 are concerned with the effects of forest management on water quality and stream flow (water yield). They aim to develop a process-level understanding of the relationships among forest management, productivity and water outcomes. This year we have continued to publish results in international journals (9 papers) and through the CRC's technical report series and conference papers (10 in aggregate). This year young scientists have made an important contribution through PhD and postdoctoral projects; a number of students submitted papers to journals and are near completion of their projects.

Harvesting and thinning in native forests

The management of native forests is a matter of contention. Our aim in studying the response of native forest streams to forest management is to provide empirical evidence and tools for the better management of forests for enhanced water outcomes and as the basis for sound policy development. This work has been done in Tasmania and Victoria.

Student projects have focused on:

- the long-term response of streams to thinning of native forest
- predicting the effects of drought on stream flow in forested catchments using the Keetch-Byram Dryness Index⁵
- the effects of native forest harvesting on headwater streams and on the lower reaches of the stream network.

The Warra Long Term Ecological Research site (in Tasmania) has been the focus of a study to quantify the impact of native forest operations on turbidity and other measures of water quality. Recent analysis of these long-term datasets indicates that hydrogeology and forest type are more important determinants of water quality than forest management history.

Fuel reduction burning

Fuel reduction burning (burning of the litter layer and understorey in a cool fire to reduce the fuel load) is an important tool for reducing the risk to life and property from wildfires. Changes to soil organic matter, understorey structure and surface soil properties all have the potential to alter important hydrologic processes including interception and infiltration. The CRC has two activities quantifying the effects of fuel reduction burning on the transport of pollutants (sediment, nutrients) to streams and both have made important findings this year.

At Long Corner Creek the team from the University of Melbourne conducted an experimental burn. The experiment has yielded new insights into the scaling of runoff production and has the potential to significantly increase our ability to model sediment and nutrient movement in forested catchments. A paper has been drafted and submitted for review.

In a similar vein, work on understanding the effect of the size and connectedness of burnt areas on runoff and sediment generation is leading to development of guidelines for landscape burning patterns and design to minimise water quality impacts.

Plantation establishment and management

The impact of plantations and their management on water yield has been a major issue for plantation managers and identified as a key factor in the 'social licence' for the plantation sector to operate for at least the past decade. Until recently, understanding of plantation water impacts has been either at the catchment or stand scale. Several projects in the CRC have been concerned with the relationship between plantations, their management and water outcomes.

We have linked the 3PG (Physiological Principles of Plantation Growth) model with a hill slope scale model of distributed flow and instrumented catchments in northern Tasmania and southern Western Australia. The past year has focused on consolidation and measurement and these datasets will be used to validate and calibrate the model. In an analogous study we applied CAT (Catchment Analysis Tool), which again links 3PG with models of hydrologic processes, in a number of Victorian catchments, presented the work at the International Congress on Modeling and Simulation (MODSIM) and published it in the conference proceedings. A further modelling study uses Bayesian statistical

⁵ The **Keetch-Byram Drought Index (KBDI)**, created by John Keetch and George Byram in 1968 for the United States Department of Agriculture's Forest Service, outlines mathematical models for predicting the likelihood of wildfire based on soil moisture and other conditions related to drought.

modelling to develop improved methods for estimating plantation establishment impacts on stream flow.

Plantation establishment and management can also have important water quality impacts and benefits. We have investigated the potential for riparian plantations managed for wood production to mitigate the effects of more polluting land uses, such as dairy farming, in streamside management zones. This year the project focused on the Willow Bend paired catchment experiment in southern Tasmania and the effects on water quality of plantation establishment and early growth. Willow Bend was established in 2007 and compares an untreated catchment with a catchment in which the riparian zone is being converted to *Eucalyptus globulus*, *E. nitens* and *Acacia melanoxylon* plantations. Water quality benefits of the riparian buffer have been identified for sediment, bacteria and phosphorus. Differences in nitrogen delivery to the stream also appear positive, but this result cannot be attributed completely to a buffering effect. No major negative effects of riparian plantations on water quality have been measured.

Salvage logging following wildfire

The Croppers Creek catchment in north-east Victoria that was burnt in the 2006–07 bushfires has given us an opportunity to measure and compare the early response of burnt mixed-species eucalypt forests and second-rotation pine plantations. Modelling of pre-fire radiata pine water use at both plot- and catchment-scales in a parallel project using the 3PG+/CAT modelling framework has proven successful and has been published. This work demonstrates that recent improvements to the 3PG+ model better represent the hydrologic processes in planted forests, and presents a successful test of the model using field data.

Analyses of the changes in runoff, sediment and nutrient production at Croppers Creek have been either published (journal paper and CRC Technical report) or submitted to a journal. These include suggested guidelines for minimising erosion and water quality impacts during salvage logging.

Integrating results for forest managers

One of the limitations of experimentation for informing future management is that all measurements are made under a unique set of conditions. This is why all of the CRC projects use models that capture the response of underlying processes. Once these models are calibrated and validated using experimental data they can be applied to test different management options under different potential futures. A range of models have been used in projects 4.1 and 4.6 because they best represent the most important processes for each context. A workshop for all industry stakeholders in February 2012 will present the experimental results, model development and application to scenario analysis under key thematic areas. This workshop will include a facilitated discussion of the most appropriate way to synthesise information for industry.

Project 4.2—Biodiversity (Project leader: Professor Brad Potts)

Maintaining or enhancing biodiversity values is increasingly important to communities. As well, there is an increasing need to predict and monitor biodiversity responses against baseline criteria for planning, legislative and forest certification requirements. The Biodiversity project focuses on three key research areas and aims to produce strategies and tools for sustaining and enhancing biodiversity values, and managing key pests and pathogens.

The project also links with Project 4.4 'Industry Pest Management Group', focusing on integrated pest management in blue gum (*Eucalyptus globulus*) plantations in south-west Western Australia and the Green Triangle (see page 28).

Monitoring and management of biodiversity in forestry landscapes

A decade of studies on the biodiversity impacts of alternative silvicultural regimes in Tasmanian wet eucalypt forests has been synthesised by CRC researchers. The CRC for Forestry has made a significant contribution to this knowledge base, with more than 32 referred research and review papers, five PhD theses and one honours thesis completed. This research has led to the identification

of mature forest elements across diverse groups of organisms, as well as indicator species for monitoring disturbance impacts. As an alternative to traditional clear-felling, variable retention silvicultural systems increase long-term retention of mature forest elements in the production landscape at the within-coupe scale. We have developed operational metrics that assess mature forest influence, retention and habitat/connectivity for monitoring the success of the operational roll-out of variable retention silviculture in Tasmania across more than 50 variable retention coupes; these have been used to guide improvements in operations and coupe design.

The majority of Tasmania's production native forests are dominated by the widespread ash species, *Eucalyptus obliqua*. A molecular study on the genetic diversity in *E. obliqua* in Tasmania undertaken by CRC researchers and a student has detected very little variation in selectively neutral, nuclear microsatellite DNA markers amongst populations. Reported genetic differentiation in quantitative traits is thus likely to be due to local adaptation. Strong spatial structure was detected in maternally inherited chloroplast DNA, suggesting pollen as opposed to seed dispersal is more important for gene flow. This chloroplast DNA structure is being used to refine the Forestry Tasmania seed zone classification for this species.

The management of forest species of high conservation significance, including species listed in threatened species legislation, is an ongoing challenge for forest managers. A key tool used by Forest Practices Officers for determining appropriate strategies for managing species of high conservation significance is the Threatened Fauna Advisor (TFA). The TFA is in the final stages of being upgraded in a new online format, with support from the CRC for Forestry and research results from several CRC PhD projects. Training days were also held to teach Forest Practices Officers how to identify and survey threatened orchids, and to inform them on tree hollow management and micro-bat ecology. Additional tools developed to help manage threatened species include a map indicating the relative availability of tree hollows—an important habitat for some species—and a map indicating the natural distribution of *Eucalyptus globulus* in Tasmania. The map of hollow availability is based on aerial photograph interpretation of forest structure and has the potential to greatly improve conservation planning for hollows and hollow-dependent fauna. The map of *E. globulus* was developed from a range of data records and will be used to help manage habitat for the threatened swift parrot. Management of masked Tasmania owls will be aided by a habitat model developed from a CRC PhD project. Another PhD study on the ecology and physiology of small to medium mammal communities found that brushtail possum populations were male-dominated and of lower density and breeding frequency in harvested areas, but that overall the species appeared tolerant of forestry disturbance at the sites studied.

A review of biodiversity outcomes from eucalypt plantation expansion into agricultural landscapes of southern Australia has been completed. Results of CRC studies on eucalypt plantations in Western Australia, South Australia, Victoria and Tasmania were synthesised. Many forest remnants in these plantation landscapes are historically degraded, with enriched nutrient levels, weedy understoreys, little eucalypt recruitment, and different invertebrate and vertebrate communities compared with healthy forest remnants. The transition in adjacent land use from agriculture to eucalypt plantations has a positive effect on many physical and biological attributes of these remnants, in part due to livestock exclusion. Fire is an important management tool for restoring remnant health. A PhD study has shown the importance of large logs in creating regeneration sites after fire, emphasising the importance of the combination of fire and coarse woody debris for forest regeneration.

Sustainable management of key pests

The CRC is undertaking research on strategies to better manage key marsupial, insect and pathogen pests of eucalypt plantations.

Non-lethal strategies to help manage browsing from marsupial herbivores have been identified, including protective stockings, repellents and increased plant natural defenses. Genetic selection for increased natural defences had a longer-lasting effect than other options, and screening of operational stock for deployment tests is being undertaken.

Lethal trap trees are being investigated as a proof of concept for 'attract and kill' technology that would be a cost-effective and more environmentally friendly alternative to control eucalypt leaf

beetles in plantations than aerial spraying with insecticides. Procedures for the application of systemic insecticides to trees have been developed and shown to create foliage that is both attractive and lethal to eucalypt leaf beetles at an individual tree level. However, in operational plantings the influence of trap trees was generally limited to an average radius of less than 100 m. Further advances are likely to be required before 'attract and kill' technology is operationally cost-effective.

Outbreaks of *Mycosphaerella* leaf disease (also known as *Teratosphaeria* leaf disease) can reduce the productivity of *Eucalyptus globulus*. A study of family trials of *E. globulus* exposed to natural disease outbreaks has shown the potential for genetic selection to increase foliar resistance to the disease. Significant genetic-based differences were shown amongst populations of *E. globulus* sourced from throughout the native range. The disease resistance of populations increased with decreasing latitude, was positively correlated with predictions of disease risk, and better predicted by temperature at the site of origin, than rainfall. Germplasm from breeding and deployment populations was also assessed for disease damage in the trials and partners can now compare breeding values of both selected and unselected native population germplasm.

Project 4.3—Communities (Project Leader: Dr Jacki Schirmer)

The CRC for Forestry is investing in research into the social dimensions of Australia's forest industries to ensure Australia's forest management is socially, as well as environmentally, sustainable. In recent years Australia's forest industries have undergone significant change, with further change anticipated. The Communities project undertakes essential research looking at the social and economic implications of ongoing change on forest workers, their families and the rural and regional areas in which the forest industry operates. In addition, work is undertaken to understand community perceptions and attitudes towards forest management, and to develop improved community engagement approaches that work to achieve a 'social licence' to operate.

Key research achievements of Project 4.3 during 2010–11 include the completion of an update to the Tasmanian forestry industry survey (FIS), the subsequent detailed analysis of the socioeconomic impacts of forest industry change, and the publication of the *Handbook for operational community engagement within Australian plantation forest management*, a guide to community engagement targeted at the Australian plantation forest industry.

Tasmanian forest industry survey (FIS) 2010

The CRC for Forestry report *Tasmania's forest industry: trends in forest industry employment and turnover, 2006 to 2010* (Technical report 204, November 2010) has helped to inform the debate surrounding the current proposed changes in the forest industry. Used in conjunction with the CRC for Forestry Technical Report 208 (*Structural adjustment assistance in the Australian forest industry: A review of recent experience and recommendations for best practice design of future structural adjustment packages*, February 2011) this research helps to improve the design and implementation of government-funded assistance packages.

Three public seminars were convened by the CRC for Forestry to share and facilitate discussion about the findings of the survey, and encourage stakeholders to use the results of CRC research as they consider the future of the Tasmanian forest industry and develop relevant policy. The seminars, held in Hobart, Launceston, and Burnie, were attended by more than 120 people, including interested community members, government and industry representatives and members of the Tasmanian and Commonwealth Parliaments. The seminars also attracted considerable media attention in Tasmania.

Socioeconomic impacts of forest industry change (Tasmania)

The ongoing discussions between industry and environmental groups and the resulting *Tasmanian Forests Statement of Principles to Lead to an Agreement (Principles Statement)*, emphasised the need to further understand the potential social and economic impacts of additional changes in the forest industry, particularly the reduction of available native forest resource. The Tasmanian FIS (2010) attracted the attention of the forest industry and government agencies, resulting in funding for an additional study into the socioeconomic impacts of forest industry change in Tasmania (see Technical Report 214). This CRC for Forestry research study focused on understanding the impacts of the

downturn and how to assist those affected by it, as well as the capacity of those dependent on the industry to adapt to further change. After the study had begun, additional funding was provided by the Australian Government Department of Agriculture, Fisheries and Forestry for the study to form part of the due diligence assessment of the *Principles Statement*. In addition to examining the impacts of forest industry change on businesses and forest industry workers, the study identifies which communities are most likely to experience negative impacts as a result of the proposed changes in the Tasmanian forest industry. This study has had high policy relevance and impact, with specific requests for researchers to provide evidence and give briefings to senior government officials and ministerial staff.

Community engagement handbook

Published in May 2011, the *Handbook for operational community engagement within Australian plantation forest management* provides a guide for forest managers in designing, planning, implementing and evaluating community engagement activities. The handbook was developed in collaboration with CRC for Forestry industry partners, using forest manager skills, understanding and experiences to target the handbook to the needs of the end users.

There has been a rapid uptake of the handbook by the forest industry since its release. The deliberate design of the handbook to ensure a good fit with the needs and skills of the forest industry has been well received, with considerable positive feedback regarding the ease of use, and its relevance for both day-to-day engagement activities and the development of longer-term engagement strategies. The handbook has also been used extensively by forest management organisations to help improve their engagement approaches in compliance with forest certification requirements.

Project 4.4—Industry Pest Management Group (IPMG) (Project Leaders: Dr Treena Burgess/ Mr Francisco Tovar)

The IPMG has a strong focus on extension work aimed at integrated pest management in *E. globulus* plantations in south-west Western Australia and the Green Triangle. Through this project the CRC coordinates regular monitoring of natural enemy and insect herbivore activity in *E. globulus* plantations, develops protocols for assessment of insect pests for project partners and provides regular technology transfer through field days and training of company personnel. During 2010–11 the IPMG released a website aimed at making information on plantation pest and diseases more accessible (e.g. pest notes, data bases and publications), launched a specialised news bulletin, began work on a field pest guide and started a program of cooperative plantation health monitoring across the Western Australian blue gum plantation estate.

3.3 Utilisation and commercialisation

As the CRC for Forestry draws toward the final year of the seven-year funding term, adoption and utilisation of research outputs has become a major focus of CRC activities, paying particular attention to sustaining and growing already high levels of industry engagement.

The CRC employs a full-time Industry Liaison Officer to assist in technology transfer and support the Industry Engagement Manager. In addition, the Industry Engagement Manager works across CRC programs to add value to existing pathways to adoption and to identify and implement new opportunities to achieve research impact. For example the ongoing 'Ideas to Impact' seminar series invited forest managers to learn about CRC-developed tools that can enhance their operations. At each on-site seminar, the presentation focused on a single tool, using real-world scenarios to demonstrate how that tool adds value. Seminar attendees were given a USB device loaded with the current suite of CRC decision-support tools, and relevant CRC publications.

The CRC Management Group maintains a discretionary fund to support commercialisation and utilisation (C&U) activities and considers applications for funding on a case-by-case basis. While the CRC is able to track expenditure relating to direct, one-off C&U initiatives, C&U expenditure also occurs within projects and is not easily identifiable. Therefore, the true value of C&U expenditure is greater than that presented in the financial tables provided to the Commonwealth. Key C&U initiatives funded during 2010–11 include:

- release of a variety of publications and presentations from Project 4.3 ('Communities') to industry, government and the wider population
- several workshops and field days for industry participants on Program Three: 'Harvesting and Operations' outputs
- data analysis to enable breeding value predictions to be integrated with existing industry systems (Program Two: 'High value wood resources')
- implementation of near-infrared remote sensing within industry for prediction of commercially-important wood properties (Program Two: 'High value wood resources').

The C&U milestones due in this reporting period, but which remain in progress are:

- milestone C1.1.2 related to Research Milestone 1.1.2 (Rapid technology available for assessing soil condition)
- milestones C2.1.3, 2.3.1, 2.3.3, 2.3.4, 2.3.5 and 2.4.3 related to Research Milestone 2.4.2 (Sampling protocols for prediction of solid wood and engineered wood log value from three species). Studies for two subtropical species were undertaken in September 2011. These six milestones will be reached by March 2012
- milestone C2.2.2, which has been replaced by a pilot program on *E. nitens* owing to insufficient industry interest in *E. globulus* processing. A workshop in December 2011 aims to find a suitable partner for this research
- milestones C2.2.3 and 2.2.4, which were delayed due to staff movements. The workshop to meet these milestones has now been scheduled for December 2011
- milestone C2.3.2, which has been revised as the priority of the issue was downgraded
- milestone C3.1.5, which has been revised due to the lack of an industry partner that is able to provide case studies
- milestone C3.2.4, which has been expanded to provide a clear picture of the impact on value between optimised harvesting vs. several different non-optimised approaches
- milestone 4.4.2, which was delayed due to staffing difficulties.

The project management system that was established in 2007 to manage project operating plans (POPs) remains in place. POPs are an important tool in C&U management as they help identify, amongst other things, pathways to adoption and resource requirements at a subproject level. The CRC Management Group reviews POPs annually, to ensure that adoption strategies are appropriate,

that sufficient emphasis is placed on these in the planning process, and that adequate resources have been identified for their implementation.

Industry partner staff are actively involved in one or more field-based research programs and are well positioned for rapid technology transfer. More structured sharing of information continues to be carried out through field days, seminars and workshops (listed at Appendix A of this report). The CRC is also planning for the next Annual Science Meeting, to be held in March 2012, which will focus on research outputs over the life of the CRC.

No patents were filed during 2010–11.

3.4 Education and training

Chair: Professor Peter Kanowski

Manager: Dr Neil Davidson

Extent to which the CRC is on target in terms of recruiting and supervising PhD and masters students

The CRC's Education and Training Program currently supports 59 research students (53 PhD, six masters by research; 54.5 full-time equivalent) at various stages of their degrees, representing the major proportion of PhD students working on forestry topics in Australia. A further eleven CRC PhD students and one masters student graduated in 2010–11. The number of enrolled and completing students satisfied the CRC's milestone requirements.

The majority (60 per cent) of CRC students are engaged with Program Four; half the remainder are engaged with Program One and the balance are split equally between Programs Two and Three. As noted in previous Annual Reports, while overall student numbers were consistent with targets, the CRC continued to experience difficulties in recruiting students for some program and project areas. In many cases, these difficulties reflected the broader challenges facing student recruitment in the forestry sector⁶. In some areas, such as Program Three, there has been progress in student recruitment following a strategic and targeted recruitment program, based in part on linkages to the National Forestry Masters Program⁷, which the CRC has supported in a number of ways.

As the CRC approaches the end of its current funding period, PhD student recruitment is being limited to projects for which supervision and support can be guaranteed beyond the life of the CRC.

Involvement of industry in research supervision

Industry partners continue to be closely involved in research students' projects through oversight of program and project activities, membership of students' supervisory panels, and in roles such as formal reviewers of students' progress. Industry partner staff are formally members of the supervisory panels of one-third of CRC research students, and involved in supporting the research of many others in a variety of ways.

Support for students, and interactions among students across the CRC

The CRC supports its students in a number of ways: financially, through the provision of full or top-up scholarships, and in the provision of operating and skills development funds; academically, through the development and conduct of projects that address both academic and industry partner needs, to the benefit of both; and professionally, through the networks the CRC helps students develop with industry partners and peers, as well as with their supervisors. CRC students report high levels of satisfaction with these arrangements.

Students within each program engaged primarily with others in the same program in a variety of ways, including regular newsletters such as Program Four's *BioBuzz* or industry workshops such as those organised by Program Three. There was no CRC-wide forum for students in 2010–11, as the reporting period fell between the timing of Annual Science Meetings.

Graduate destinations

Of the 11 CRC PhD students who graduated in 2010–11, one is undertaking postdoctoral forestry research with a CRC research partner; two have accepted or continued work with CRC for Forestry industry partners; three took up forestry or environment-related work with other organisations; and five were travelling or seeking employment at the time of writing.

⁶ de Fégely, R. 2010. *Australian forestry education review*. Forest and Wood Products Australia.

<http://www.fpwa.com.au>

⁷ www.forestry.org.au/masters

End-user involvement in developing undergraduate and graduate courses

CRC industry partners continue to be closely involved in the development and delivery of many courses offered by CRC partner universities. Their involvement takes a number of forms: direct roles in development and delivery, for example in the *Plantations and the Environment* course offered by the University of Tasmania to both graduate and undergraduate students; or in the delivery of specialist components in the classroom and/or the field, as in the *Forest Operations* course offered by the University of Melbourne.

In addition, staff of the CRC at each of the participating universities teach undergraduate and graduate courses that are informed by their CRC work in association with industry partners; one example among many is the *Participatory Resource Management* course, delivered at the Australian National University with substantial contributions from researchers in the CRC's Communities project (4.3). The CRC and its staff continue to play a fundamental role in supporting the National Forestry Masters Program, in which four of our five participating universities are involved.

Partners in the National Forestry Masters Program were successful in securing an Australian Learning and Teaching Council Discipline Network grant of \$95 000 to further develop a National Forestry Education Network. This grant will be used to further develop graduate courses relevant to industry needs, guided by a steering committee on which the CRC and a number of industry partners are represented.

Nature of seminars/workshops/courses run for industry

Industry staff have participated in many of the modules and courses offered as part of the National Forestry Masters Program. Industry partners and others have also attended workshops, seminars and short courses offered by the CRC. More detail of these is provided at Appendix A.

Contribution to skill development in the industry

CRC education funds continue to support individual students to participate in other targeted, generic skills training, such as scientific writing and statistics. Much of this is done within the CRC's research programs through courses, workshops and field days run as part of research activities.

The CRC's focus is on producing graduates who are 'industry ready' and this is an important part of building capacity and skill in the industry.

A comprehensive list of seminars, workshops and courses is listed at Appendix A. The engagement of industry with CRC activities is also discussed in Section 3.5.

3.5 SME engagement

During the second half of our current funding term, the CRC's strategy has been to progressively increase the level of emphasis and resourcing to end-user engagement, implementation of adoption strategies and communication with stakeholders. The CRC currently employs an Industry Engagement Manager, full-time Industry Liaison Officer and Communications Manager, and part-time Communications Officer and Communications and Administration Assistant.

The CRC's program coordinating committees are chaired by industry representatives, and each project steering committee includes representatives of stakeholder organisations and research end users. A steady stream of specialist workshops, field days, research bulletins and technical reports assists research adoption. But it is the personal contact between scientists and practitioners and the close involvement of industry people in all stages of a project that ensures CRC research can be translated to policy and practice.

End users are systemically involved in all CRC projects involving field or operational trials. The table below lists end-user participants actively contributing on a project-by-project basis, through involvement of personnel in research and development activities or project oversight, provision of field trial sites and logistic support, or participation in operational trials. Note that at an organisational level, some organisations (e.g. state agencies) participate both as research providers and research users. All acronyms, initialisms and abbreviations are listed in full in the glossary on page 44.

Project	End users directly involved in project execution and delivery
1.1	ABP, DPI NSW, DSE, Elders, FFIC, FPC, FT, Gunns, Hansol, HVP, Norske Skog, Oji, Timberlands Pacific, WAPRES
1.2	ABP, DPI NSW, DSE, Elders, ForestrySA, FPC, FT, Gunns, Hansol, HVP, Midway, Norske Skog, Oji, WAPRES
1.3	ABP, DSE, Forests NSW, FPC, FT, Gunns, Hansol, Midway, Norske Skog, Oji, QDPIF, WAPRES
1.4	ABP, DEEDI, Elders, Gunns
2.1	DPI NSW, Elders, FPC, FT, Gunns, Hansol, Norske Skog, Oji, STBA, WAPRES
2.2	DSE, Elders, FPC, FT, Gunns, Hansol, HVP, Midway, Oji, STBA, WAPRES
2.3	Elders, Forests NSW, FPC, FT, Gunns, Hansol, Oji, STBA, WAPRES
2.4	Elders, FPC, FT, Gunns, Hansol, Midway, Oji, STBA, WAPRES
2.5	Elders, Forests NSW, QDPIF
3.1	ABP, AFCA, DPI NSW, Elders, FFIC, ForestrySA, FPC, FT, Gunns, Hansol, HVP, Midway, Norske Skog, Oji, SEFE, VicForests, WAPRES
4.1 & 4.6	DSE, ForestrySA, FPA, FPC, FT, Gunns, Hansol, HVP, Oji, WAPRES
4.2	DSE, FFIC, ForestrySA, Forests NSW, FPA, FPC, FT, Gunns, Hansol, Midway, Oji, STBA, WAPRES
4.3	DPI Vic, Elders, FFIC, FPC, FT, Green Triangle Regional Plantation Committee, Gunns, Hansol, Norske Skog, Oji, WAPRES
4.4	ABP, APFL, Elders, ForestrySA, FPC, GSTH, Gunns, WAPRES

Many of the CRC's industry participants are SMEs (see table below). The CRC also engages with non-participant SMEs including through industry peak bodies.

Participant name	Participant type
Hansol PI Pty Ltd	Essential
WA Plantation Resources Pty Ltd	Essential
Elders Forestry (T/A Integrated Tree Cropping Limited)	Supporting
Forest Enterprises Australia Ltd (under external administration)	Supporting
Hancock Victorian Plantations Pty Ltd	Supporting
Midway Ltd	Supporting
Norske Skog Paper Mills (Australia) Ltd	Supporting

South East Fibre Exports Pty Ltd	Supporting
Southern Tree Breeding Association Incorporated	Supporting
Timberlands Pacific Pty Ltd	Supporting
VicForests	Supporting

The table below sets out examples of the range of CRC research and outreach activities that provide benefits to SMEs.

CRC activity	SME end users	Benefit
Industry Liaison Officer	All industry partners	On-the-ground engagement to assist with uptake and implementation of CRC research outputs, tools and decision-support systems.
Ideas to Impact seminars	All attending industry partners	Small-group demonstration of CRC decision-support tools using real-world scenarios. Demonstrates how each tool will add value considering specific examples raised by participants. Follow-up on-site training is also available to help implement tools in operational settings.
Technical report series	All partners	Shares technical information and results from research projects.
Industry bulletin series	All partners	Research results in an easy-to-digest and understand format with a focus on the application of the results for industry partners.
Global calibrations for NIR prediction of wood properties and training in NIR use	All Program Two partners	Partners able to predict wood properties with reduced time and cost for tree breeding and resource evaluation.
Technology transfer of research outputs from Program Three: Machine Evaluation Toolbox, Onboard computers guide, FastTRUCK	All Program Three partners	Direct contact with researchers on how to apply tools resulting from research results, with the opportunity to investigate particular examples for their own applications. Accelerated uptake and impact.
<i>Community engagement handbook</i>	Forest managers, ENGOs, industrial site managers, local government	Improved understanding and implementation of community engagement. This highly accessible document encourages improved approaches to community engagement and helping to re-design communication-based corporate policies and procedures. Improved community engagement helps to reduce social conflict and promote sustainable forest management practices that suit the community and the forest management organisation.
CABALA workshops	All industry partners on demand	Provide training for forest managers to enable use of powerful modelling tools to better manage forest assets.
Decision-support suite of tools — industry workshops and company-based training	All industry partners on demand	Provide tools and training for partners to use available information to make better-informed decisions to manage and value-add to plantations
TAS Forest Industry Survey 2010	Forest industry members and representative groups, policy-makers, local government	Provides timely evidence of employment trends in the forest industry resulting from the downturn in the Tasmanian forest industry. Improved the understanding of the extent of the impact of the forest industry downturn on Tasmania's forest industry businesses and workers. Resulted in increased attention to the needs of affected forest industry workers and communities.
Socioeconomic impacts of forest industry change	Forest industry members and representative groups, policy-makers, local government	Evidence of current and potential impact of proposed forest industry change on Tasmanian forest industry workers and dependent communities. Improved design of structural adjustment and assistance packages through an enhanced understanding of socioeconomic impacts resulting from changes in the forest industry.

Industry Pest Management Group	Industry partners in south-west Western Australia and the Green Triangle	Improved efficiencies in plantation pest management, across regional and industry scales, minimising risks and silvicultural inputs for plantation managers.
MODIS technology transfer	All industry partners on demand	Provision of free, broad scale, forest health surveillance technologies. A simple user interface facilitates industry uptake and allows forest health to be office monitored in pseudo real time, increasing monitoring and reducing field costs.
Second Rotation (2R) Industry Collaborative	Industry members in south-west Western Australia	The Collaborative provides an amalgamation of industry data for the development of 2R growth models, used to predict harvest volumes and develop long-term business models. Without collaboration, there is insufficient data within individual companies to produce such results.
Sustainable and socially acceptable strategies for controlling vertebrate browsing	Tasmanian industry partners	Improved plantation productivity while minimising chemical use and community concerns. Enhanced social licence to operate.
Strategies for the management of keystone and listed threatened taxa in production landscapes	FPA and Tasmanian industry partners	Allows forest practices officers and forest planners to sustainably manage forest biodiversity. Improved biodiversity outcomes and social licence to operate.
Parameterised carbon reporting models for some Australian forest conditions	Forest managers and policy makers	<p>Despite the desire for uniform carbon reporting systems, FULLCAM⁸ is designed to report at a national scale. Many forest managers have data at the site scale, which provides far more accurate information at the site level of many managed forests.</p> <p>The CRC's work evaluates site-level predictions of forest carbon accounting tools and their integration with forest managers systems and datasets. This work will evaluate the utility of the models to guide forest management decisions. The work will also be important for forest managers to maximise opportunities arising from a future carbon price.</p> <p>This work will assist forest managers to apply site-scale forest carbon accounting tools to maximise opportunities arising from a future carbon price</p>
LiDAR technology transfer: two-day workshop	All attending industry partners	Improve efficiency of forest assessment through use of remote sensing technology to generate terrain models, stand-level metrics and to identify and measure tree crown elements.
Hemispherical photo processing tool	All industry partners on demand	Provides a tool for automated, rapid and consistent analysis of hemispherical photographs.
Fact sheets and technical reports on establishing and harvesting plantations in streamside management zones	Farm-foresters and regional NRM bodies	Provide confidence that plantations can be established in streamside management zones to attain multiple benefits including water quality improvements, and that they can be harvested without compromising water quality.

⁸ FullCAM (Full Carbon Accounting Model) is part of the National Carbon Accounting Toolkit and accounts for carbon stock changes associated with land use and management.

3.6 Collaborations

The CRC for Forestry is characterised by high levels of collaboration among research providers, and between research groups and end users. International collaboration has increased in 2010–11, including fruitful collaboration with research partners in countries including China, Spain, France, the Netherlands, the United Kingdom, the United States, Canada, New Zealand, South Africa, Brazil, Portugal and Vietnam.

Collaborations among research participants

There is significant inter-program collaboration, manifested through shared supervision of students, joint data collection, pooling of analytical and modelling expertise and joint publications.

For example, in Program One, Project 1.2.2 examines plant responses to defoliation and involves a shared postdoctoral fellow (Eyles) with the Tasmanian Institute of Agricultural Research (University of Tasmania). Joint publications are beginning to flow, for example Pinkard *et al.* (2011) and Battaglia *et al.* (2011). Project 1.3 collaborates closely with Project 1.1.1 collecting data for textural classes of soils across a paired plots network.

Researchers in Program Two collaborate with others in Program Four on developing improved methods to analyse competition between trees in plantations, to better forecast impacts of silvicultural treatments such as thinning and pruning. This research also involves collaboration with Jurgen Bauhaus of the University of Freiburg (Germany).

Within Program Four, a newly affiliated PhD student project under Project 4.2 on ecological factors affecting forest carbon stores is jointly supervised with Project 4.6 staff. Another PhD student (Project 4.1.3) is jointly supervised by the leader of Project 1.1.

The project leader of Project 4.1 has recently contributed as co-author to three papers on stand-scale water balance published through Program One.

Within Project 4.2 'Biodiversity' there are strong links among research participants in all subprojects through in-kind staff participation and/or joint supervision of research students. Most CRC PhD projects based at the University of Tasmania working on biodiversity impacts of alternative silvicultural systems or threatened taxa have supervisors from University of Tasmania, Forestry Tasmania or the Forest Practices Authority, and, in some cases, all three organisations.

There are well-developed collaborative linkages between Project 4.2 'Biodiversity' and other CRC research participants: 13 of the 49 published and in press journal articles for 2010 are joint publications between the University of Tasmania and other CRC research partners (both research providers and end users—Forestry Tasmania or Forest Practices Authority, Tasmania); three involved authors from different research partners and one University of Tasmania publication included an external end user as co-author.

Research collaboration in Project 4.2 often involves multiple research providers and collaboration occurs across all CRC research programs. There are links with Program One on (i) disease risk and disease genetics through joint supervision of a student (at Murdoch University) and preparation of a joint publication (CSIRO, University of Tasmania, Forestry Tasmania), and (ii) physiological impacts of simulated browsing (University of Tasmania, CSIRO) through joint student supervision. Links with Program One focus on expertise in the biodiversity gene pool management area (Project 4.2—University of Tasmania, University of Melbourne, Southern Cross University).

Collaboration between Project 4.2 and Program Two work on association genetics (Project 2.1) involves multiple research providers (University of Tasmania, University of Melbourne, Southern Cross University) in the development and application of a high throughput DArT marker system for genetic diversity and mapping studies in eucalypts.

Programs Two (CSIRO, University of Tasmania), Three (University of Tasmania, University of Melbourne) and Four (Project 4.2 University of Tasmania) are collaborating on an integrated study of growth, wood properties and harvesting variables using two genetics trials in Western Australia.

Collaborations between researcher and end-user participants

Collaboration with industry partners includes:

- maintenance of a paired plots network (blue gum in the Green Triangle and south-west Western Australia), with efforts now turning to maintaining this resource beyond the current CRC
- work with onboard computer systems involving trials with industry partners: ForestrySA, HVP, VicForests, L.V. Dohnts (contractor to WAPRES, Gunns and ABP).
- machine productivity evaluations: HVP, ForestrySA, FNSW, WAPRES, APFL/APEC
- trials on biomass harvesting alternatives: HVP, FNSW, Elders
- developing a machine replacement decision-support method based on the role of a given machine in the broader harvest system and existing contractual constraints: AFCA.

There are strong links between Project 4.2 'Biodiversity' research staff and end-user participants. For example, several senior CRC in-kind research staff from Forestry Tasmania and the Forest Practices Authority, who work closely with University of Tasmania CRC staff and students, provide key links to operational forest management and regulation within Forestry Tasmania and the Forest Practices Authority, respectively. This link allows rapid dissemination and adoption of research results (e.g. through the Forest Practices Authority Threatened Fauna Advisor, Forestry Tasmania management prescriptions, industry newsletters, joint field days and workshops).

Collaboration on biodiversity monitoring for forest biodiversity conservation, as well as CRC PhD project supervision, is being undertaken with staff from the NSW Department of Industry and Investment as well as the Arthur Rylah Institute, Victoria.

In Project 4.4, Murdoch University CRC staff are closely linked with multiple industry partners through the Industry Pest Management Group.

Collaborations between end-user participants

Nil reports.

External linkages

In Program One, national collaborations with organisations and individuals external to the CRC are in three main areas: mathematics/statistics supporting research into remotely sensed data processing; physiological ecology and plant processes informing forest systems and modelling research; and carbon accounting.

In the mathematics area a strong collaboration exists with the University of Melbourne and significant collaborations have been developed with the Centre for Plants and the Environment, University of Western Sydney, via shared students and research examining physiological response to climate change in important plantation species such as *E. globulus* and *P. radiata*. Experiments to examine responses of *E. globulus* to elevated CO₂ and temperature are being conducted in the Hawkesbury Forest Experiment whole tree chambers (UWS). Glasshouse studies of drought mortality on *E. globulus* have examined drought-induced mortality at elevated CO₂ and elevated temperatures. The Program also maintains strong collaborations with the climate change cluster at UWS and at Charles Darwin University.

Other examples of collaborations in Program One are with:

- Rob Hyndman, Professor of Statistics, and Kate Smith-Miles, Professor and Head of the School of Mathematical Sciences at Monash University, co-supervise CRC student David Lazaridis
- Derek Eamus, Professor of Environmental Sciences at the University of Technology Sydney, and Lindsay Hutley, Associate Professor, Environmental Science at Charles Darwin University collaborate on the CRC's Project 1.3, working to predict growth at the individual tree level

- Professors David Ellsworth and David Tissue at the Centre for Plants and the Environment, University of Western Sydney collaborate on measurement and management of forest health
- the Australian Government Department of Climate Change (Projects 4.5 and 1.6).

International collaborations in Program One are with:

- Jan Verbesselt at Wageningen University (Netherlands), Maurizio Mencuccinni of the University of Edinburgh, and Denis Loustau at INRA in Bordeaux as part of the TRANZFOR⁹ project
- the Canadian Forest Service on the partitioning of over-storey and understorey carbon and water fluxes. Research results will be captured in modelling frameworks.

Program Two collaborations include:

- with Ta Ann Tasmania Pty Ltd to evaluate the results of veneering trials of plantation-grown *Eucalyptus nitens* logs carried out by CRC researchers at the company's Smithton veneering plant
- with the CSIRO Plant Industry forest genetics team external to the CRC, together with the Southern Tree Breeding Association and industry partners Gunns Ltd and Forestry Tasmania on the integration of molecular and quantitative genetic information for breeding value prediction
- with the China Eucalypt Research Centre of the Chinese Academy of Forestry, which supported a visit by Dr Geoff Downes to develop collaboration on NIR prediction of wood properties
- with The Galician Timber Technological Innovation and Services Centre (CIS-Madera) on value-added uses of timber produced from *E. globulus* plantations.

Program Three has been collaborating on an onboard system for forest machine management trial with Stellenbosch University (South Africa) to expand case study knowledge to build industry guides to select and implement these systems in Australia. The Stellenbosch collaboration has resulted in a joint paper to be presented at the International Symposium on Forestry Mechanisation (October 2011).

The Program Three Manager is chair of a committee on Southern Hemisphere Forest Operations Research Collaborative Group (SHFORC). The group was formed to promote collaboration and coordinate strong nationally-focused forest operations research across the Southern Hemisphere and highlight forest operation issues that are common across the Southern Hemisphere. Current SHFORC participants are:

- Forest Engineering (South Africa)
- Future Forest Research Ltd (New Zealand)
- CRC for Forestry
- Forest and Wood Products Australia
- College of Agronomic Sciences — F.C.A. / Sao Paulo State University (UNESP) (added in 2010–11).

Mark Brown, manager of Program Three, is also the Australian representative on COST (European Cooperation in Science and Technology) Action FP0902 (Development and harmonization of new operational research and assessment procedures for sustainable forest biomass supply). In 2010–11, Mark Brown was appointed as a member of the executive for the COST Action, as a co-leader of a working group and as a section editor for the journal of forest energy (created and hosted by the COST Action).

⁹ A project to strengthen research partnerships through staff exchanges and networking activities between three European research organisations from France, Portugal and United Kingdom, and two organisations from Australia and New Zealand.

Research in Program Four is enhanced through multiple external linkages and collaborations involving CRC staff and student projects.

Domestically, external links include:

- with the ARC Environmental Futures Network, as well as Discovery and Linkage projects, which inform CRC Biodiversity research
- with the Threatened Species Unit of the Department of Primary Industries, Parks, Water and Environment in Tasmania, contributing data to enhance the threatened species and risk assessment database, revision of the *E. globulus* distribution, and gene flow from plantations
- with several Bushfire CRC projects. CRC for Forestry research on forest remnant and gene-pool management was facilitated by close interaction with the Bushfire CRC, and its application enhanced through linkage with the external end user Greening Australia Pty Ltd, extending research results to biodiverse carbon plantings
- Tasmanian Community Forest Agreement research into alternatives to the use of 1080 to control browsing mammals, and with Bayer Environmental Sciences on systemic insecticides. Project 4.2 also collaborates with Dr Angus Carnegie (Department of Industry and Investment, NSW) and Geoff Pegg (Tree Pathology Centre, The University of Queensland/Queensland Department of Primary Industries and Fisheries) on molecular taxonomy of eucalypt pathogens
- the national research effort on Forests and Water (Project 4.1). This engages the CRC in collaborations with researchers from CSIRO Land and Water on the effects of plantations on water resources and fire effects on streamflow, CSIRO Marine and Atmospheric Research through the Terrestrial Ecosystem Research Network and the OzFlux network, the Melbourne Water Bushfire Research Program, the Department of Sustainability and Environment Integrated Forest Ecosystem Research Program and Future Fire Project and the Bushfire CRC Fire in the Landscape Program.

The CRC for Forestry also collaborates with the CRC for Future Farm Industries in its work to improve the biomass productivity and water use efficiency of oil mallees.

International collaborations in Program Four include:

- with the international EUCAGEN network of scientists working on eucalypt genetics and genomics, with key collaboration involving the University of Pretoria (South Africa) and Universidade Católica de Brasília (Brazil)
- with the Technical University of Lisbon (Portugal) on both quantitative genetics of *E. globulus* and its hybrids and modelling wilding establishment risks from *E. globulus* plantations. CRC scientists leading research on alternative silvicultural systems maintain close links with scientists involved with variable retention research in Patagonia, Pacific north-western USA, British Columbia and Alberta
- Sue Baker, as part of a World Forestry Institute Fellowship in Oregon, is collaborating with scientists from these countries to assemble suitable datasets to conduct a meta-analysis testing the forest influence effect—a key ecological objective of variable retention silviculture
- Mark Neyland and Sue Baker are collaborating with a number of other international scientists on a review of retention forestry worldwide
- Steve Read is collaborating with scientists from the University of Alberta on a comparison of variable retention in boreal and temperate eucalypt forests. The Warra Long Term Ecological Research site, where silvicultural treatment studies are being undertaken, is part of the international long-term ecological research (LTER) network
- Professor Marco Restani of St Cloud State University (Minnesota, USA) provided input into a wedge-tailed eagle nest monitoring project
- with the disease research group at the Forestry and Agricultural Biotechnology Institute (FABI) of the University of Pretoria (South Africa), among the leaders in eucalypt fungal taxonomy and genetics. Collaboration with this group is enhancing progress with research on disease spread and fungal communities, particularly involving *Mycosphaerella* species

- collaboration on eucalypt pest and disease research also occurs with the University of Pretoria, South Africa and the Forest Science Institute of Vietnam
- Dr Philip Smethurst has continued his collaboration with Professor Dan Neary from the Rocky Mountains research station of the USDA Forest Service. Professor Neary visited in 2009–10 and continues to contribute to reports and publications from the project on the effects of riparian plantations and their management on water quality.

Jurgen Bauhaus of the University of Freiburg (Germany) collaborates with CRC researchers in Program Two on research developing improved methods of analysing competition between trees in plantations, to better forecast impacts of silvicultural treatments such as thinning and pruning.

4 Other activities

Forest and Wood Products Australia (FWPA) provided \$482 000 to support a project adapting the Blue gum Productivity Optimisation System (BPOS). The project will create a new tool, FPOS (Forest Productivity Optimisation System), which will adapt BPOS for new species, silvicultural approaches and future climates. The project will conclude one year after the end of the current CRC.

FWPA also provided \$82 000 (over three years) for a critical review of recent work on the potential of managed forests to contribute to reduction in greenhouse gas emissions.

The Department of Premier and Cabinet (Tas) commissioned a review of the Tasmanian Government's Forest Carbon Study and advice on the scope of the Forest Carbon Study Project (\$5400).

The CRC completed four contracts for measurement of basic density and NIR-predicted pulp yield in sets of wood samples (for Elders, Oji Paper, Forestry Tasmania and Midway). The total value of the contracts was \$11 436.

The CRC completed work on a guide to the selection and implementation of onboard computer systems, a project part-funded by a two-year grant (\$348 000) from Forest and Wood Products Australia. The project concluded with a series of regional workshops that saw the guide delivered directly to more than 100 forest managers and contractors.

Research in Project 4.2 was facilitated through ARC grants held by participating CRC for Forestry scientists. In particular, three grants focused on supporting landscape-level biodiversity studies will contribute to several subprojects that are developing in-coupe prescriptions for maintaining biodiversity:

- two ARC Linkage Grants to the University of Tasmania (totalling \$894 168, including funding from industry of \$269 168)
- a grant from FWPA to Forestry Tasmania (totalling \$522 400, including FT's contribution).

Understanding the biodiversity effects of variable retention silvicultural regimes was aided by a one-year fellowship (US\$33 796) at the World Forest Institute, Portland, Oregon (Gottstein Trust/FWPA/the Harry Merlo Foundation) to Sue Baker (Project 4.2.1).

Gene pool management will similarly benefit from interactions with a new ARC Discovery Grant (\$285 000) to the University of Tasmania as well as a Churchill Fellowship awarded to Rebecca Jones (\$25 271).

The Department of Environment and Conservation (WA) provided \$40 000 for data analysis as part of research on adaptation in eucalypts across an environmental gradient.

Wedge-tailed eagle surveys have been supported by the Mohamed bin Zayed Species Conservation Fund (\$15 000).

External grants are assisting student projects on:

- gene flow from *E. globulus* plantations (FWPA: \$51 000 over three years)
- bat research (Mohammed Bin Zayed Species Conservation Trust: \$16 406; Bat Conservation International Inc.: \$2500; Holsworth Wildlife Research Endowment Grant: \$18 000; Forest Practices Authority Student Research Grant: \$2000; Royal Zoological Society of NSW Ethyl Mary Read Award: \$1500; Bookend Trust Scholarship: \$1000; Winifred Violet Scott Charitable Trust: \$40 000)
- mammal response to silvicultural treatments (WV Scott Charitable Trust: \$39 000; Holsworth Wildlife Research Fund: \$15 000; MA Ingram Trust: \$1980).

The Holsworth Wildlife Research Fund provided additional funding for Ryan Burrows' PhD, extending support for another year. The funding of \$5000 will allow Ryan to present his research at the Society for Freshwater Sciences (Louisville, Kentucky) in May 2012.

Project 4.3—Communities received funding (\$48 500) from the Department of Agriculture, Fisheries and Forestry for additional work to be completed as part of the *Socioeconomic impacts of change* study undertaken in Tasmania. While linked to the socioeconomic impact work undertaken as part of

the Commonwealth Agreement, this additional work was undertaken as part of the due diligence assessment of the *Tasmanian Forests Statement of Principles to Lead to an Agreement (Principles Statement)*, using the capacity of the CRC for Forestry.

5 Additional requirements

5.1 Third-year review

In November 2008 the CRC for Forestry underwent its third-year review. The review panel made 12 recommendations it felt would add value to the business. Nine of the 12 recommendations were implemented immediately and were reported in the 2009–10 annual report. The remaining three have now been addressed, and are reported below.

Recommendation	Strategies to implement
<p>R3</p> <p><i>The Panel recommends that the CRC should encourage industry to form a peak body to represent forest operations research across the sector.</i></p>	<p>The national forestry research, development and extension strategy was endorsed by the Primary Industries Ministerial Council in 2010, and a peak advisory body (the Forestry RD&E Forum) was established in September 2011. The Forum includes senior representatives of industry, government and research agencies. The CRC for Forestry Chief Executive Officer is a member of the Forum Executive. The scope of the Forum will include forest operations research.</p>
<p>R11</p> <p><i>The Panel recommends that the CRCF considers mechanisms to ensure that there is an on-going capacity to train end users in the operational use of the model CABALA.</i></p>	<p>A decision-support system based on CABALA (BPOS—the Blue gum Productivity Optimisation System) has been deployed and trialled with industry partners.</p> <p>An additional decision-support tool (FPOS—Forest Productivity Optimisation System) is in development. FPOS will include additional species, future climates and different product types.</p> <p>In addition, workshops have been held to build capacity among ‘expert users’ of CABALA.</p>
<p>R12</p> <p><i>The Panel recommends that the CRCF consider alternative strategies to meet their contractual research commitments should the planned recruitment of postgraduates not eventuate or be delayed.</i></p>	<p>The CRC has met most recruitment targets for postgraduate students in strategic areas.</p> <p>In some cases, the CRC has redirected funds towards technical and research contract positions designed to deliver project outcomes.</p>

6 Glossary of terms

Abbreviations, acronyms and initialisms

ABP	Australian Blue gum Plantations
AFCA	Australian Forest Contractors Association
AFG	Australian Forest Growers
AGM	Annual General Meeting
ALPACA	Australian Logging Productivity and Cost Assessment tool
ALS	airborne laser scan
ANU	Australian National University
APEC	Albany Plantation Export Company
APFL	Albany Plantation Forest Company
APVMA	Australian Pesticides and Veterinary Medicines Authority
BoM	Bureau of Meteorology
ARC	Australian Research Council
BPOS	Blue gum Productivity Optimisation System
C&U	commercialisation and utilisation
CA	Commonwealth Agreement
CABALA	a linked carbon, water and nitrogen computer model of forest growth for silvicultural decision-support (from carbon balance)
CASR	Collaboration and Structural Reform Fund
CAT	Catchment Analysis Tool
CE	community engagement
CERF	Commonwealth Environment Research Facilities Program
CIPMC	Commercialisation and IP Management Committee
CRC for Forestry	(our working name)
CRC Forestry Limited	(our registered business name)
CRC	Cooperative Research Centre
CRCA	The Cooperative Research Centres Association
CRES	Centre for Resource and Environmental Studies
CSIRO	The Commonwealth Scientific and Industrial Research Organisation (Australia)
CWD	coarse woody debris
DArT	diversity arrays technology (a generic genotyping technology)
DBH	diameter over breast height
DED	Department of Economic Development (Tasmania)
DEEDI	Department of Employment, Economic Development and Innovation (Queensland)
DEST	The Australian Government Department of Education Science and Training
DPI NSW	Department of Primary Industries (NSW)
DPIW	Department of Primary Industries and Water (Tasmania)
DSE	Department of Sustainability and Environment (Victoria)
DSS	decision-support system
ENGO	environmental non-government organisation
ESA	Ecological Society of Australia
FABI	Forestry and Agricultural Biotechnology Institute, University of Pretoria
FEA	Forest Enterprises Australia Ltd

FFIC	Forests and Forest Industry Council of Tasmania
FIAT	Forest Industries Association of Tasmania
FIS	forest industry survey
FNSW	Forests NSW
FORTHREATS	European network on emerging diseases and invasive species threats to European forest ecosystems. For more information on this project please refer to http://www.ulb.ac.be/sciences/lubies/forthreats.html
FPA	Forest Practices Authority, Tasmania
FPC	Forest Products Commission, WA
FPOS	Forest Productivity Optimisation System
FT	Forestry Tasmania
FWPA	Forest and Wood Products Australia
FWPRDC	formerly Forest and Wood Products Research and Development Corporation (now Forest and Wood Products Australia Limited)
GL	Gunns Ltd
GSL	Great Southern Limited
GSP	Great Southern Plantations, a partner to the CRC for Forestry, changed its name to Great Southern Limited in 2006.
GSTH	Great Southern Timber Holdings
GTRPC	Green Triangle Regional Plantations Committee
Gunns	Gunns Limited
Hansol	Hansol PI Pty Ltd
HVP	Hancock Victorian Plantations
IEGN	International <i>Eucalyptus</i> Genome Network
IP	intellectual property
IPMG	Industry Pest Management Group
ISSN	International standard serial number
ITC	ITC Limited
IUFRO	International Union of Forest Research Organisations
LGS	longitudinal growth strain
LiDAR	light detection and ranging
LTER	long-term ecological research (There is an LTER site located at Warra in southern Tasmania.)
MC	Management Committee
MIS	Managed Investment Scheme
MLD	Mycosphaerella leaf disease
MODIS	Moderate Resolution Imaging Spectroradiometer
Murdoch	Murdoch University
NIR	near infrared
NIRS	near-infrared scanning
NRM	natural resource management
NS	Norske Skog Paper Mills (Australia) Ltd
NSW DPI	New South Wales Department of Primary Industries
Oji	Oji Paper Co. Ltd
PA	Participants' Agreement
PCC	A CRC for Forestry program coordinating committee
PFT	Private Forests Tasmania
PSC	a CRC for Forestry project steering committee

QDPIF	Queensland Department of Primary Industry and Fisheries
QTL	quantitative trait loci
SCU	Southern Cross University
SED; sedub	small end diameter; small end diameter under bark
SEFE	South East Fibre Exports
SMEs	small to medium enterprises
SPC	Strategic Policy Committee
SST	silvicultural systems trial
StanForD	Standard for Forestry Data
STBA	Southern Tree Breeding Association
TASVEG	Tasmanian Vegetation Map
TC	Timbercorp Ltd
TCFA	Tasmanian Community Forest Agreement
TIAR	Tasmanian Institute of Agricultural Research
UniMelb	University of Melbourne
UTas	University of Tasmania
VR	variable retention
WAPRES	WA Plantation Resources
3PG	Physiological Principles of Plantation Growth

Appendix A Publications, outreach and technology transfer

Formal publications

Book chapters

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- Almeida A, Siggins A, Smethurst P, Silva CVJ, Baillie C (2010) Establishment of experimental catchments to quantify water use by different vegetation types. Oral presentation to IUFRO Conference on Remote Sensing and GIS Applied to Forestry, 19–21 October 2010, Curitiba, Brazil.
- Baker S, Wardlaw T, McElwee D, Read S (2010) Adaptive management through research-directed monitoring of the operational roll-out of variable retention silviculture in Tasmania. Ecological Society of Australia Annual Conference, Canberra, Australia, 6–10 December 2010.
- Baker S, Grove S, Jones N (2010) Using beetles as a monitoring tool for aggregated retention silviculture in Tasmania, Australia. 24th International Congress for Conservation Biology, Edmonton, Canada, 3–7 July 2010.

- Bialkowski K, Archibald R, Hardy G, Burgess T (2010) Chemical and biochemical properties of the soil as potential tools for monitoring woodland restoration in south-western Western Australia. Oral presentation at the Seventh European Conference on Ecological Restoration, Avignon, France, 23–27 August 2010.
- Bialkowski K, Archibald R, Hardy G, Burgess T (2010) Substrates used in SIR assays can inhibit basal respiration in rewetted soils. Poster presentation at 19th World Congress of Soil Science, Brisbane, Australia, 1–7 August 2010.
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- Brown M (2010) Biomass supply chains down under: An emerging opportunity and challenge, International Conference 'Harvesting Forest Biomass: A Global State of the Art', COST Forest Energy Action, Trento, Italy, 8 October 2010.
- Brown M, Ghaffariyan M (2010) Forest Biomass Harvesting in Australia: Building on International Experience, FFIC Biomass Energy Public Forum, Hobart, Australia, 20 October 2010.
- Brown M (2011) Sustainable Biomass Supply Chains: A new era of forest biomass use in Australia, Joensuu Forestry Networking Week 2011: Forests and Energy, Joensuu , Finland, 22–27 May 2011.
- Cawthen L, Nichol S, Munks S, McCallum H, Law B (2010) Whose calling? Developing a Tasmanian state-wide bat call identification key. Poster presentation at 14th Australasian Bat Society Conference, Darwin, Australia, 12–14 July 2010.
- Dare M, Schirmer J (2011) The effects of spatial proximity to land use change on individual and community wellbeing: Experiences from plantation establishment in South-West Western Australia. The International Symposium on Society and Resource Management, Madison, USA, 4-8 June 2011.
- Forrester DI, Collopy J, Beadle C, Warren C and Baker T (2010) Growth and water-use efficiency in a *Eucalyptus nitens* plantation following thinning, pruning and fertilising. In 'Canopy Processes in a Changing Climate', IUFRO Working Group 2.01.12, Falls Creek, Victoria and Tarraleah, Tasmania, 7–15 October 2010.
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- Grove S (2011) A deadwoodologist's digest: an A-to-Z of learnings from a decade of research in Tasmania. Oral presentation at the International Symposium on Dynamics and Ecological Services of Deadwood in Forest Ecosystems, Quebec, Canada, 15-19 May 2011.

- Grove S, Baker S (2010) Keeping arthropod conservation relevant in sustainable forest management: tips from Tasmania, Australia. 24th International Congress for Conservation Biology, Edmonton, Canada, 3-7 July 2010.
- Grove S, Forster L (2011) A decade of change in the saproxylic beetle fauna of eucalypt logs in the Warra long-term log-decay experiment, Tasmania. Oral presentation at the International Symposium on Dynamics and Ecological Services of Deadwood in Forest Ecosystems, Quebec, Canada, 15–19 May 2011.
- Grove S, Wardlaw T, Read S (2010) Measuring the contribution of CAR reserves to mature-forest biodiversity in production forest landscapes. Ecological Society of Australia Annual Conference, Canberra, Australia, 6–10 December 2010.
- Harwood C (2010) What happens when you process plantation-grown blue gum and shining gum logs? Invited presentation to NAFI/FIAT Industry Forum, Hobart, Australia, 1 December 2010.
- Harwood C (2011). CSIRO submission and spoken evidence to House of Representatives Inquiry into the Australian Forestry Industry.
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- Kanowski P, Duff G, Bossinger G (2011). Submission and spoken evidence to House of Representatives Inquiry into the Australian Forestry Industry, Hansard, 24 June 2011.
- Knight M, Loyn R, Hamilton A (2010) Bird communities and biodiversity conservation in complex landscapes of farmland, tree plantations and embedded remnant forest. Oral presentation at the Fifth International Ornithological Congress, Campos do Jordao, Brazil, 22–28 August 2010.
- Loxton EA, Schirmer J and Kanowski P (2011) Cumulative socio-economic effects of natural resource policy change: learning from Social Impact Assessment. The International Symposium on Society and Resource Management, Madison, USA, 4–8 June 2011
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- Read S, Baker S, Grove S, Neyland M, Wardlaw T (2011) Silviculture guided by natural disturbance: variable retention in wet eucalypt forests. Oral presentation at the 7th International Conference on Disturbance Dynamics in Boreal Forests, Saguenay, Canada, 29 May – 3 June 2011.
- Read S, Baker S (2011) Contrasting social and ecological drivers for management change in Tasmanian forests. Resilience2011 Conference, Arizona, USA, 11–16 March 2011.
- Schirmer J, Bull L (2010) Adapting to new economic opportunities arising from climate change. Paper presented to the Climate change adaptation and governance workshop, Institute of Environmental Studies, University of New South Wales, Sydney. Australia, 16–18 November 2010.
- Schirmer J (2011) What are the critical information gaps/research needs necessary to guide policy and implementation? Panel discussion held for IUCN symposium 'The role of biodiversity and

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Smethurst PJ, Neary DG, Petrone KC, Baillie CC, Worledge D (2011) Paired-Catchment and Stream Reach Studies of Effects of Streamside-Management-Zone Plantations on Water Quality. Oral Presentation to International Union of Geodesy and Geophysics (IUGG) General Assembly, Melbourne 28 June – 7 July 2011.

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Field days, seminars and workshops hosted

July 2010

Forest Operations Management, 7-8 July 2010 Traralgon. Presenters/instructors: Jon Dey, Martin Strandgard, Brad Shuttleworth, Martin Castonguay and Mark Brown.

August 2010

Climate change and the carbon cycle. Forestry Tasmania 'Forestry Talks' series, Hobart, 18 August 2010. Speaker: Martin Moroni.

P1.1.2 and P1.2.2 Integration meeting, Clayton, 18 August 2010. Facilitators: Caroline Mohammed and Darius Culvenor. Presenters: Caroline Mohammed, Darius Culvenor, Libby Pinkard and Christine Stone.

CABALA (CARbon BALance) process-based forest productivity model workshop, 26 August 2010, WAPRES. Presenter: Jody Bruce.

September 2010

High-value products from hardwood plantation timber. Forestry Tasmania 'Forestry Talks' series, 15 September 2010, Hobart. Speakers: Paul Adams, Matt Wood

October 2010

Field day: identification and survey of native orchids, 28 October 2010, Latrobe, Tasmania. Facilitated by: Anne Chuter, Tim Leaman. Presenter: Mark Wapstra

The Future of Forestry and Forest Science Conference, 1 October 2010, Melbourne. Speakers: Forest-based industries – Gordon Duff, Lyndall Bull Social and community challenges –Kathryn Williams International forest policy –Peter Kanowski.

IUFRO Canopy Processes Working Group, 7–15 October 2010, Falls Creek, Victoria and Tarraleah, Tasmania. CRC researchers on the organising committee: Anthony O’Grady, Chris Beadle, Michael Battaglia, Jane Medhurst; Plenary Chair: Professor Gordon Duff; CRC presenters (Oral): David Forrester, Don White, Audrey Quentin, Libby Pinkard, Auro Almeida (Poster): Libby Pinkard, Jane Medhurst, Alieta Eyles, David Forrester.

How do pests, diseases and wood value affect which eucalypt we grow? Forestry Tasmania ‘Forestry Talks’ series, 13 October 2010, Hobart. Speaker: Tim Wardlaw.

November 2010

Industry Pest Management Group – Executive Meeting, 11 November 2010, Albany, Western Australia. Chair: F Tovar.

Overview of the research and science: The genetics of pest and disease resistance in plantation eucalypts. Fighting fungi and munching mammals with good genetics. Forestry Tasmania ‘Forestry Talks’ series, 17 November 2010, Hobart. Speaker: Brad Potts.

2R Industry Field Tour, 22–23 November 2010, Albany, Manjimup and surrounds, Western Australia. Presenters: Don White, Daniel Mendham.

December 2010

CRC for Forestry Program Two workshop: Review of research progress and prospects for solid and engineered wood products from plantation-grown *Eucalyptus nitens* and *E. globulus*, 7–8 Dec 2010, Hobart and Southwood wood processing complex, Tasmania, Facilitator: Chris Harwood.

What do people want from native forests? Forestry Tasmania ‘Forestry Talks’ series, 8 December 2010, Hobart. Speaker: Kathryn Williams.

Adaptive management for forest biodiversity – simplifying the process. Special presentation and field visit by Professor Fred Bunnell from the Department of Forest Sciences, University of British Columbia, 9–10 December 2010, Presentation at University of Tasmania, Hobart. Field trip to the Styx Valley. Organiser: Sarah Munks.

Biodiversity management: a genetics perspective. Invited talk at the Grasslands Field Days, Gunns Ltd, 14–15 December 2010, Bayside Hotel, Burnie. Presenter: Brad Potts.

January 2011

Social benefits and costs of plantations for rural communities, Forestry Tasmania ‘Forestry Talks’ series, 19 January 2011, Hobart. Speaker: Jacki Schirmer.

Field day: identification and survey of native orchids, 31 January 2011, Hobart and Kingston, Tasmania. Facilitated by: Anne Chuter, Tim Leaman. Presenter: Mark Wapstra

February 2011

MODIS Web Tool Training Session, 10 February 2011, Offices of Elders Forestry, Richmond, Victoria. Presenters: Neil Sims and Anders Siggins.

Ecologically sustainable forestry – comparisons between western USA, Canada and Tasmania. Forestry Tasmania ‘Forestry Talks’ series, 16 February 2011, Hobart. Speaker: Sue Baker.

March 2011

MODIS Web Tool Training Session: Phone conference and webinar with Department of Industry and Investment, NSW. 3 March 2011 Presenter: Darius Culvenor.

MODIS Web Tool Training Session: Phone conference and webinar with Hancock Victorian Plantations. 15 March 2011 Presenters: Darius Culvenor and Anders Siggins.

Ideas to Impact workshop series. Forestry Tasmania, 17 March 2011, Perth, Western Australia. Facilitator: Mark Brown.

Tree planting for carbon sequestration: are landholders interested? Seminar. 17 March 2011, Canberra; 21 March 2011, Hobart. Presenters: Jacki Schirmer, Lyndall Bull.

Onboard systems guide workshops, 18–29 March 2011, Launceston, Albany, Bunbury, Mt. Gambier, Traralgon, Tumut. Instructors: Martin Strandgard, Mark Brown.

CABALA (CARbon BALance) process-based forest productivity model workshop. 9 March 2011, Perth, Western Australia. Presenters: Jody Bruce, Mike Battaglia.

Tree hollow management and Tasmanian micro-bat field event, 3 March 2011, Cluan Tier. Presenters/instructors: S Munks, L Cawthen.

Industry Pest Management Group – Executive Meeting, 30 March 2011, Bunbury, Western Australia. Chair: F Tovar.

April 2011

MODIS Web Tool Training Session: Phone conference and webinar with Forestry Tasmania. 4 April 2011 Presenter: Darius Culvenor.

CABALA (CARbon BALance) process-based forest productivity model workshop. 5 April 2011, Forestry Tasmania, Hobart. Presenter: Jody Bruce.

Biomass bundler productivity in Eucalyptus residue, 5–7 April 2011, Fourth Forest Engineering Conference, White River, South Africa. Presenter: Mark Brown.

Onboard systems guide, 5–7 April 2011, Fourth Forest Engineering Conference, White River, South Africa. Presenter: Martin Strandgard.

Cable logging option for FNSW native forests, 12 April 2011, FNSW offices, Coffs Harbour, Presenters: Raffaele Spinelli, Mark Brown.

Tree planting for carbon sequestration: are landholders interested? Seminar. 12 April 2011, Melbourne. Presenters: Jacki Schirmer, Lyndall Bull.

Bioenergy Workshop, 14 April 2011, Canberra. Presenters/instructors: Raffaele Spinelli, Richard Allen, Dean Allen, Andrew Widdowson, David Coote, David Atkins, Mohammad Ghaffariyan, Damian Walsh and Mark Brown

May 2011

Workshop "Global overview of tree retention as a biodiversity conservation tool", 9-13 May 2011, Stockholm and Krusenberg, Sweden. Presenters: Mark Neyland, Sue Baker.

Industry Pest Management Group – ABP membership meeting, 18 May 2011, Albany, Western Australia. Chair: F Tovar.

Sustainable biomass supply chains in Australia. Joensuu Forestry Networking Week 2011: Forests and Energy, 22–27 May 2011, Joensuu, Finland. Presenter: Mark Brown.

CRC for Forestry research program, METLA/European Forest Institute/University of Eastern Finland, 30 May 2011, Joensuu Finland. Presenter: Mark Brown.

June 2011

Industry Pest Management Group – Operations meeting, 7 June 2011, Albany, Western Australia. Chair: F Tovar.

2R Industry Collaborative workshop, 9 June 2011, Albany, Western Australia. Facilitator: CRC Industry Liaison Officer, Justine Edwards.

Ideas to Impact workshop series, Forestry Tasmania, 17 June 2011, Perth, Western Australia.
Presenter: Mark Brown.

Ideas to Impact workshop series, Forestry Tasmania, 29 June 2011, Tumut, NSW. Presenter: Mark Brown.