



# TROPICAL SAVANNAS CRC

Cooperative Research Centre for Tropical Savannas Management

## Annual Report 2006–07



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

**Mission: To achieve sustainable use and conservation of Australia's tropical savannas through excellence in collaborative research, communication and education.**

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# CONTENTS

<b>Centre Objectives .....</b>	<b>1</b>
<b>Executive Summary.....</b>	<b>2</b>
Context and major developments during the year .....	4
<b>National Research Priorities.....</b>	<b>5</b>
National research priority goals.....	5
<b>Governance and management .....</b>	<b>6</b>
Specified Personnel .....	8
<b>Research Programs .....</b>	<b>9</b>
Research activities and achievements.....	9
Research collaborations .....	27
<b>Commercialisation and utilisation .....</b>	<b>29</b>
Intellectual Property Management.....	33
Communication Strategy .....	33
End-User Involvement and CRC's Impact on End-Users .....	34
<b>Education and Training .....</b>	<b>49</b>
<b>Performance measures .....</b>	<b>52</b>
<b>Finance.....</b>	<b>56</b>
<b>Abbreviations and acronyms.....</b>	<b>57</b>
<b>Appendix 1 Finance .....</b>	<b>60</b>
<b>Appendix 2 Education .....</b>	<b>62</b>
<b>Appendix 3 Communication .....</b>	<b>70</b>
<b>Appendix 3 Communication.....</b>	<b>71</b>
Publications .....	71

## Tables

<b>Table 1: National Research Priorities.....</b>	<b>5</b>
<b>Table 2 Specified Personnel.....</b>	<b>8</b>
<b>Table 3: Research Outputs and Milestones.....</b>	<b>25</b>
<b>Table 4 End user involvement in CRC activities .....</b>	<b>36</b>
<b>Table 5: Education and training milestones .....</b>	<b>50</b>
<b>Table 6 Consultancies and Research Contracts .....</b>	<b>60</b>
<b>Table 7 Details of HDR student progression.....</b>	<b>62</b>
<b>Table 8 Employment status for Round 2 TS–CRC supported research students.....</b>	<b>67</b>
<b>Table 9 Enrolments in the Tropical Environmental Management program.....</b>	<b>69</b>

<b>Table 10</b>	<b>Ggraduations from the Tropical Environmental Management program...</b>	<b>69</b>
<b>Table 11</b>	<b>Presentations—Staff Outreach Activities.....</b>	<b>70</b>
<b>Table 12</b>	<b>Public relations and communication: Media coverage .....</b>	<b>70</b>

**Figures**

<b>Figure 1</b>	<b>TS–CRC organisational structure.....</b>	<b>6</b>
<b>Figure 2</b>	<b>Number of Publications that acknowledge the CRC * .....</b>	<b>53</b>
<b>Figure 3</b>	<b>Extent to which researchers are attracted to visit the Centre.....</b>	<b>54</b>
<b>Figure 4</b>	<b>Awards and invited papers.....</b>	<b>54</b>
<b>Figure 5</b>	<b>Number of non-university or collaborative staff involved as supervisors</b>	<b>54</b>
<b>Figure 6</b>	<b>Media Recognition.....</b>	<b>55</b>
<b>Figure 7</b>	<b>Number of Postgraduate Students * .....</b>	<b>55</b>

# CENTRE OBJECTIVES

The Centre will provide up-to-date and scientifically sound information to underpin management of the tropical savannas for sustainable use and for conservation. It will develop scientific principles and conceptual knowledge about the ecological, economic and social functioning of landscapes for the benefit of Australia's tropical savannas and the people who use them.

The Centre will tie its studies into the broad context defined by governments, stakeholders, land users and the community. In addition to its basic research, it will facilitate better management by conducting research, development and learning experiences in participation with tropical savanna stakeholders.

In particular, the Centre will produce:

- management options, along with assessments of their benefits and costs.
- policy options, with analyses of their benefits and costs.
- information packages and training in their use.
- educational packages and access processes.

Achievement of the objectives will be focused through the following key result areas and their specific output targets.

## **1. Healthy landscapes—ecological, economic, and social**

- indicators and attributes of health.
- predictive models of landscape function and the impact of interventions.

## **2. Sustainable management systems**

- landscape monitoring systems and associated management tools and packages.
- management strategies for fire, grazing, tree clearing, restoration and decision support tools and packages.
- environmental management systems and codes of practice.

## **3. Viable and socially desirable regions**

- policy and management options for regional planning and development and associated guidelines and tools.
- regional strategies for multiple land use, restructuring and reinvigoration.

## **4. Productive and capable people**

- communication strategies and processes.
- learning packages and education strategies.
- knowledgeable and employable postgraduate researchers.
- participating staff are more skilled and knowledgeable and able to work in multidisciplinary teams using participative processes.

## EXECUTIVE SUMMARY

The year was notable for the increase in a national focus on northern Australia, with the Tropical Savannas CRC being in an ideal position to contribute its knowledge, advice and networks to this heightened awareness. Having succeeded in gaining acceptance of our preliminary business plan during the previous financial year considerable resources were committed to assembling our full business case to support funding of the TS-CRC for a third term. This was submitted in August 2006, but, regrettably, was rejected without any opportunity being provided for the Centre to challenge the reasons given for rejection at interview. This failure to achieve ongoing funding for the TS-CRC was all the more disappointing when set against the Prime Minister's statement only a few months later that 'there is a knowledge gap in the north which must be filled'. How true.

Senior staff changes were also a major feature of the year. The CRC's CEO, Professor Gordon Duff, departed in September 2006. He led the CRC with passion and skill for the first five years of its second term, and deserves great credit for helping bring Indigenous Natural Resource Management into the mainstream through the growth of the North Australian Indigenous Land and Sea Managers Alliance. He also brought an entrepreneurial flair to the CRC which saw the Centre take a leading role in major NRM initiatives across the north as well as gaining international stature.

Our thanks go to him for his very significant contribution to the CRC.

Sadly, we lost both our Business Manager Brian Slatter who died after a short illness in December 2006, and project leader Professor Geoff McDonald who was forced to retire due to ill-health during the year, dying in July 2007. We acknowledge all that they did to make the CRC the success that it is today. Dr John Ludwig, our Theme 1 Leader retired, although we are fortunate in being able to continue to benefit from his depth of knowledge and enthusiasm, which will contribute to a number of ongoing research and publication projects.

The CRC is now widely recognised as having contributed directly to the economic, ecological and social sustainability of a number of different savanna sectors, creating unique enduring linkages across northern Australia. One measure of its stature is the continued success that it has enjoyed in attracting significant external funding for many projects, particularly for NRM and Indigenous activities.

The increased public awareness of, and interest in, global warming has highlighted the growing importance of fire research within the CRC—research which can justifiably be claimed to be world class in its innovative approach to the problems of understanding and managing savanna fires. The West Arnhem Land Fire Abatement Project (WALFA) has been the most tangible success story here. It aims to manage wildfires in West Arnhem Land more effectively over the next 17 years, thereby reducing carbon dioxide emissions which can be offset against the emissions from the liquefied natural gas plant near Darwin, at Wickham Point. This is the first agreement of its kind in the world, mixing world-class science with strong Indigenous involvement and biodiversity conservation, but there is potential for many more similar agreements. CRC staff are currently editing a book on management of fire and options for support through payment for ecosystem services such as WALFA.

The savannas of northern Australia support a thriving cattle industry, but much is still to be learned about best management practices in this field. Tools and strategies developed by the CRC for the pastoral industry continue to be adopted at an accelerating rate. CRC research has concentrated on the key result area of sustainable management systems supported by practical tools and strategies for managing natural resources. There is strong evidence that while some areas of northern Australia are over-stocked there are other areas that could carry more cattle without serious impact on the environment if managed efficiently and intelligently. Spread of woody vegetation has been recognised as a problem and we need to develop a better understanding of the factors responsible for driving this structural change across the savannas of northern Australian. CRC research continues on this, culminating in publication of a book. A series of four Beef Industry Best Practice Natural Resource Management manuals was released during the year aimed at documenting knowledge and skills in the industry.

It is vital to understand the needs and structure of savanna communities. CRC research has produced a range of products, from the relatively theoretical and abstract to applied research on pressing issues. A scoping demographic study in collaboration with the Desert Knowledge CRC in Australian desert and tropical savannas is now complete. Ongoing work on outback livelihoods has identified key social and economic issues affecting the viability of outback regions in three case study areas—the Upper

Burdekin in Queensland, and Anmatjere, and Ngukkur in the Northern Territory. A separate study has evaluated the economic multipliers in different regional settings throughout the savannas and has made recommendations on how development can be most effectively pursued. This research and recommendations will be brought together in a book to be published during the last year of the CRC. Further research on multiple use in savannas will suggest a mechanism for assembling formal and informal rules governing resource use and assessing how changes in rules would affect behaviour. Frameworks are being designed with regional NRM organisations and agencies across Queensland, the Northern Territory and Western Australia to capture and share lessons to support adaptive management at the regional, State and Territory scales.

The continued growth and development of the North Australia Indigenous Land and Sea Management Alliance (NAILSMA) was a highlight of the year, generating new partnerships and leveraging substantial new funding for Indigenous capacity building, enterprise development and natural resource management on Indigenous lands across the north. The Alliance manages an increasing number of projects that centre on Indigenous issues related to fire, water management, Indigenous knowledge, and sustainable management of dugongs and marine turtles. It also serves as a hub for establishment of Indigenous networks across northern Australia and it is hoped that this can be maintained after the end of the CRC.

The last years of the CRC will place even greater emphasis on its role as a knowledge broker, and in northern Australia websites can be particularly effective in this. To date the following sites have been established and it is hoped that there will be sufficient support to maintain at least some of these for an extended period after the end of the CRC:

- The North Australian Fire Information (NAFI) fire-tracking site. Coverage has now been extended down to the NSW border and there are also a number of other new features.
- The EnviroNorth website marks the first time NT schools have been given access to a comprehensive range of online educational resources focusing on the tropical savannas
- Web-based mapping of NT biodiversity, weeds and feral information through the InfoNet site. The tools developed for this site will also be useful for Queensland and Western Australian land managers and planners.
- Land Manager website—a one-stop-shop for access to information from a diverse range of sources, much of it inaccessible until now.
- Savanna Explorer: which brings together information for the general public on the savannas.
- North Australian Land and Sea Management Alliance (NAILSMA) website hosted by the Tropical Savannas CRC.

The TS-CRC's knowledge brokering was supplemented by generation of new ideas and findings thanks to very strong contributions from PhD students. In addition there was a continued high rate of publication in a variety of journals, proceedings and monographs, coupled with requests from various media groups for interviews and reports.

A preliminary Wind-Up Strategy and Plan for the CRC was submitted to DEST and the CRC's focus then swung to successful completion and delivery of CRC projects, yielding a range of high quality, practical legacy products. Planning will also continue aimed at continuing at least some CRC activities after funding ends in mid-2008.

In conclusion, it is encouraging to note the conclusion of the Productivity Commission's report *Public Support for Science and Innovation* (March 2007) that stated the emphasis on industrial, commercial and economic factors in the CRC guidelines has gone too far and that there should be a return to greater support for public good and distributed private good CRCs such as the CRC for Tropical Savannas Management. While the recommendation may have come too late to extend the life of this CRC, it does give some encouragement for establishment of future research in this field. There is still much to be done.

**Dr David Garnett, CEO, Tropical Savannas CRC, Charles Darwin University**

## **Context and major developments during the year**

There were four key developments in the TS–CRC’s operating environment in 2006–07:

The CRC was unsuccessful in its bid for a further round of funding and consequently re-focused its efforts to complete its current research activities and deliver a wide range of high-quality legacy products.

The North Australian Indigenous Land and Sea Management Alliance (NAILSMA), which is hosted by the CRC, continued to grow and to attract significant external funding for its activities, demonstrating the critical role it fills in addressing a range of north Australian Indigenous issues. It is hoped that it will be possible to find ways for the Alliance to continue after the closure of the CRC.

Public interest in climate change and greenhouse gas offsets continued to increase during 2006–07, highlighting the urgency to understand greenhouse gas emissions, including those factors involved in carbon cycling in the savannas. As with NAILSMA, it is hoped that ways will be found to continue the collaborative research in this field after the end of the CRC.

The completion and release of the EnviroNorth website marks the first time NT schools have been given access to a comprehensive range of online educational resources focusing on the tropical savannas. This website is just one of a range of sites developed by the CRC in partnership with other agencies which have radically improved the availability of savanna knowledge. Again, it is hoped that means will be found to support these sites beyond the life of the CRC.

There were two senior staff changes in the year. The CEO, Professor Gordon Duff, left to take up a similar position with the Forestry CRC, and was replaced by Dr David Garnett. The Business Manager, Mr Brian Slatter, died after a short illness and was replaced by Mr Kieth Boakes.

# NATIONAL RESEARCH PRIORITIES

## National research priority goals

A strong theme running through the TS–CRC centres on transforming existing industries in a sustainable manner by improving understanding of underlying processes. In the cattle industry the TS–CRC has been able to demonstrate that, at least in the short term, there are regions of the savannas where there is no impact on biodiversity even at quite high grazing levels (20% utilisation). In Queensland, woody thickening is proving to be an increasing problem for graziers, and the Centre’s research is making major advances in understanding the drivers behind this. Arguably the greatest highlight of the year was the signing of a major world-first fire management and greenhouse emissions offset project between the Northern Territory Government and ConocoPhillips. This could not have happened without the underpinning science provided by the CRC, and the CRC will continue to have a role in providing emissions monitoring capability. This project incorporates national research priority themes relating to biodiversity, climate change and smart information use, but also has a social component in that it provides encouragement for people from remote Indigenous communities to move back into the healthier environment of their country and contribute to its productive management. The CRC continues to commit significant resources to its websites and other communications media, and this emphasis on smart information use will become even more marked during the last year of the CRC.

**Table 1: National Research Priorities**

National Research Priorities	CRC Research (%)
<b>An Environmentally Sustainable Australia</b> —Transforming the way we use our land, water, mineral and energy resources through a better understanding of environmental systems and using new technologies.	
Transforming existing industries	30
Overcoming soil loss, salinity and acidity	5
Sustainable use of Australia’s biodiversity	20
Responding to climate change and variability	10
<b>Promoting and Maintaining Good Health</b> —Promoting good health and well-being for all Australians	
Preventive healthcare	2.5
<b>Frontier Technologies For Building and Transforming Australian Industries</b> —Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting edge research	
Smart information use	32.5

# GOVERNANCE AND MANAGEMENT

## Structure

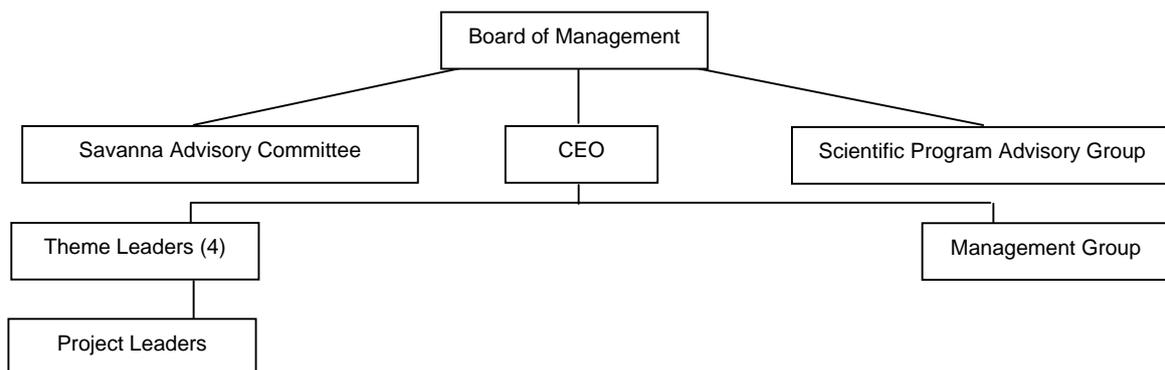
The sustainable use and conservation of northern Australia is the focal point of the TS–CRC. The Centre is an unincorporated joint venture between the Commonwealth and the partner agencies listed below:

- CSIRO
- Department of Agriculture Western Australia
- Department of Conservation and Land Management (CALM WA)
- Director of National Parks
- James Cook University (JCU)
- Meat & Livestock Australia (MLA)
- North Australian Indigenous Land & Sea Management Alliance (NAISMA)
- Northern Territory of Australia
- Charles Darwin University (CDU)
- The State of Queensland
- The University of Queensland (UQ)

As a result of the business plan provided to the Commonwealth in July 2001, the TS–CRC has adopted the organisational structure shown in Figure 1. This new structure has proved to be a sound framework for implementing the Centre’s strategic directions.

The TS–CRC has a clear strategic framework for the conduct of its scientific, educational and financial business. Stakeholders are actively involved in the policy, strategic and operational decision making of the Centre through membership of the Board of Management and Savanna Advisory Committee (SAC).

Figure 1 TS–CRC organisational structure



## Board of Management

The TS–CRC Board of Management plays an important leadership role. The Board must be analytical and decisive, while at the same time mindful of the need to consult with, understand and incorporate the needs of partner agencies and stakeholders.

Equal representation on the Board between stakeholders and partner agencies is an important mechanism for ensuring that this leadership is provided and that the key result areas of the Centre are achieved.

The Board of Management met three times during the past year. The meetings took place in Darwin in October 2006, by phone in November 2006 and again in Darwin in February 2007. In addition, a joint Board/Savanna Advisory Committee (SAC) Workshop was held in Darwin in February 2007. The October 2006 meeting was held consecutively with a SAC meeting. The independent chair of the Board of Management is **the Hon. John Kerin**.

### Membership as at 30 June 2007

#### *Representatives from the TS–CRC partner agencies*

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**Dr David Ritchie**, Northern Territory of Australia

**Dr Greg Robbins**, State of Queensland

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**Mr Roger O'Dwyer**, State of Western Australia

**Prof. Bob Wasson**, Universities

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**Dr Brian Keating**, CSIRO

**Ms Anne-Marie Delahunt**, Parks Australia

#### *Stakeholder representation*

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**Mr Darryl Pearce** (Chair, Savanna Advisory Committee)

**Ms Jann Crase** ACF (Conservation sector)

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NAILSMA (Indigenous sector) Vacant following the resignation of Mr Peter Yu

(Mining sector) Vacant following the relocation and resignation of Mr Craig Stewart

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**Mr John Courtenay**, Probe (Tourism sector)

**Mr Tom Stockwell**, Sunday Creek Station (Pastoral sector)

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## Savanna Advisory Committee (SAC)

The TS–CRC conducts research, communication and education activities for a range of stakeholders involved in natural resource management in northern Australia. These stakeholders include Aboriginal and conservation interests and the pastoral, defence, mining, and tourism sectors. Stakeholders have formally contributed to strategy and program development through the SAC. This Committee was established by, and reports to, the Board of Management. The Committee met twice during the past year in Darwin, in October 2006 and in February 2007. In consultation with the Chair of SAC, the Board decided that it was not necessary for SAC to continue to meet after the joint SAC/Board workshop on 8 February 2007, since no new research project proposals would be brought forward during the remaining life of the CRC.

### Membership as at 8 February 2007

<b>Mr Darryl Pearce</b> (Chair), Indigenous Management Group, Perth, WA	<b>Mr Tony Law</b> , DoD, NT (Defence sector)
<b>Ms Jann Crase</b> , Northern Australia Environment Alliance (Conservation sector)	<b>Mr Roger Landsberg</b> , Trafalgar Station, Qld (Pastoral sector)
<b>Mr Ross Brunckhorst</b> , Pastoral Enterprises, Qld (Pastoral sector)	<b>Dr Wayne Hall</b> , MLA, Qld (Pastoral sector)
<b>Mr Ross McDonald</b> , (Mining sector)	<b>Mr Rick Murray</b> (Tourism sector)
<b>Mr Tom Vigilante</b> , KLC, WA (Indigenous sector)	<b>Dr Sonia Tidemann</b> , Batchelor Institute of Indigenous Tertiary Education, NT (Education sector)
<b>Mr Paul Jenkins</b> , ILC, SA (Indigenous sector)	

### Scientific Program Advisory Group

The Scientific Program Advisory Group (SPAG) conducted part of the Fifth Year Review of the CRC in February 2006. It was not called upon for further input during 2006–07.

### Membership as at 30 June 2007

<b>Dr Roy Powell</b> , CARE, Armidale, NSW	<b>Mr Barney Foran</b> , Formerly CSIRO SE, Canberra, ACT
<b>Prof. Jon Altman</b> , CAEPR, ANU, Canberra, ACT	<b>Prof. Richard Hobbs</b> , Murdoch University, Murdoch, WA

### Management Group

After 2004, the research portfolio for the CRC was largely finalised and consolidated, so the project development and review role played by the Management Group was significantly reduced. During 2005–06, the advisory functions of the Management Group were largely taken over by a smaller executive, consisting of CEO, Theme Leaders, Business and Contract Managers and this arrangement continued in 2006–07.

### Specified Personnel

**Table 2 Specified Personnel**

Title and Name	Contributing Organisation	% of total working time in CRC	Role in Centre
Prof G Duff	CRC	25	CEO
D Garnett	CRC	75	CEO/Theme Leader 1
P Jacklyn	CRC	100	Communication Coordinator and Theme Leader 4
B Slatter	CRC	50	Business Manager
K Boakes	CRC	42	Business Manager
D Garnett	CRC	25	Contracts Manager/Theme Leader 1
P Novelty	CRC/WA	100	Theme Leader 2
P Whitehead	CRC/Northern Territory/CDU	25	Theme Leader 3
J Morrison	CRC/Northern Territory	50	Theme Leader 4

In 2006-07 a number of staff changes occurred: CEO Prof. Gordon Duff resigned in early October 2006 to be replaced by Dr David Garnett; Business Manager Mr Brian Slatter died in late December and was replaced by Mr Kieth Boakes in February 2007 and the position of Theme Leader 1 was taken on by Dr Garnett after the retirement of Dr John Ludwig in June 2006.

# RESEARCH PROGRAMS

## Research activities and achievements

### THEME 1: LANDSCAPE ECOLOGY AND HEALTH

**Leader: Dr David Garnett, Tropical Savannas CRC, Darwin**

#### Summary

Project 1.1.5 (*Impacts of exotic grasses*) is now complete. The three remaining projects in Theme 1 are all close to completion and since no new projects were proposed for 2007–08 it was decided not to replace Dr John Ludwig as Theme 1 Leader. Consequently Theme Leader functions were taken over by the CEO, Dr David Garnett. While all three projects were due for final reporting by June 2007, it became clear that the quality of these final reports would be greatly enhanced if an additional six months was allowed for completion, taking final completion date into 2007–08.

#### Progress

##### **Project 1.1.2 Riparian health, Leader: Dr Michael Douglas, CDU:**

The Savanna Riparian Health Project progressed well during 2006–07. The trial application of the tropical rapid assessment of riparian condition (TRARC) across the Ord River catchment was completed in September 2006. The trial was funded under the NHT in collaboration with WA Department of Conservation and the Ord River Catchment Reference Group. A report and poster on the outcomes will be printed in late 2007. A user-friendly field manual (printed on waterproof paper) is being developed for applying the TRARC more generally across the savannas. The field manual complements the technical guidelines produced last year in collaboration with Land and Water Australia will be published in late 2007. All TRARC publications and guides are available as free downloads on the CRC website. Feedback and training session for stakeholders in Kununurra are planned for October 2007. Trials of the TRARC were also completed in the Gulf of Carpentaria in a collaborative project with Griffith University, James Cook University and the Northern Gulf NRM Group in November 2006. This project was funded by the Northern Gulf NRM Group and Land and Water Australia and produced two progress reports with the final report due in the third quarter of 2007.

Outcomes from most of the student projects are, or soon will be, available. Ally Lankester (JCU) completed her MSc in 2006 and Kasper Johansen (UQ) was awarded his PhD at the beginning of 2007 and has completed four peer-reviewed publications. Gillian McCloskey, Caroline Chong and Aaron Petty have completed field work and chapter drafts for their PhDs. Nicole Cranston completed fieldwork but is on a 12-month leave of absence.

##### **Project 1.1.3 Measuring soil health, Leader: Dr Tracy Dawes-Gromadski, CSIRO SE**

This project is closely aligned with Meat and Livestock Australia's Wambiana grazing trial, located near Charters Towers, Queensland, where vegetation and soil health are being monitored as affected by different livestock grazing strategies. The project has now completed most sampling and analysis of soil health. Results so far have demonstrated that as macropore density increases (in turn found to be an indicator of macro-invertebrate activity), the percentage of rainfall captured by the soil increases. Patches of the native grass *Carissa* showed the greatest macropore densities and thus water capture, independent of grazing strategy. However, as grazing pressure increases, grass patches showed the greatest reduction in macropore density and water capture. All patch types show decreased levels of water infiltration under heavier grazing.

Analysis of nutrients in the soil and soil buffering capacity was greatest in *Carissa* patches where macro-invertebrate activity is highest. Soil microbial biomass and organic matter decomposition were also greatest in *Carissa* patches.

During the April 2007 field trip the team's work on the potential of soil macro-invertebrates as indicators of soil health was also further developed. Building on data collected during March last year, the development of a transect method for the rapid assessment of soil macro-invertebrate activity and soil ecohydrological function was refined and tested.

A sub-model of Savanna.au (a modelling tool for researchers which enables fire and weed management modelling) was developed, which simulates how changes in soil health affect water infiltration and runoff processes, and the impacts of grazing on these relationships.

The project continues to provide resource material for Grazing Land Management Packages and is successfully continuing to build relationships with land managers and regional NAP management bodies and effectively disseminate information about the effects of management on soil health.

#### **Project 1.1.4 Savanna carbon dynamics—Leaders: Dr Dick Williams, CSIRO Darwin SE and Dr Chris Stokes, CSIRO SE, Townsville**

This year the project assessed savanna carbon sequestration potential, and sensitivity to fire:

- Savannas are a weak sink (about 1 t C ha<sup>-1</sup> yr<sup>-1</sup>); annual early dry season fires maintain sink capacity; late dry season fires, however, cause savannas to be a GHG source
- Determined the amount, and consumption by fire, of coarse woody debris in savannas: amount about 4 t C ha<sup>-1</sup>; consumption about 0.5 t C ha<sup>-1</sup>
- Assessed the market potential of savannas for providing carbon off-set services, which is substantial, for both institutional and smaller investors
- Assessed the impact of elevated CO<sub>2</sub> on savannas and tropical pastures: a CO<sub>2</sub>-rich atmosphere changes patterns of ecosystem water use with far-reaching consequences including stimulated grass growth and changes in biodiversity and also reduces forage quality (reduced protein content and reduced digestibility)
- Ecosystem modelling of global change impacts on savannas: with rising CO<sub>2</sub> soil moisture conserved by grasses could accelerate tree seedling recruitment

The project's focus in 2007–08 will be to synthesise project findings, extrapolate the results to other areas through simulation modelling, and highlight potential opportunities for mitigating greenhouse gas emissions, and adapting to climate change. This synthesis will provide an invaluable resource as national efforts get underway to tackle the pressing problems of predicting the likely impacts of climate change and searching for solutions to adapt to these changes.

#### **Project 1.1.5 Exotic grasses: Assessing the Risks (Samantha Setterfield, Michael Douglas and John Clarkson)**

This project was successfully completed in 2006–07.

One component of the project focused on the functional ecology of selected native and exotic species in the mesic savannas of the Northern Territory, and used a comparative approach to determine how the invaders alter: hydrology pools and fluxes of nitrogen, fire regimes (fire intensity and frequency) and community structure.

Arguably the exotic species causing most concern was gamba grass (*Andropogon gayanus*), a tall perennial African grass introduced into northern Australia as a pasture grass, but which is now established outside of pastoral systems in the Northern Territory and Queensland, where this project has shown that it has significant environmental impacts and threatens a much wider part of the savannas than had previously been thought. Results showed that:

- Gamba grass can establish and survive regardless of canopy cover or soil disturbance
- Gamba grass changes fire regimes through:
  - forming taller, denser stands than native grasses, which cure later in the dry season, supporting higher fuel loads.
  - creating fuel loads of typically 11–15 tonnes/ha (and as high as 30 tonnes/ha) compared to native grass fuel loads of typically 2–4 tonnes/ha.

- fuelling early dry-season fires about eight times more intense than those of native grasses
- fuelling later dry-season fires, when the gamba grass is more fully cured, that have intensities almost 25 times higher than those recorded in adjacent native grass savannas.
- The increase in fire intensity can lead to a decline in trees and shrubs, resulting in a process called the 'grass–fire cycle'. Examination of historic and current aerial photography of areas in the Darwin rural area, together with field surveys has shown that over twelve years there was a 50% reduction in tree canopy cover.
- Gamba grass also alters hydrology with:
  - significant differences demonstrated in soil-moisture dynamics between native grass and gamba grass plots, where gamba uses a larger amount of water
  - enhanced competition for soil moisture between evergreen savanna trees and gamba
- Gamba grass affects nitrogen cycling by changing the amount of nitrogen stored in various components of the savanna ecosystem. It modifies the rate of transfer of nitrogen among these components: compared to plots dominated by native grasses, grass-nitrogen pools in gamba grass plots are seven times higher, soil nitrate availability is three times lower and soil ammonium availability three times higher.

The project also developed a Weed Risk Assessment (WRA) tool that forms part of an overall Weed Management (WRM) system appropriate for use in northern Australia. The project was also central to the development of the WRM through workshops that ensured broad stakeholder involvement while drawing on as much expertise and knowledge from interstate experts and borrowing where possible from tried and tested systems.

The WRM's guiding principles ensure transparency and accountability, and ongoing stakeholder interaction. It has a two-stage assessment process that involves:

- an initial assessment of weed risk and feasibility of control for all candidate species using questions modified from the South Australian WRA model,
- and a more detailed assessment of costs and benefits (based on the Queensland WRA system) for those species with low risk which are considered to have substantial benefit to some land users.

To date, 80 candidate plant species have been assessed. Development of the WRA system will be completed by the end of 2007 resulting in recommendations on weed risk and management actions to be presented to DNRETA. Significant external research funds have been sourced to continue research and implementation of weed risk management systems by the project team.

## **Future Directions**

In Project 1.1.2. a further six months is required to complete two additional reports (Characterisation of riparian vegetation in Kakadu National Park and Indigenous values and management of riparian vegetation in Kakadu National Park), a set of non-technical guidelines for riparian vegetation management based on the outcomes of the CRC and material for the land manager's website, and the three additional PhD theses. Completion of these tasks did not require new funding but the carry-over of current remaining funds. A final report will also be produced by Projects 1.1.3 and 1.1.4 in 2007-08.

## THEME 2 INDUSTRY AND COMMUNITY NATURAL RESOURCE MANAGEMENT

**Leader: Paul Novelly, Department of Agriculture and Food, Western Australia, Kununurra**

### Summary

Theme 2 brings together savanna researchers and land managers to develop practical tools and strategies for managing natural resources in ways that are both ecologically sustainable and contribute to economically and socially viable enterprises and communities. The Theme has seen coordinated and integrated management projects develop rapidly and which include significant stakeholder participation. Project boundaries were frequently and deliberately blurred by sharing information, expertise, study sites and personnel to ensure values of integration could be developed. This was a particularly important feature of Theme 2's operation.

Some Theme 2 projects were completed during 2006–07. However, in the case of FIREPLAN and the Vegetation Dynamics projects, some studies will continue during 2007–08.

### Progress

#### **Project 2.1.4: FIREPLAN: Fire management for savanna communities—Leader: Dr Jeremy Russell-Smith, Bushfires NT**

The project in its entirety is on track, and on schedule. All milestone reporting requirements were satisfactorily met and all reports due were completed. Major activities to report are:

- The Western Arnhem Land Fire Abatement (WALFA) greenhouse emissions monitoring activity is a major fire management and greenhouse emissions offset project recently signed off between the Northern Territory Government and ConocoPhillips. TS–CRC involvement is to provide emissions monitoring capability to project. The project is on track with delivery of agreed abatement targets. The project has abated more than 250,000 t CO<sub>2</sub> (equivalent)—a substantial achievement exceeding its targets at this stage.
- A major research funding proposal concerning the establishment of two new emissions abatement projects in central Arnhem Land and the north Kimberley, was completed. The project has many institutional research partners from the Northern Territory, Western Australia and nationally, and also substantial financial backing from private enterprise.
- By their very nature each of the above studies, including the PhD studies listed below developed out of identified stakeholder needs, and has involved multi-party collaborative research partnerships.

This project continues to do excellent work with a range of stakeholders across northern Australia. The breadth of subjects being addressed can be seen from the project's activity list. These include:

1. Improving estimates and management of savanna burning emissions.
2. Estimating greenhouse emissions from savanna fires.
3. The WALFA project for greenhouse emissions monitoring.
4. Fire management in northern Australia: Integrating ecological, economic and social outcomes.
5. Community-based fire management projects.
6. Fire information products for the savanna community.
7. Writing a book *Managing fire regimes in north Australian savannas—ecology, culture, economy* to collate and synthesise much of the FIREPLAN project during the second phase of the TSCRC, but focusing especially on the Arnhem Land work.

Finally, the FIREPLAN project supports several PhD students, including Peta Standley (*Traditional fire management Cape York*) and Leasia Felderhof (*Fuels management North West Queensland*). Leasia Felderhof's PhD thesis has been awarded.

**Project 2.4.2: Savanna biodiversity—Leaders: Dr. John Woinarski, Dr. Alaric Fisher (NT NRETA) and Dr Alex Kutt (CSIRO SE)**

This project began in 2004–05, evolving from a set of three previous disparate CRC biodiversity-related projects. It was directed towards improving the knowledge base of the distribution, ecology and land management responses of biodiversity, and conservation responses appropriate to the tropical savannas, and then providing various ways that biodiversity managers and planners can access this knowledge.

Research was essentially complete as of June 2007, culminating in numerous publications about the nature of biodiversity in the tropical savannas, the pressures on biodiversity, biodiversity responses to land management, and appropriate management responses. The project was also fundamental in developing biodiversity monitoring and assessment tools for land managers and planners, extending both research and its uptake beyond the life of this project.

Information delivery focused on providing access to, and synthesis of, all available information on biodiversity management. Therefore, a major output of this project has been to support the substantial investment that the TS–CRC has made into the North Australian Land Manager Website <[www.landmanager.org.au](http://www.landmanager.org.au)>, both in the delivery of biodiversity information and in its integration with other sustainable land management information, with a successful NHT funding application allowing information delivery to expand into the provision of spatial data to land managers and planners. However, the provision of a savanna biodiversity manual also remains an important project output. This manual will contain bioregional overviews of landscapes, plants, animals, weeds and pest animals.

Project outputs included:

- Development and maintenance of a set of information about biodiversity and the relationship between biodiversity and land management.
- Major contribution to the development and maintenance of a web portal allowing easy access to the biodiversity information, at a variety of spatial scales and levels of complexity.
- Completion of a survey and report on the biodiversity information needs of key stakeholder groups.
- Collation and collection of biodiversity data for poorly serviced NRM regions across the tropical savannas for use in developing appropriate targets and priority actions for their NRM plans.
- Development of an illustrated, plain-English biodiversity manual providing information about biodiversity and land management relevant to users across the tropical savanna.
- Other practical information products such as species identification decks targeted toward particular user groups and/or regions.
- Assessment and development of robust and realistic biodiversity monitoring framework for NRM boards and other tropical savanna land managers that can be used to assess the success of investment in NRM.

Like FIREPLAN, this project was also very successful in attracting external funds to the TS–CRC, with funding being obtained from Land and Water Australia, the Natural Heritage Trust and Meat and Livestock Australia.

**Project 2.1.1 Developing grazing management tools to improve savanna condition—Leader: Dr Neil MacDonald, NT DBIRD, Katherine, NT**

This project comprised interlinked activities to develop sustainable grazing management tools, and seeks to promote better decision making by producers / land managers in tropical savanna regions. The aim is to assist land managers to better estimate cattle carrying capacity at different scales.

The project developed a range of tools to assist both agencies and land managers develop sustainable grazing systems, including Veg Machine (savanna cover change analysis), Carrying Capacity Estimator

for the Northern Territory and Grazing Land Management packages (in conjunction with Meat and Livestock Australia). This has been a very well integrated and linked project, incorporating staff from three state agencies (NTDPIF, QDPIF and DAFWA), and producer groups in Queensland, the Northern Territory and Western Australia, as well as MLA and Heytesbury Beef. The new products (see below) are being actively communicated to stakeholders (many of whom were involved in product and tool development).

- **Activity 1** (various aspects of the estimation of stock carrying capacity) is virtually complete within the defined TS–CRC project, although a few sites will still operate in 2008 because of hold-ups due to poor seasonal conditions in the south and in some cases unplanned fires. This project also included a report on development of relationships between potential and current carrying capacity and range condition, including consultation and field validation, and the second year of a research grant from Meat and Livestock Australia, *Developing sustainable carrying capacities in the NT*. The data are already being used as it is collected and is attracting considerable attention, particularly from the NT Pastoral Land Board. However, various issues of this quite complicated aspect of grazing management remain unresolved. Proposals identified by the project team included continuing the interstate networking for carrying capacity after the end of the TS–CRC between the agencies across north Australia dealing with carrying capacity research.
- **Activity 2** dealt with the development of a decision support / risk management tool, and was conducted in collaboration with Heytesbury Beef. Dr Mick Quirk of Meat and Livestock Australia took on the role of investigating the business model needed for development of the tool and the resulting product will be incorporated into a delivery system prepared by another consultancy group sponsored by the Australian Government Department of Agriculture, Fisheries & Forestry.
- **Activity 3** The assessment of MODIS and comparison with Landsat data carried out by Ms Kate Richardson was completed and a final report submitted. The report noted that while MODIS data were of value; their value was greatest on the open black soil savanna plains, where over-storey (tree) species were not a problem. Additionally, there was a loss of scale (sensitivity) with MODIS compared with Landsat. Extrapolating this work to the more variable, higher tree cover red soils is an ongoing issue. Both a web-based document and CD were produced.
- **Activity 4** These activities link to the development of Desert Uplands and Gulf versions of the Grazing Land Management (GLM) package, and material was prepared for the education package. Meat and Livestock Australia provided funding to support the development of a GLM package for the Kimberley region, to be completed early 2008. This followed on from the development of the Queensland and Northern Territory GLM packages which proved to be immensely popular with savanna land managers.

**Project 2.4.1 The dynamic savanna: Assessing and managing structural change in woody vegetation in northern Australian savannas—Leaders: Professor David Gillieson, JCU; Dr Garry Cook, CSIRO**

This project began in February 2005 with a series of activities, the overall objective of which was to increase the ability of land managers and policy makers to make informed decisions regarding the management of woody vegetation dynamics in the savannas of northern Australia.

The debate about historic tree dynamics has centered on the relative role of fire and rainfall variability and has occurred in a context of political debates about tree clearing and allocation of carbon credits.

The project's modelling of tree dynamics with an assumption of constant growth rates suggests that the two views can be reconciled, because fire management and rainfall variability can interact strongly in their effects on tree dynamics. In a region of high rainfall variability, represented by Charters Towers in Queensland, fire serves to reduce the size of peaks in the saw-tooth response of vegetation to cycles of high and low rainfall. In contrast, in the monsoonal belt further north, where rainfall is less variable, modelling indicates that tree basal areas are held in check by the frequent, but short-term dry seasons rather than major droughts at decadal time-scales, with fire having a greater effect. This is consistent with observations reported elsewhere in the literature that drought dieback events are rarely observed in the monsoonal tropics which receive highly summer dominant rainfall from the inter-tropical

convergence zone, but more commonly observed in the more southerly quasi-monsoonal zone and the occasional occurrence of frontal rain throughout the cooler months.

Project outputs include:

1. A 'Dynamic Savanna' website, <[www.dynasav.org.au](http://www.dynasav.org.au)>, providing a forum for documenting evidence of change and interpretation of change from diverse perspectives.
2. A protocol for interpreting vegetation change from historic and recent aerial photographs
3. A synthesis of existing information and an analysis of gaps in knowledge of woody vegetation change across northern Australia, presented as a website.
4. A photo library (geo-referenced) illustrating woody vegetation change in selected case study regions across northern Australia (including the Northern Gulf of Queensland) using photographic and oral history sources
5. Scientific papers and reports describing change in woody vegetation structure in terms of historical events, biodiversity and production costs and benefits, and likely responses to and costs of management options.
6. A protocol for interpreting historic and future trends from current vegetation structure developed using TRAPS data and FLAMES model of tree dynamics.
7. Development of a state-and-transition model describing patterns and processes underlying change in woody vegetation structure across northern Australia.

Because of its delayed start, this project will continue through 2007–08. In the coming year, the project will:

- synthesize information from its various activities,
- build on the 'Dynamic Savanna' website to provide an active forum for exchange of information on woody vegetation dynamics in north Australia from diverse perspectives and the
- prepare a book integrating the output from all activities and illustrated with historical landscape and aerial photographs, and scientific and oral history information collated for the case study regions. This publication will complement the TS–CRC volume *Slower than the Eye Can See* written by Daryl Lewis for the Victoria River District.

### **Integrated Natural and Cultural Resource Management Project, East Kimberley**

The Integrated Natural and Cultural Resource Management (INCRM) Project in the East Kimberley was aimed at achieving a greater understanding of the opportunities and challenges faced on Indigenous-held pastoral properties. It was unique in that it focused on the sustainable use and management of both cultural and natural resources. It ran from 2004 to early 2007 and operated at both a property scale and an overarching regional scale.

At the property scale it recommended that the strategies chosen should be informed by:

- Ascertaining the level of energy and resources available to each of the aspirations identified;
- Prioritising the aspirations of the community;
- Further defining how community aspirations are interlinked and addressing the vulnerabilities and constraints to their fulfilment; and
- Understanding the capacity of each enterprise to meet the broader livelihoods goals.

The project identified numerous natural, culture, community and enterprise resources.

At the regional level the focus was on the administrative framework that impacted on the properties. It assessed both the opportunities and the constraints provided by both government and a range of non-government organisations.

It recognised that there are substantial cross-jurisdictional differences in the institutional landscape across the Tropical Savannas zone and this would affect the application of an INCRM model across the zone

## **Future Directions**

In the final year of the Centre this theme will focus on producing all the outstanding outputs scheduled for delivery, particularly for FIREPLAN and the Dynamic Savanna projects which will continue into 2007–08. In this year we also should also see some of the theme's activities continue to build on the collaborative research links established by the CRC and secure external sources of funds, so they can continue to conduct vital NRM research and deliver important services for northern Australian NRM after June 2008. This should be the case, for example, in fire management where the carbon abatement research and associated fire management is set to expand into other areas of the savannas like the Kimberley region.

## **THEME 3 REGIONAL PLANNING AND MANAGEMENT**

**Leader: Peter Whitehead, Department of Natural Resources, Environment and the Arts, Darwin, Northern Territory**

### **Summary**

Theme 3 deals with social, economic and institutional influences on the way savanna communities interact with landscapes and the natural resources that those landscapes support. These issues are particularly important in the savannas, because most savanna residents outside the major centres depend directly on using natural resources for their livelihoods and well-being. Their capacity to use individual resources or classes of resources and to care for land is determined by a large array of factors, many of which have little to do with the issues of ecological sustainability that the other TS-CRC Themes emphasise.

Work in the Theme 3 program is organised in four components:

- the status and dynamics of regional communities and economies and dominant influences on them
- options for diversifying regional economies
- regional plans for natural resource management and
- enhanced application of knowledge held by the community and agencies to local and regional management.

### **Regional Dynamics**

Two projects have been conducted in collaboration with the Desert Knowledge CRC. They seek basic understanding of the ways in which remote communities in the rangelands, including the tropical savannas, differ from rural and urban communities elsewhere. An important long-term goal is to understand how external pressures and local or regional policy interventions might influence their dynamics.

**Project 3.3.4: Understanding outback livelihoods—identifying and linking key social and economic issues affecting the viability of outback regions; and**

**Project 3.3.7: Predicting regional and landscape dynamics—Leader: Dr Rolf Gerritsen, TS-CRC, Darwin, NT.**

In the aggregate these projects will provide a much better informed view of savanna communities and provide government and communities with some of the knowledge and tools they need to assess the likely impacts of various investment decisions or other policy interventions. In April 2007 workshops were held among the various researchers in the projects to explore options for a synthesis of the results of the various socio-economic studies. It was concluded that there was sufficient complementarity to warrant production of an edited book drawing out the major conclusions and implications for resource management and social policy in savanna regions. The tentative working title for the proposed volume is *The other Australia: problems of northern development*, which is proposed for completion in early 2008.

**Burdekin Queensland Case Study** During 2006–07 a model for regional grazing viability using a Bayesian Livelihoods Network for the Upper Burdekin in Queensland was completed. Rule-based inference was employed to explore relationships among demographic and other attributes of regional communities, external (e.g. market-driven) influences, climate and weather, and perceptions of the viability of regional communities. A final report summarising that model was submitted in early 2007, and published online. An important, albeit preliminary, conclusion from the work is that such methods can make useful contributions to an integrated understanding of the drivers of the choices made by individuals and groups in regional settings.

During 2007–08 other publications will be prepared, including a related chapter for a proposed CRC book (see below).

**Ngukkur, Northern Territory Case Study** The Ngukkur, Northern Territory study in innovative service delivery is well advanced. It delivers an improved understanding of issues for effective delivery of basic services in remote regions, as well as the way locations to which services are delivered can affect realisation of economic opportunity. The latter will be illustrated through development of a business model for commercial fire management services for mitigation of greenhouse gas emissions, centred on outstations.

**ABS Indices Study** Associated NT Government researchers also completed a project on the usefulness of the indicators of remoteness used by the Australian Bureau of Statistics, and proposed changes.

**Economic Multipliers Study** Work on economic multipliers was completed during 2006–07 and a final report submitted in mid-2007, showing that:

- businesses in the savannas spent more of their revenue on labour than businesses in the same sectors elsewhere in Australia;
- they also spent proportionally more in the retail sector;
- few spent a significant proportion of revenues on goods and services sourced from the mining or agriculture sectors which include many of the largest businesses in the savannas;
- education services were most likely to be imported from outside the region, followed by wholesale, transport, retail and manufacturing sectors;
- within regions (postcodes), the household sector received the largest share of local revenues, with the retail sector receiving the next highest share;
- the government and health sectors spent the largest proportion of their total revenues within their local communities;
- as a consequence health and government had the highest business level multipliers at 2.4 and 2.1 respectively; and
- the lowest level multipliers occurred within the accommodation and transport sectors (1.4 and 1.5).

An important implication of this work is that investments in the health or government sectors will do more to stimulate local economic activity than expansion of the accommodation or transport sectors. These benefits will be increased if investments in education and health also help overcome some of the labour shortages experienced by the mining and agricultural sectors in the savannas.

The research indicates that much of the difference in multipliers is attributable to the different input needs of the sectors, and the fact that many of those inputs are presently unavailable or less readily available in the savannas. Investments encouraging the development of support industries to supply the missing inputs may be a particularly effective way to stimulate local and regional economies.

The report is available online and a number of hardcopies will also be printed.

<[www.savanna.cdu.edu.au/publications/outback\\_livelihoods.html](http://www.savanna.cdu.edu.au/publications/outback_livelihoods.html)>

### **Diverse regional economies**

This area of work has been grouped within a single project examining options for more diverse uses of savanna landscapes and the barriers to moving beyond the orthodox and into multiple uses of landscapes.

#### **Project 3.3.6: Multiple use in savanna regions—Leader Dr Tim Lynam, CSIRO Sustainable Ecosystems, Townsville.**

This project was originally designed to develop a framework for examining options for multiple uses of savanna landscapes and analysing the trade-offs or synergies that may result from diversification of use. It ultimately delivered studies of the regional costs and benefits of tourism in predominantly pastoral and Indigenous settings, and options for application of trading to water management for agriculture in a developing savanna region.

During 2006–07 two reports were completed regarding issues and options for introducing markets in water in the Daly River region. The first summarised issues in water management and potential scenarios for trading, and the second dealt more comprehensively with the wider institutional issues that should be considered in policy-making for the region.

Some of the implications of this work will be picked up in syntheses produced in the Outback Livelihoods work area (Project 3.3.4).

### **Regional planning**

The States, Territories and Commonwealth are presently planning for the third implementation of the Natural Heritage Trust. Rearrangements will draw heavily on reviews of performance, including those of the quality of regional plans and performance of regional bodies made within this program.

#### **Project 3.3.5: Healthy savanna planning systems—Leader: Dr Cathy Robinson, CSIRO Sustainable Ecosystems, St Lucia.**

The project builds and applies long-term, regionally focused monitoring, evaluation and improvement frameworks for regional planning arrangements and plans. Frameworks are being designed in partnership with regional NRM organisations and agencies across Queensland, the Northern Territory and Western Australia, to capture and share lessons which support adaptive management at the regional and state or territory scales. The project builds on evaluation frameworks designed in earlier foundation regional planning projects.

During 2006–07, the project largely completed a synthesis of the regional planning experience addressing two critical questions: *are regional NRM arrangements genuinely capable of delivering the outcomes they seek?*; and, *do government and other investors know the full (environmental, economic and social) impact of regional NRM?*

A full report will be delivered early in 2008, adding to a number of reports already delivered and available online (see <[www.savanna.cdu.edu.au/publications/nrm\\_planning.html](http://www.savanna.cdu.edu.au/publications/nrm_planning.html)>). But important issues and conclusions summarised in progress reports and other publications (published by the TS–CRC) included:

*Ability to demonstrate the effectiveness of selected actions, partnerships and governance arrangements is increasingly questioned by government programs, and community and commercial investors.*

Three years of benchmarking the progress of regional NRM arrangements have emphasised that judgements about effectiveness of delivery in savanna regions need to consider a broad range of costs, issues in management effectiveness, and weigh up the different value of the many outcomes that NRM partners seek from their activities. Relationships between actions and outcomes within the regional NRM setting are complex. Regional bodies must accommodate their various partners' different views of links between actions and outcomes when assessing the effectiveness, efficiency and appropriateness of government program, voluntary, social and other investment.

*Negotiation of programs of action is not enough to ensure delivery.*

Delivery of agreed outcomes is too often compromised by mismatches between stated goals, understanding of the timing, intensity and scale of activities needed to reach them and the realities of local community capabilities, agendas and needs. Appropriate information and financial resources are also critical, though often overlooked precursors for NRM activities. Concurrent action by other parties (neighbours, government agencies, etc) is also a critical factor that can affect the extent and success of NRM delivery. This raises important questions of how to estimate public-private NRM benefit-allocations to inform cost-sharing arrangements that consider all types of contributions and costs. Thresholds for adequate performance can also have environmental dimensions like the size and location of habitats and interconnections between key areas that need to be protected to achieve regional resource condition outcomes.

*There is a pressing need to improve participatory evaluation processes to capture the range of outputs and outcomes generated from project delivery.*

Despite repeated and clear recognition that landscape change is desired and that multiple benefits are delivered from environmental improvements, many outcomes reported from project activities focus on short to intermediate-term contributions to individual capacity and regional social capital. They highlighted such things as the level of 'trust' built between partners, including those who have traditionally had disparate interests and agendas; 'increased knowledge about NRM issues' by

landholders, local councils and community groups; and a 'sense of ownership' of the projects and their outcomes by those community players involved.

These short to intermediate-term outcomes were particularly evident with uptake of 'sustainable' land management practices and technologies, establishment of environmental monitoring exercises, and involvement in forums or on-ground land management activities which enabled different stakeholders to align agendas and NRM priorities.

How these short and intermediate-term outcomes translate into long-term benefits and change in resource condition is often unclear or absent from evaluation processes and arrangements reviewed.

The project team will raise such issues with program managers and other relevant decision-makers during 2007–08.

### **Knowledge building**

This area comprises a small group of sub-projects done in close collaboration with savanna resource managers. Studies are based around application of Bayesian Belief Networks (BBN) to elicit, record and apply knowledge to pressing issues in savanna resource management.

During 2006–07 work was completed on a model for management of grazing land condition. The model incorporates linked modules for ground cover and pasture condition, tree density and weed abundance. A comparison was made between the conceptual models of graziers and researchers working in land condition science. FLAMES (a fire model also developed under the TS–CRC program) was used to convert the conceptual model of tree density to a science-based decision-support tool using knowledge of fire regimes and responses in Kakadu and grazing areas of Charters Towers.

An important feature of this work has been the capacity demonstrated to use these modelling tools and associated processes to bring together formal scientific results with the accumulated experience of pastoralists to produce approaches to analysis and problem solving that both groups regard as robust.

A major report summarising work completed throughout the project was submitted in June 2007. In parallel, developments of web-based implementations of BBN models have continued. A noteworthy development is that researchers supported by the TS–CRC have engaged with other research groups such as the CERF Landscape Logic Hub and an ARC funded project on restoration of fragmented landscapes. These groups are assisting with the funding of a new "commercial quality" version of the web tool. These enhancements to improve usability are expected to be completed by the end of 2007 and will bring the project to a close. At present 10 PhD projects in the University of Queensland are applying the processes and tools developed in this project.

### **Future Directions**

Most projects completed the bulk of their active data gathering and analysis during 2006–07 and produced major reports or other significant publications. Work during 2007–08, the CRC's final year, will be devoted to an important synthesis of the Outback Livelihoods studies, and other efforts to improve the accessibility of existing products. These efforts will include the development of an improved system for delivery of knowledge building capability through the web, completion of various publications in journals and elsewhere over the whole of the Theme's work, and workshops and seminars with research users to promote application of work.

## **THEME 4 HUMAN CAPABILITY DEVELOPMENT**

**Leaders: Dr. Peter Jacklyn, TS–CRC, Darwin; Mr Joe Morrison, NAILSMA, Darwin**

### **Summary**

This theme focuses on developing the capacity of people and communities so that research findings and local knowledge can be more effectively used in land management in the tropical savannas. This is a particularly important role in north Australia where capacities to inform research and to use research are often low.

Capacity building activities in this theme include working with communities to help them conserve and pass on local knowledge (*Indigenous Capacity-building*) and providing communities and enterprises with tools and information that enhances their NRM capacity (*Communication Resources*). Importantly, capacity building is focused on specific NRM activities and user groups associated with the TS–CRC’s participative projects so that it is more likely to result in actual improvement in NRM outcomes.

Because of the great diversity of stakeholders involved in managing the tropical savannas, equipping future researchers to better engage with, and meet the research needs of these stakeholders is also a priority and is the focus of the project on higher education.

Promotion of the Centre’s activities and outputs and enhancing communication between Centre staff and raising awareness of tropical savannas issues (*Tropical Savannas Knowledge in Schools*) are also key roles played by this theme.

The program comprises the following projects and their leaders.

#### **Project 4.1.1: Higher education—Leader: Dr Penny Wurm, CDU**

See Education and Training section, p. 49.

#### **Project 4.3.1: Communication resources for the tropical savannas—Leader: Dr Peter Jacklyn, TS–CRC**

This project develops tools, websites, workshops and publications that help build capacity and enhance adoption of NRM research; enhance collaborative research; and increase awareness of the Centre and savanna issues. This project continues to develop practical websites for north Australian land managers and others:

The NAFI site <[www.firenorth.org.au](http://www.firenorth.org.au)> continues to be a vital tool for north Australian fire managers and continues to be improved in response to user feedback, for example, maps from the site can now be uploaded to hand-held GPS units used in aerial monitoring of fire. The site is now being extensively used across western Queensland through the Rangelands Fire project of CYPDA. Web statistics show that the site is increasing in popularity each year with the 2007 fire season being the most heavily used period in its history with the site often generating more than 5000 maps a day for users at the height of the fire season.

The *North Australian Land Manager* website <[www.landmanager.org.au](http://www.landmanager.org.au)> was launched in February 2007. This site is a clearinghouse of practical information for natural resource managers in north Australia and contains thousands of items relevant to better land management in the north, presented in a context relevant to north Australian land managers. Usage has grown strongly in 2006-07.

The new *Savanna Explorer* website <[www.savanna.org.au](http://www.savanna.org.au)> was launched in mid-2006. This site provides information on the natural history and NRM-based livelihoods of northern Australia and its various regions for the general public, tourists, the media and school students. It supercedes the *Savanna Explorer* section of the TS–CRC website which was the most-used section of that site.

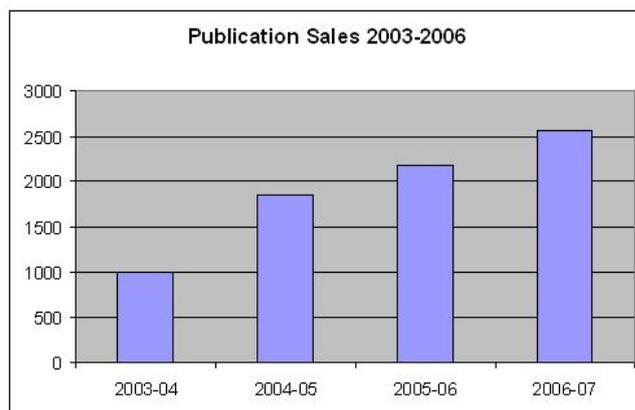
A pilot *InfoNet* website was developed to allow land managers to produce maps, graphs, species lists and other information for property and regional planning by using web-based maps. It is being tested by a range of land managers.

An initial version of a web-based mapping site that maps vegetation change data has been produced for the Dynamic Savannas project. See: <[www.dynsav.org.au](http://www.dynsav.org.au)>

A number of new TS–CRC supported publications were produced this year

- The four-book set *Perspectives on managing Grazing country* in which successful and experienced graziers and pastoralists talk about managing grazing country in four regions of northern Australia have been printed and are being distributed.
- *TRARC Field guide*—a practical guide for users of the Tropical Rapid Appraisal of Riparian Condition method.
- *Threatened Plants of Cape York Peninsula* describes one of the highest concentrations of rare, endemic or officially threatened plants species in Australia and makes recommendations for better listing of such species and for improving conservation outcomes on Cape York Peninsula.
- Several project reports covering topics ranging from using new satellite imagery to gauge land condition to reviews of regional NRM planning in the savannas
- *Tools and Information for Savanna Country*, our comprehensive products and publications booklet which lists dozens of books, scores of newsletters and fact sheets, and all the natural resource management and educational websites that are accessible through the Centre’s main website.

More than 2500 hard-copy publications were sold and over 4400 distributed free in 2006–07 (excluding Annual Reports and newsletters)—a record year (see below). More than 7000 publications were downloaded from the website.



**Project 4.3.2: Tropical Savannas knowledge for schools—Leaders: Ms Julie Crough, TS–CRC and Ms Louise Fogg of the NT Department of Employment, Education and Training.**

This project will provide curriculum support resources and materials that enhance and improve the understanding of Australia’s tropical savannas.

The project involves:

- TS–CRC (its partners) and the Northern Territory Department of Employment, Education and Training (NT DEET), teachers and schools to develop a comprehensive and interactive website—*EnviroNorth*—which covers tropical savannas knowledge and links with the Northern Territory Curriculum Framework, VET modules and Stage 1 and 2 SSABSA courses.
- Education Queensland to develop a collaborative effort to produce curriculum support materials according to identified needs.
- Department of Education and Training, Western Australia to develop a collaborative effort to produce curriculum support materials according to identified needs.

After much collaboration between researchers, land managers, teachers and students the *EnviroNorth* website was launched in February 2007. This website features the *Savanna Walkabout* interactive module for students with animation, brilliant graphics and mini-movies that emphasise not just the wonder of north Australian landscapes and wildlife but also the people who manage and know the

country. A CD of the module was distributed to every school throughout the Northern Territory with a letter of support from Department of Employment, Education and Training CEO, Margaret Banks. Web statistics and direct teachers' feedback has shown increasing uptake of *EnviroNorth* and *Savanna Walkabout* throughout the year. This has included a range of primary and secondary schools including urban, rural and remote schools such as Katherine School of the Air.

*EnviroNorth* was widely promoted face-to-face with teachers in the NT through the Sustainable Schools initiative. Resources were also promoted with key education stakeholders in Queensland, Western Australia and other states. *EnviroNorth* and *Savanna Walkabout* are now being incorporated in pre-service teacher training courses at Charles Darwin University.

#### **Project 4.4.2: Indigenous capacity building—Leader: Mr Joe Morrison, TS–CRC**

This project aims to improve coordination, collaboration and collegial engagement between Indigenous land managers and owners, the TSM–CRC, its partners and current and future projects. It aims to do this by essentially supporting the development of Indigenous land and sea management across the savannas by linking Indigenous people with other groups engaged in land management in the region.

Various initiatives were developed to promote Indigenous capacity building throughout the year:

- Further progress towards completing the north Australian Indigenous Knowledge Strategy developed by Steve Johnson.
- NAILSMA produced a booklet providing advice and guidance to researchers wishing to undertake research in Indigenous communities, particularly in natural and cultural resource management. It set out NAILSMA's requirements for research approval, requirements of Indigenous partner organisations and Land Owners as well as legislative permit requirements (available online).
- The work of the Dugong and Marine Turtle Management Project (DMTP), led by Dr Rod Kennett, is ongoing with Indigenous communities in the Kimberley, Top End of the Northern Territory, Gulf of Carpentaria, Cape York and the Torres Strait. Significant progress was made throughout the year in developing management activity plans and engagement with communities, with several established sea ranger groups joining the program. The project also released its first Message Disk, an informative and entertaining DVD showcasing the work of community groups involved in the project.
- The North Australia Fire Project was finalised and project leader Jean Fenton is currently employed through a newly initiated project focusing on greenhouse gas abatement through the provision of environmental services through the effective abatement of wildfire across northern Australia.
- A number of key communication materials were produced. The recently released third edition of *Kantri Laif*, which will reach around 3000 readers nationally and internationally, highlights stories from traditional owners reporting on land and sea management activities on their own country across northern Australia.
- Samara Erlandson who has been involved with *Kantri Laif*, has also assisted with awarding 60 Indigenous people scholarships in the last round of applications approved by the Study Assistance Program. The next phase of the Leadership program "Future Leaders – the Land is in Our Hands" is undergoing review.
- Honorlea Massarella has been working with low capacity Indigenous groups on small to medium scale enterprise development.
- Lorrae McArthur provided communication support to the seeding project on engaging Indigenous people in the water reform processes under the National Water Initiative through the Indigenous Water Policy Group (IWPG). The group's work has significantly progressed to include an Indigenous Community Water Facilitator Network, and it has also developed international links through the United Nations University (UNU). Representatives from the university attended an IWPG meeting, and as a result, ways are being explored to link IWPG to communities from other countries with experience of water policy issues. Work has begun compiling and analysing case studies from Northern Australia and Central America (Mexico and Ecuador) and the south-west USA that demonstrate how Indigenous communities have been able to integrate traditional management systems and values associated with water into

broader water governance regimes. Pending finalisation of the arrangements with the Northern Territory Government, UNU-IAS will open an office at Charles Darwin University in Darwin.

Two new staff members were employed during the year: Joshua Kitchens who will provide communication and project support to the Dugong and Marine Turtle Project and Melissa Bentivoglio who will coordinate work with Honorlea on Enterprise Development.

The NAILSMA website is continuing development, with the support from the TS-CRC's communication team. Visits to the website increased 80% on last year's number of visits and the number of downloads from the website also increased 85%. A regular e-news bulletin is circulated every two months and provides news on NAILSMA and its initiatives. The website has an up-to-date project list and provides access to its various publications, issues papers and occasional media releases.

### **Future Directions**

In 2007-08, the Communication Resources project will be helping produce the final outputs of the Centre, such as the major publications on fire management and vegetation management emerging from Theme 2, and the InfoNet website for northern land managers and planners. The project will also be securing funding and setting up administrative arrangements so that many of the TS-CRC's existing services such as the NAFI, Land Manager and Savanna Explorer websites can be continued beyond June 2008.

The Tropical Savanna Knowledge in Schools project will be producing further interactive modules for schools in 2007-08, which will cover topics like fire management and cattle country. This project will also be looking to secure funding arrangements so it can continue beyond the end of the CRC.

NAILSMA will move from being administered by the TS-CRC to becoming a part of Charles Darwin University with links to the United Nations University in 2007-08. NAILSMA will look to continue its current growth and important work for Indigenous Land and Sea Managers for many years into the future.

**Table 3: Research Outputs and Milestones**

<b>Output Milestone Number</b>	<b>Description</b>	<b>Contracted Achievement Date</b>	<b>Achieved (Yes or No)</b>	<b>Reasons why not achieved (if applicable)</b>	<b>Strategies to achieve unmet milestones</b>
<b>Theme 1: Landscape Ecology and Health</b>					
1.	Integrated and coordinated suite of projects established to enable modelling of landscape function	30/06/2003	Yes		
2.	Validated models of landscape function and process available	30/06/2006	Yes		
3.	Validated monitoring methodologies available	30/06/2006	Yes		
4.	Tested models for landscape and biodiversity restoration available	30/06/2008	On track		
5.	Models of adaptive management of savanna landscapes available	30/06/2008	On track		
<b>Theme 2: Industry and Community Natural Resource Management</b>					
1.	Coordinated and integrated management projects in place and they included participation of stakeholders	30/06/2003	Yes		
2.	Management guidelines and tools are developed and tested by managers and service agencies	30/06/2006	Yes		
3.	Environmental codes of practice are tested and available to the grazing industry	30/06/2006	Yes		
4.	Indigenous land management planning principles and guidelines are documented and used in co-management planning.	30/06/2006	Yes		
5.	Management tools and products are being used in resource management	30/06/2008	On track		
6.	Decision support systems are available to	30/06/2008	On track		

**Table 3 Research Outputs and Milestones Cont.**

<b>Output Milestone Number</b>	<b>Description</b>	<b>Contracted Achievement Date</b>	<b>Achieved (Yes or No)</b>	<b>Reasons why not achieved (if applicable)</b>	<b>Strategies to achieve unmet milestones</b>
<b>Theme 3: Regional Planning and Management</b>					
1.	Reviews conducted which provide the information to design appropriate projects	30/06/2003	Yes		
2.	Regional stakeholder groups are participating in project development	30/06/2003	Yes		
3.	The processes of regional social and economic planning and functioning are understood	30/06/2006	Yes		
4.	Models of regional change are developed for validation	30/06/2006	Yes		
5.	Validated models of regional planning and change and resource management are available	30/06/2008	On track		
<b>Theme 4: Human Capability Development</b>					
1.	Comprehensive programs of development of education and learning packages are established	30/06/2003	Yes		
2.	A program of postgraduate research and education is established	30/06/2003	Yes		
3.	Education and learning packages are available for both formal and informal learning opportunities	30/06/2006	Yes		
4.	Web based information is available to all people in the tropical savannas	30/06/2006	Yes		
5.	Complete education packages available for all levels of education	30/06/2008	On track		
6.	Capacity development opportunities are being utilized by indigenous people	30/06/2008	On track		

## Research collaborations

In 2006–07 projects have been focused on generating outputs, yet this year still saw new collaborations develop and existing collaborative links continue to be used with an emphasis on getting the outputs used.

The TS–CRC aims to break down the barriers to cooperative R&D in north Australia by encouraging collaboration between different researchers and between researchers and end-users. The Centre is well placed to do this as its partners comprise most of the NRM research organisations working in the tropical savannas: CSIRO and the universities; and government land management agencies. The partners also include representatives of the main research users: Aboriginal land managers, pastoralists and again land management agencies that employ park rangers etc.

Working with these partners the Centre has established a portfolio of projects that have collaboration at their core. The collaboration takes the following forms.

**Collaboration between jurisdictions across northern Australia** allows different regions to learn from each other about common land management challenges.

- Most projects have links with agencies that straddle at least two jurisdictions, with many projects having links that connect across all three—Western Australia, the Northern Territory and Queensland.

**Collaboration between different industry sectors** including conservation agencies and primary industry agencies allows practices and strategies that take a whole-of-savannas approach to be developed. This cross-sectoral approach is seen in most of the Centre’s projects. Examples include:

- The *Savanna Biodiversity* project works with the agricultural sector—pastoral companies, NT DPIF&M, QDPIF as well as Indigenous bodies like NAILSMA and the Land Councils and agencies in the conservation sector such as NRETA, DEC and QEPA. This ensures the biodiversity management knowledge base is accessible to the whole range of land managers in north Australia.
- The FIREPLAN project has developed a number of sub-projects in various sectoral settings: on Indigenous lands, on grazing lands and in national parks. Within each of these sub-projects, however, links with all major sectors are involved—so for example, the West Arnhem Fire Abatement Project has collaborative links with the grazing land managers to the south of Arnhem Land, and with Kakadu National Park to the west.

**Collaboration with national bodies** is extensive and many draw on the Centre’s role as the main umbrella organization for NRM across a major part of the continent.

- The *Savanna Riparian* project continues to have major collaborative links with Land and Water Australia through a series of workshops and meetings in 2006–07 which have culminated in the establishment of the Centre for Tropical Rivers and Coastal Knowledge.
- The TS–CRC also has major contracts with the Natural Heritage Trust to provide capacity and information on fire management and turtle and dugong management to north Australian land managers; it is contracted to provide information on tropical savanna carbon cycles for the Australian Greenhouse Office; four projects on sustainable grazing management receive funding from Meat and Livestock Australia.

**Collaboration with international bodies** continues to be significant. In 2006–07 the TS–CRC had more than a dozen collaborative links with international groups through its projects. Examples include: collaboration with NASA to develop robust fire-scar mapping techniques; collaboration with the Universities of Wurzburg and Ruhr, Germany, the University of Cape Town, South Africa and the Natural History Museum of London on measurement of soil health in the savannas.

**Collaboration between researchers and end users** allows relationships to develop and learning to occur that ultimately enables research to be used effectively.

- A meeting of the North Australian Fire Managers Forum was held in May 2007 in Darwin. This meeting is part of a regular schedule of meetings that brings together the three bushfire agencies of Western Australia, the Northern Territory and Queensland, who are major end-users of fire management research, as well as the TS–CRC, the Bushfires CRC, WA Department of Land Information and Geoscience Australia who are major research providers.

- Work undertaken by the Centre's project on the impact of exotic grasses (Project 1.1.5) developed links between land managers, government agencies (both Territory, State and national) and industry bodies during the development of a Weed Risk Management framework for northern Australia. The framework established a reference group comprising key stakeholders, as well as a technical committee. The framework's guiding principles ensure transparency, accountability, and ongoing stakeholder interaction.
- Most projects in Themes 2 and 3 have direct links with the community that will use their research or through links with a partner agency. This is mostly participative research that actively involves end-users in the project and is an important part of the Centre's technology transfer and utilisation strategy (see p. 29).

An important partner in the Centre's collaboration is the North Australian Land and Sea Managers Alliance (NAILSMA)—a partner in the Centre, and itself a collaborative group of Indigenous land and sea management groups across north Australia. NAILSMA and its networks play a major role in a number of Centre projects.

# COMMERCIALISATION AND UTILISATION

## Commercialisation and utilisation strategies and activities

### Strategies and activities

The year 2006–07, the sixth year of the Centre, saw the following highlights in commercialisation and utilisation: widespread use of research-based tools for fire management developed by the TS–CRC; continued uptake of tools for monitoring riverbank condition; uptake of tools used to manage biodiversity; uptake of tools used to manage grazing; use of educational material in schools.

These developments are an outcome of our basic strategy to produce research-based tools and information that tropical savanna land managers can use, that make a difference, and that enhance their ability to manage country sustainably, and to support the use of such tools with long-term funding from industries that benefit from their use.

To achieve these goals, however, some key challenges in the tropical savannas needed to be overcome:

- Researchers are often isolated and can find it difficult to establish the critical mass of people needed to produce useful, innovative research products.
- Research users, many of whom are in Small to medium sized enterprises (SMEs) such as pastoral enterprises or Indigenous land management corporations, are also isolated and do not have the access to information and expertise that allow them to use new research products effectively.
- This isolation is exacerbated by the cultural gulfs that often exist between researchers and the varied mix of research users.
- Researchers and research users have to deal with new, emerging natural resource management issues which have not been the subject of major research efforts.

These challenges imply we need to invest in people's skills and knowledge resources as part of the pathway to the development of innovative products. The following strategies are therefore used.

### Fostering collaborative, participative research

The sparseness of the research community in the tropical savannas underlines the need to develop links across research disciplines, across industry sectors, and with researchers across Australia and overseas to achieve the critical mass needed to produce high quality, innovative tools and information for savanna land managers and planners.

Research needs to be relevant and useful, so it should be driven by the 'pull' of users, not the 'push' from researchers to get their projects funded. Therefore participative research, which involves end users—many of whom are involved in savanna SMEs as active participants—is fostered in our projects. For example, the FIREPLAN project works actively with local groups of fire managers on fire management issues suggested by those groups.

This process will often involve establishing strong personal relationships on the ground between researchers and end-users that can bridge cultural distance, and will also involve using local knowledge together with researchers' knowledge.

### Investing in access to information and knowledge

Even relevant and practical research findings can end up on the shelf if the users and researchers do not have the capacity to ensure those findings are used effectively—and many savanna communities and researchers lack such capacity. User needs include better access to NCRM (Natural and Cultural Resource Management) options from across the tropical savannas and in 2006–07 the Centre's new Land Manager website <[www.landmanager.org.au](http://www.landmanager.org.au)> was used by land managers across northern Australia to access such options.

Often a greater need for research users is the capacity to use their own local knowledge systems more effectively, for example in many Indigenous communities there is a desire to have traditional NCRM knowledge more effectively passed on to the younger generation, and in many pastoral SMEs people want to be able to use their own and other pastoralists' local knowledge more effectively. This means that the TS-CRC uses people skilled in building such capacity in SMEs (for example in the *Indigenous Ecological Knowledge Project*, the *Integrating Research with Land and Sea Management Project* and the *Beef Industry Best Practice Project*) as well as using people skilled in brokering research know-how.

### **Developing practical tools**

One of the most effective ways of making research useful is to convert it into practical tools useful to research users. For example, the Centre's NAFI fire-tracking website <[www.firenorth.org.au](http://www.firenorth.org.au)> is used every day during the fire season by fire managers across north Australia. These tools feature integrated research findings and knowledge that could not be created easily by individual partner agencies.

### **Developing better education and training**

Savanna researchers also need additional skills, such as the ability to engage more effectively with indigenous communities and pastoral enterprises. The TS-CRC offers Masters and Graduate Diploma courses in Tropical Environmental Management that not only allows agency staff to learn about the latest NRM research, but exposes them to the issues and concerns of the varied group of research users in the savannas. The Centre's PhD program aims to produce new researchers in tune with research users' needs. Refer to the Education section, p. 49.

### **New or improved products, services or processes**

Many of the TS-CRC's services and products are web-delivered and there have been a number of new developments in this area in 2006-07

- The CRC's fire-tracking North Australian Fire Information website <[www.firenorth.org.au](http://www.firenorth.org.au)> was upgraded for the 2007 fire season with extended fire mapping and hotspot coverage for the whole of Queensland's rangelands, satellite imagery as a background option, downloadable fire data from a user-generated map, and downloadable fire maps for GPS units.
- The CRC launched a new North Australian Land Managers website <[www.landmanager.org.au](http://www.landmanager.org.au)> in early 2007. This site is designed to fill the gap in relevant NRM information for land managers and planners in Australia's far north and helps them find information to assist their land management decisions. The site directs users both to content on the site, and to other reputable information sources.
- A new website for schools, the EnviroNorth website was also launched in February 2007. This website marks the first time Northern Territory schools have been given access to a comprehensive range of online educational resources focusing on the tropical savanna environments in which the students live. The site features an interactive module *Savanna Walkabout* full of animation, engaging graphics and mini-movies that emphasise not just the remarkable north Australian landscapes and wildlife but also the people who manage and know the country.

Other products are publications and information now being used by land managers to assist with NRM.

- A technical manual that outlines how to use the Tropical Rapid Appraisal of Riparian Condition (TRaRC) method to assess riverbanks was published and distributed to hundreds of land managers and planners. This is the first time a nationally certified, locally adapted technique like this has been developed for tropical rivers in Australia.
- Four books on the local knowledge of successful northern pastoralists and graziers on managing for healthy country in different regions of northern Australia were produced. The books cover the Cape River and Northern Gulf regions of Queensland and the Victoria River District and Sturt Plateau areas of the NT.
- New material on sustainable NRM has been incorporated into Grazing Land Management (GLM) packages.

The ways in which our users can access these new products were also improved

- An improved TS–CRC website that supports our publications and tools brochure and is linked to an easier-to-use newsletters section was developed.
- A new website for the North Australia Indigenous Land and Sea Management Alliance was launched which provides access to the Alliance’s publications and activities and which can be updated by NAILSMA staff.

A new Products and Tools booklet, outlining the Centre’s now substantial publication and web catalogue, was circulated to more than 300 customers across Australia and internationally.

## **Outcomes**

### **Continued success of the West Arnhem Land Fire Agreement**

This \$20M, 17-year agreement between the Darwin Liquefied Natural Gas (DLNG) consortium and Indigenous fire managers has seen a reduction in Greenhouse Gas emissions equivalent to 256,000 tonnes of CO<sub>2</sub> from the West Arnhem Land plateau due to effective control of wildfire in the first two years of the agreement.

By implementing patchy burns across the landscape early in the fire season, Indigenous ranger groups reduced the fuel available for wildfires which in turn reduces the emission of greenhouse gases.

This is a remarkable achievement and represents an impact similar to removing 25,000 cars from the road in that period. This is also the first time anywhere in the world that such substantial emission reductions have been achieved within a carbon offset agreement involving fire management.

The agreement is underpinned by research and verification monitoring conducted by the TS–CRC, and its fire-tracking website <[www.firenorth.org.au](http://www.firenorth.org.au)> is used by the fire managers involved in the agreement daily.

Limiting wildfires is also helping conserve environmental and cultural values of the Plateau—equivalent to those in the adjacent World Heritage-listed Kakadu National Park. Importantly the project helps Indigenous communities associated with the plateau secure meaningful employment, pass on their cultural, ecological and scientific knowledge to younger generations, and create better links with each other.

The success of the project has led to similar projects being proposed and developed for the Kimberley in Western Australia, other parts of Arnhem Land and the Gulf region in the Northern Territory.

### **Increased uptake of fire management tools across north Australia**

Better fire management is a crucial factor in sustaining productivity and biodiversity in north Australia—each year around 80% of the area burnt by bushfires in Australia occurs in the north. It is therefore a significant development that the TS–CRC’s North Australian Fire Information (NAFI) fire-tracking website <[www.firenorth.org.au](http://www.firenorth.org.au)> has now expanded its coverage and is being used by fire managers across outback Queensland. The site is being used by Queensland’s Rangelands Fire Project and is being promoted by the project across Queensland’s rangelands.

The fire-mapping techniques developed by the TS–CRC’s FIREPLAN project are now being used by various groups across northern Australia with workshops being held in the Northern Territory, Queensland and the Kimberley in 2006–07. These techniques and mapping products are now widely used by pastoral and conservation land managers, bushfire agencies, environmental consultants and Indigenous land managers.

Guidelines for fire management from FIREPLAN were incorporated into the Strategic NRM plans of most of the regional NRM groups in fire-prone far north Australia and into the plans of other fire managers such as National Parks and Bushfire agencies.

The uptake of these tools flows from contracted research and development with the Natural Heritage Trust project *Developing knowledge-based fire management for northern Australia savanna communities*.

### **Continued growth in use of Rapid Assessment techniques for Riverbank Monitoring**

Together with Land and Water Australia, the TS–CRC developed a standard, practical method for rapidly appraising the condition of one of the most vital-and vulnerable-areas of savanna landscapes: the vegetation surrounding their rivers, creeks and streams. The Tropical Rapid Appraisal of Riparian Condition (TRARC) methodology is being taken up by numerous groups across northern Australia with around 670 copies of the TRARC technical manual being distributed to riparian land managers and planners.

### **Developing a Weed Risk Management System**

The TS–CRC’s research on the exotic grass, *Andropogon gayanus* (gamba grass) has now shown that the grass threatens much more of the savanna ecosystem than previously thought, changing fire regimes by initiating a destructive grass–fire cycle and limiting the availability of soil-moisture and nutrients to native grasses and trees. As well as providing scientific evidence for the need to manage this exotic grass, researchers developed a Weed Risk Assessment (WRA) tool. This WRA is part of a broader Weed Risk Management system (WRM) that the project was central in developing. The WRM is appropriate for northern Australia, and specifically the Northern Territory.

The WRM ensures transparency and accountability, and ongoing stakeholder interaction. It includes a two-stage assessment process: firstly an initial assessment of weed risk and feasibility of control for all candidate species and secondly, a more detailed assessment of costs and benefits for those species with low risk which are considered to have substantial benefit to some land users. A Reference group was formed to guide the development of the broader WRM framework.

Development of the WRA will be completed by the end of 2007 resulting in recommendations on weed risk and management actions to be presented to the NT Department of Natural Resources, Environment and The Arts. Significant external research funds were sourced to continue research and implementation of weed risk management systems by the project team.

### **Uptake of techniques and options for managing biodiversity**

In 2006–07, the TS–CRC’s new north Australian Land Manager website <[www.landmanager.org.au](http://www.landmanager.org.au)> was used regularly by land managers—particularly biodiversity managers—across northern Australia to assist with NRM.

The site provides downloadable maps, books and reports, guidelines and advice on fire, weed and pest animals and conservation; practical case studies on a range of NRM; plain English research summaries and references; plant responses to fire; contacts and project summaries. The resources on the site are now being used to produce practical species management guides for different regions in portable, weather-proof booklets.

### **Uptake of techniques and options for sustainable grazing management**

Various aspects of TS–CRC research on sustainable grazing management are now incorporated in Grazing Land Management workshops being delivered across northern Australia. These workshops were supported by groups like MLA and delivered by groups like the Edge Network. An example of recent TS–CRC research delivered through workshops was the work on soil health by Tracy Dawes-Gromadski and the *Perspectives on managing grazing country* books which describe graziers’ views on managing for healthy country in north Australia. These four publications were outcomes of contracted research with Meat and Livestock Australia.

### **Uptake of management tools in the Dugong and Marine Turtle Project**

The project involves communities across northern Australia from the Kimberley to Cape York and Torres Strait working to a long-term goal of “healthy and sustainable populations of marine turtle and dugong in northern Australia that support Indigenous livelihoods”. The project has made significant progress in enhancing indigenous capacity for the sustainable management of dugong and marine turtle as well as supporting the development and delivery of government policy and process. In 2006-07 the project has seen community-based managers use tools developed by the project for managing dugong and marine turtles and has seen partnerships created with government and researchers for better management, research and training. The project is run by the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) which is hosted by the CRC.

### **Use of findings from the Healthy Savanna Planning Systems Project**

The planning by the States, Territories and the Commonwealth for the third implementation of the Natural Heritage Trust has drawn on the findings of the TS-CRC's Healthy Savanna Planning Systems Project (3.3.5) particularly in relation to the situation facing regional planning in the more remote northern regions of Australia.

### **Use of Educational Material in schools**

The *EnviroNorth* website and interactive learning module *Savanna Walkabout* produced by the *Tropical Savannas Knowledge in Schools* project is now used by primary and lower secondary schools throughout the Northern Territory. The learning module was developed collaboratively with the NT Education Department and teachers and is integrated into the NT curriculum.

### **Commercialisation and Utilisation Outputs and/or Milestones**

The Commercialisation and Utilization outputs for the Tropical Savannas CRC are not listed separately in its Centre of Agreement but as individual milestones under each Theme, see Table 3 (p. 25).

## **Intellectual Property Management**

All IP generated by the Centre's activities is owned by the Centre partners as tenants in common in proportion to their participating shares. The partners are obligated to use their best efforts to identify IP generated by Centre activities, and to vest ownership of such IP in the partners. If patenting or other registrable forms of IP protection are pursued it is to be in the joint names of all the partners as tenants in common proportional to their participating shares.

The Centre partners may bring background intellectual property to the Centre's activities - and such IP remains the property of the partner concerned but can be used royalty-free by the other partners in the Centre's activities other than for commercialisation. The Centre's Business Manager maintains a register of such background IP.

## **Communication Strategy**

In 2006–07 the Centre's Communication Strategy helped raise the awareness of the Centre's activities. It was, however, mainly focused on assisting the take-up of research by users.

### **Communication, SMEs and the pathway to adoption**

The Centre's communication strategy is focused on ensuring our research gets used and makes a difference. The communication used here is not "tacked on" to the end of the research process but is integrated into the management and conduct of the research as described in the section on technology transfer and use and in the section on collaboration:

- End users, many of whom are in SMEs, are asked about what research projects they need through the extensive networks built up by the Centre over the last few years so that research is initiated by user demand where possible.
- SMEs and other end users are actively involved in participative research
- Communication resources are provided to assist capacity building in both researcher and user groups.
- Communication resources are provided so that project participants keep in touch and work collaboratively
- Theme leaders are given communication roles to ensure collaboration
- Once an area of research emerges as being ready for successful adoption, considerable communication resources are then provided to produce practical tools. A range of media are used to suit different users and applications.

The isolation, cultural diversity and low capacity of many savanna user groups and even many research groups means that the TS-CRC does not focus on research-based Knowledge Brokers like some other CRCs. Instead the CRC uses a mix of people, some of whom broker knowledge, others of whom may broker resources and funds to implement the broad adoption strategy above.

## **Links with Business and Strategic Direction**

The Centre's links with business and subsequent use and commercialization are premised on the research and adoption achieved through participative projects. For example, the CRC's fire management projects have established a research-based case for reducing greenhouse gases and conserving cultural and biodiversity values through improved fire management on the Arnhem Land Plateau, and the CRC's projects have seen Arnhem Land fire managers take up techniques and tools that allow them to manage fire more effectively. Against this background the NT Government was able to negotiate a 17-year, approximately \$20 million dollar agreement with Darwin Liquefied Natural Gas to support fire management in Arnhem Land in return for the greenhouse gas reductions that could be offset against the emissions from DLNG's Darwin plant.

Other large corporations in the mining and energy and philanthropic sectors are in talks with the Centre to broker similar offset agreements with local land managers that are based on the Centre's research and adoption record in more effective fire and land management in north Australia. Such commercial agreements should yield long-term support for better management of greenhouse gas emissions and biodiversity as well as significant social and economic benefits for the local communities of land managers. This is the key strategic direction being pursued by the Centre.

## **Communication and raising awareness**

In the longer term it may be difficult to sustain well-informed land management policies and practices in the tropical savannas without having a well-informed broader, mostly urban community. To raise awareness of the tropical savannas in this broader community requires considerable resources, and the TS-CRC's strategy here is to use the education system to raise awareness rather than focusing on the mass media or public presentations. The recently established project *Tropical savannas knowledge for schools* aims to provide information on the tropical savannas tailored to the primary and secondary school curricula in northern Australia.

In the short term, however, some sections of the broader community can be targeted effectively. TS-CRC researchers continue to attract widespread media interest through our partner agencies, with appearances on national television shows such as ABC's *Catalyst*, as well as local print media and radio. Care is taken not to jeopardise the pathway to adoption strategy above with these awareness-raising activities—collaborative links will not be risked for the sake of a high-profile media coverage.

## **End-User Involvement and CRC's Impact on End-Users**

In 2006 the Centre for International Economics assessed the impacts of the Centre's research on the industries that were end-users of that research (CIE (2006) *Evaluation of the CRC for Tropical Savannas: looking back* Report). They made the following findings:

- The net value to the pastoral industry of pastoral research taking place in this round of the TS-CRC is \$25.8 million due to higher stocking rates in some regions; higher productivity due to better pasture management and lower management costs. This assessment did not take into account the potential for establishing 'green' credentials for marketing.
- The net present value of the fire management tools produced by the TS-CRC to the pastoral industry through improved grazing productivity was estimated to be \$39.0 million over the 20 years from 2001. The industry would also benefit from reduced infrastructure losses, resources used for fighting major fires and health impacts due to smoke haze.
- As a result of fire management tools such as NAFI, mining operators are likely to have fewer shutdowns due to better preparation for fires and fewer electricity outages. The value to mines in terms of the potential reduction in shutdowns less their implementation costs is estimated as many millions of dollars from reduced loss of infrastructure..
- There are a significant public returns on investment in CRC research. For example, health benefits of the reduction in smoke haze due to better fire management. These have been estimated to have a present value of \$42.8 million in the reduced health costs of asthma associated with smoke irritation. These costs include costs of lost work as well as medical costs for treatment.
- In total the benefits due to the CRC's fire management research total \$120.5 million over the next 20 years.

The CIE assessment was only able to quantify a relatively narrow range of direct economic benefits from CRC research. Indirect economic benefits for end-users are also likely to be realised from:

- The social, economic and health benefits that flow from better NRM-based employment opportunities for remote indigenous communities;
- The long-term benefits for tourism and environmental services from enhancing efforts to conserve of biodiversity

### **Publications Impact across the Savannas**

The TS-CRC plays a key role in synthesizing NRM knowledge from across north Australia and making it easily accessible to end-users. In 2006–07 more than 2500 hard-copy publications based on TS-CRC research were sold and more than 4400 distributed free in 2006–07 (excluding Annual Reports and newsletters)—a record year. More than 7000 publications were downloaded from the website in 2006–07. Research findings also available on newly developed websites aimed at land managers and schools. These new sites <[www.landmanager.org.au](http://www.landmanager.org.au)> and <[www.environorth.au](http://www.environorth.au)> are showing good growth in usage.

Following is Table 4, which summarises end user involvement in CRC activities.

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Pastoral industry sector</b>								
Meat & Livestock Australia	✓	✓	✓	✓	✓	✓		
North Australian Beef Research Council	✓		✓	✓		✓		
Agforce Qld				✓				
Kimberley Beef Research Committee				✓				
Kimberley Aboriginal Pastoralists Association				✓				
NT Cattlemen's Association				✓		✓		
Heytesbury Beef			✓	✓				
Australian Agricultural Co.				✓				
North Australian Pastoral Co.				✓				
Stanbroke Pastoral Co.				✓				
Katherine Pastoral Industry Advisory Committee				✓				
Barkly Region Advisory Committee				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Conservation interest groups</b>								
World Wide Fund for Nature				✓				
Environment Centre NT				✓				
Northern Australia Environment Alliance	✓			✓				
The Wilderness Society				✓				
Queensland Conservation Council				✓				
Conservation Council of WA				✓				
Australian Conservation Foundation				✓				
Birds Australia				✓		✓		
<b>Mining industry sector</b>								
BHP Billiton	✓			✓				
McArthur River Mining Pty Ltd				✓				
ConocoPhillips				✓	✓			
Earth, Water, Life Sciences Pty Ltd				✓				
Queensland Nickel			✓	✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Mining industry sector.</b>								
Ergon Energy				✓				
Nabalco			✓	✓				
<b>Aboriginal community groups</b>								
Balkanu Cape York Development Corporation			✓	✓				
Bawinaga Association				✓				
Cape York Land Council			✓	✓		✓		
Kimberley Land Council	✓		✓	✓		✓		
Kimberley Aboriginal Law and Culture Centre				✓				
Indigenous Land Corporation				✓				
Northern Land Council			✓	✓		✓		
North Australian Indigenous Land & Sea Management Alliance	✓	✓	✓	✓				
Jawoyn Association				✓				
Yanyuwa Community				✓				
Carpentaria Land Council			✓	✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Aboriginal community groups</b>								
Central Land Council				✓				
Torres Strait Regional Authority			✓	✓				
<b>Tourism industry sector</b>								
Northern Gateway Pty Ltd				✓				
Probe	✓			✓				
Tour Guides Association NT				✓				
Savannah Guides Ltd			✓	✓				
Gulf Local Authorities Development Association				✓				
Undara Experience				✓				
Tourism Queensland				✓				
<b>Funding agencies</b>								
Australian Centre for International Agricultural Research			✓	✓				
Land & Water Australia			✓	✓	✓			

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Environment Australia (Biodiversity Group)				✓	✓			
Environment Australia (State of Environment)				✓				
<b>Funding agencies cont.</b>								
Rural Industries Research Development Corporation				✓				
Bureau Resource Sciences				✓				
Australian Research Council				✓				
Natural Heritage Trust				✓			✓	
<b>Government agencies</b>								
Australian Defence Force	✓		✓	✓				
Bureau of Meteorology				✓				
Great Barrier Reef Marine Park Authority				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Government agencies cont.</b>								
Department of Agriculture and Food WA	✓	✓	✓	✓				
Landgate WA			✓	✓				
Department of Conservation and Land Management WA		✓	✓	✓				
Bushfires NT			✓	✓		✓		
Northern Territory Department of Primary Industry and Fisheries		✓	✓	✓				
CSIRO Sustainable Ecosystems	✓	✓	✓	✓				
CSIRO Land and Water			✓	✓				
CSIRO Climate and Atmosphere				✓				
Queensland Department of Primary Industries and Fisheries	✓	✓	✓	✓				
Queensland Department of Natural Resources and Mines		✓	✓	✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Government agencies cont.</b>								
Queensland Environment Protection Agency		✓	✓	✓		✓		
Australian Greenhouse Office			✓	✓				
North Australia Rural Fire Managers' Forum				✓				
National Land and Water Resources Audit				✓				
Western Australia Fire & Emergency Services Authority				✓				
Parks Australia	✓	✓	✓	✓	✓			
Queensland Fire and Rescue Authority				✓				
NT Department of Natural Resources, Environment and The Arts	✓	✓	✓	✓		✓		
<b>Cooperative Research Centres</b>								
CRC for the Conservation and Management of Marsupials				✓				
CRC for Tropical Rainforest Ecology and Management				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Cooperative Research Centres</b>								
CRC for Aboriginal and Tropical Health				✓		✓		
CRC for Desert Knowledge			✓	✓				
CRC for Freshwater Ecology				✓				
CRC for Cotton				✓				
CRC for Sustainable Tourism			✓	✓				
CRC for Catchment Hydrology			✓	✓				
CRC for Greenhouse Accounting			✓	✓				
CRC for Tropical Plant Protection			✓	✓				
CRC for Weed Management			✓	✓				
<b>Community groups and professional bodies</b>								
Desert Uplands Build-up and Development Strategy Committee				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Community groups and professional bodies</b>								
Dalrymple BeefPlan Producer Group				✓				
Sturt Plateau Best Practice Group				✓				
Victoria River District Conservation Association				✓				
Northern Gulf Resource Management Group				✓				
Cape River Management Group				✓				
Cape York Peninsula Development Association			✓	✓				
Torrens Creek Landcare Group				✓				
Burdekin Dry Tropics Board				✓				
Fitzroy Basin Association				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Community groups and professional bodies</b>								
Victoria River District Regional Bushfire Council Committee				✓				
Roper River Landcare Group				✓				
Coastcare				✓				
Burdekin Rangelands Strategy Implementation Group				✓				
Landcare Council of the NT			✓	✓	✓			
Southern Gulf Catchments Inc.			✓	✓				
WA Rangelands Regional Group			✓	✓				
Kimberley Regional Fire Management Project			✓	✓		✓		
Upper Burdekin Landcare Group				✓				
Dalrymple Landcare Committee				✓				

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Community groups and professional bodies</b>								
Northern Territory Chamber of Commerce				✓				
Centralian Land Management Association				✓				
Karumba Progress Association				✓				
<b>Educational institutions</b>								
Centre for Indigenous Natural and Cultural Resource Management, NTU				✓				
University of Western Sydney				✓				
James Cook University		✓	✓	✓		✓		
University of Queensland		✓	✓	✓		✓		
Curtin University				✓				
Charles Darwin University	✓	✓	✓	✓		✓		
University of Melbourne			✓	✓				
Australian National University	✓		✓	✓		✓		

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>Educational institutions</b>								
Central Queensland University				✓				
Batchelor Institute of Indigenous Tertiary Education	✓			✓		✓		
Murdoch University	✓			✓				
University of Adelaide				✓				
South Australian Museum				✓				
<b>International collaboration</b>								
Colorado State University			✓					
University of Virginia			✓					
Indonesian fire managers (through ACIAR)			✓	✓		✓		
University of Ruhr			✓	✓				
University of Florida				✓		✓		
NASA, USA			✓	✓				
University of Wurzburg			✓	✓				
Texas A&M University								

**Table 4 End user involvement in CRC activities**

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
<b>International collaboration</b>								
University of London				✓				
Royal Botanic Gardens, Kew				✓				
Conservation International, USA				✓				
CSIR, South Africa				✓				
University of Cape Town				✓				
Natural History Museum, London				✓				
Japanese Space Development Agency			✓	✓				
University of California				✓				
European Space Agency				✓				
Institute Supérieur d'Agriculture Rhone Alpes				✓				
South African National Park Service			✓	✓				
Satya Wacana and Nusa Cendana Universities (Indonesia)				✓		✓		

# EDUCATION AND TRAINING

## **Recruiting and supervising PhD and masters students**

The TS–CRC is on target with Higher Degree by Research (HDR) student recruitment overall. As the TS–CRC failed in its rebid no new students were recruited in 2006-07. The TS–CRC Round 2 recruited 33 new HDR students (above the target). Of these, nine have now either submitted or lodged their theses and five have withdrawn during the last five years for reasons (including health, other professional and family commitments (Appendix 2, Table 7, p. 62).

Almost all current HDR students have been involved in part-time or short-term employment contracts (Appendix 2, Table 8, p. 67). While this slows completions times, it is good for longer-term employment prospects of these students and demonstrates the regional need for capacity presented by TS–CRC supported HDR students.

## **Involvement of industry in research supervision.**

Each TS–CRC research student has at least one industry supervisor (Appendix 2, Table 7, p. 62), although in some cases supervisors have moved either to or from academia during the student's candidature.

## **Graduate destinations, if known.**

Available information about graduate destinations for Round 2 HDR students is presented in Appendix 2, Table 8, p. 67.

## **Nature of end-user involvement in developing undergraduate courses.**

Charles Darwin University, Satya Wacana Christian University and Nusa Cendana University are collaborating on a field intensive unit to be held in eastern Indonesia and attended by advanced undergraduate and postgraduate students at all three universities. The curriculum will draw upon research outcomes of research projects undertaken by academic and industry partners, including TS–CRC supported fire projects.

## **Nature of seminars/workshops/courses run for industry**

A collaborative curriculum development workshop was held in Kupang in December 2006, attended by Charles Darwin University, Satya Wacana Christian University and Nusa Cendana University. The purpose of the workshop was to develop a curriculum plan for a field intensive unit (described above). The workshop costs were funded by Crawford ATSE Fund.

CRC research projects also run substantial numbers of industry seminar, workshops and field days. See the Staff Outreach Table, Appendix 3, Table 11, p. 70.

## **Contribution to skill development in the industry**

The research project investigating the impact of the postgraduate coursework program in Tropical Environmental Management on the professional practice of its graduates is ongoing. This will be reported on in 2007–08.

Numbers of students and graduates in the coursework postgraduate Tropical Environmental Management program are presented in Tables 9 and 10 respectively in Appendix 2, p. 69.

Postgraduate students contribute to many CRC projects, which in turn have significant links to industry. The CRC therefore provides substantial pathways for students to work with stakeholders and end users of their research.

## **Overall project progress**

Progress against project milestones for 2006–07 is presented in Table 5.

**Table 5: Education and training milestones**

Type of Milestone and/or Output	Description of all 2006–07 milestones and/or outputs incl. past milestones which have not been met (and date)	Achieved	If achieved, progress in 06–07	Reasons why milestones and/or outputs have not been achieved	Strategies to achieve milestones which have not been met
<b>Doctorate of Tropical Environmental Management (DTEM)</b>	<p>Assist students with application, research project formulations, and other logistics associated with candidature.</p> <p>Ongoing maintenance of DTEM website, Course Information booklet, and CDU course repository, mail-outs to TS CRC partners and advertisements as appropriate.</p>	<p>Yes, now three enrolled DTEM candidates in 2006/07 and several inquiries, including from overseas students.</p>	<p>Aim to build candidate numbers</p>		
<b>Master of Tropical Environmental Management (MTEM)</b>	<p>Update of SBI507 <i>Ecology and management of Tropical Savannas</i></p> <p>Ongoing coordination of MTEM projects, including fostering industry links through supervision, examination</p> <p>General support for MTEM program</p>	<p>Update of SBI507 <i>Ecology and management of Tropical Savannas</i></p> <p>Ongoing coordination of MTEM projects, including fostering industry links through supervision, examination</p> <p>General support for MTEM program</p>	<p>Ongoing and operational</p>		<p>Course evaluation to be completed in 2007–08</p>
<b>Evaluation of impact of TEM program</b>	<p>Complete research proposal</p> <p>Complete questionnaire design, human ethics clearance, identify participants</p> <p>Data collection (interviews with participants)</p> <p>Interview transcription</p> <p>Analysis of interviews</p> <p>Preparation of TS CRC report, and presentation at HERDSA conference</p> <p>Preparation of journal article</p>	<p>Complete research proposal</p> <p>Complete questionnaire design, human ethics clearance, identify participants</p> <p>Commenced</p> <ul style="list-style-type: none"> <li>• Data collection (interviews with participants)</li> <li>• Interview transcription</li> <li>• Analysis of interviews</li> </ul>	<p>Will continue with:</p> <ul style="list-style-type: none"> <li>• Data collection (interviews with participants)</li> <li>• Interview transcription</li> <li>• Analysis of interviews</li> <li>• Preparation of TS–CRC report, and presentation at HERDSA conference</li> <li>• Preparation of journal article</li> </ul>	<p>TS–CRC education project Leader position has become part-time.</p> <p>Less time available than planned among other research team members.</p>	

**Table 5: Education and training milestones**

Type of Milestone and/or Output	Description of all 2006–07 milestones and/or outputs incl. past milestones which have not been met (and date)	Achieved	If achieved, progress in 06–07	Reasons why milestones and/or outputs have not been achieved	Strategies to achieve milestones which have not been met
<b>Capacity Building for HE in eastern Indonesia</b>	<p>Action plan of projects, priorities and funding sources completed</p> <p>Application for postgraduate study at CDU for one staff member from UKSW</p> <p>Funding applications for collaborative curriculum development, training and staff exchanges</p>	<p>MoU signed between CDU, UKSW and UNDANA universities</p> <p>UKSW staff member due to attend CDU in 2008 to study GIS/Remote sensing</p> <p>Funding applications submitted to NT Innovations Fund grant was not successful, but funding was received from Crawford fund for curriculum development workshop in Kupang, Dec 2006</p>			
<b>Higher Degree by Research Students</b>	Reporting on completions, progress and extension requests	yes	Ongoing and operational		

# PERFORMANCE MEASURES

## Quality and Relevance of the Research Program

- Table 6, Appendix 2: Consultancies and contracts secured by the Centre
- Figure 2: Number of publications that acknowledge the CRC
- Figure 3: Extent to which researchers are attracted to the Centre
- Figure 4: Awards and invited papers

## Strategy for Utilisation and Commercialisation of Research Outputs

- The Savanna Advisory Committee provided direction to the research program.
- Specific issue forums such as the North Australian Fire Managers Forum are well-supported (see Research Collaborations, p. 27.)
- Researchers participating in education and extension project activities. See Figure 5, Number of non-university or collaborative staff involved as supervisors.
- Figure 6, and Table 12, Appendix 3, media recognition focused on outlets for stakeholders (i.e. newsletters, etc. used by land managers, conservation managers and other research user groups)
- Easily accessible research findings and information
  - More than 2500 hard-copy publications were sold and more than 4400 distributed free in 2006–07 (excluding Annual Reports and newsletters)—a record year. More than 7000 publications were downloaded from the website in 2006–07.
  - Research findings also available on newly developed websites aimed at land managers and schools. These new sites <[www.landmanager.org.au](http://www.landmanager.org.au)> and <[www.environmentnorth.au](http://www.environmentnorth.au)> are showing good growth in usage.
- Uptake of outputs (for more details see Commercialisation and Utilization, p. 29):
  - Feedback from users and website usage indicates that the CRC's NAFI website <[www.firenorth.org.au](http://www.firenorth.org.au)> is now the major fire tracking tool used to manage large scale fires in the fire prone areas of northern Australia. During the northern fire season the site delivers many thousands of fire maps a day and is used regularly in projects like the West Arnhem Land Fire Abatement Project (see below).
  - Fire monitoring techniques developed by the CRC underpin fire management across north Australia including the West Arnhem Land Fire Abatement Project in the NT and the Rangelands Fire Project in Queensland.
  - Sustainable land management guidelines for grazing developed by the TS-CRC are now taken up by grazing managers through the Grazing Land Management Workshops delivered across northern Australia.
  - Based on the two case studies conducted by the Centre for International Economics, the uptake of the TS-CRC's grazing tools are likely to produce a net benefit of \$25.8 million, while uptake of the fire management tools will produce a net benefit of \$120.5 million over the next 20 years. Alone, these two returns imply a return on CRC investment of almost \$7 for each dollar investment in the CRC. (CIE (2006) *Evaluation of the CRC for Tropical Savannas: looking back* Report)
- Commercialisation of outputs: TS-CRC research and uptake has underpinned greenhouse offset agreement between NT Government and DLNG in which DLNG will fund Arnhem Land fire managers for next 17 years at over \$1M a year (see p. 31.)

## Education and Training

- Three enrolled candidates in the Professional Doctorate of Tropical Environmental Management in 2006–07 and several inquiries, including from overseas students.
- 68 students have graduated from the TEM course since 2001–02.
- TS–CRC is collaborating with the Indonesian university Satya Wacana Christian University (UKSW) to build capacity for postgraduate education in savanna management in eastern Indonesia.
- A total of 33 research students have received support from the TS–CRC, as either full scholarships, top-up scholarships or operational support. See Figure 7 (p. 55) and Table 7 (p. 62) on the number of postgraduate students. Of these five have withdrawn, and nine graduated with a further 15 expected to graduate by the end of 2007. Eighteen of these students secured employment related to their studies, almost all in industry-related positions, see Table 8 (p.67).
- More than 60 Indigenous students have taken up special scholarships/study assistance in land and sea management courses (supported by TS–CRC and offered through NAILSMA)

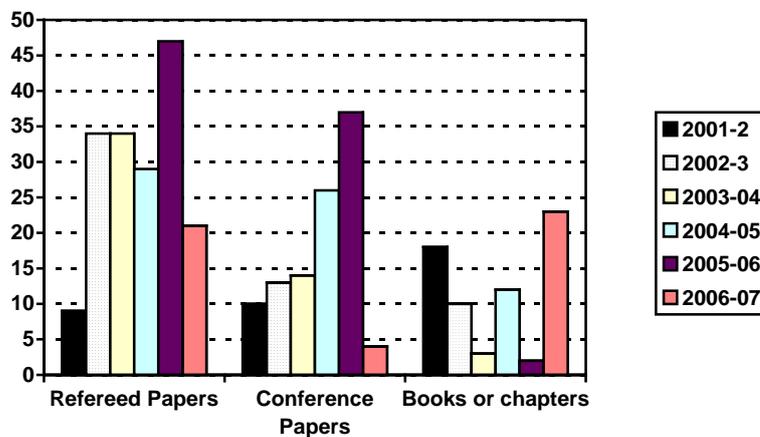
## Collaborative Arrangements

- 100 per cent of research projects are multi-agency.

## Resources, Management Structure and Performance Evaluation

- Effective and efficient project management system.
- Resources committed in accordance with the Commonwealth’s agreement under direction of the Board of Management, taking into account input from the Savanna Advisory Committee and the Management Group.

Figure 2 Number of Publications that acknowledge the CRC \*



\*(In press publications from previous year included)

Figure 3 Extent to which researchers are attracted to visit the Centre

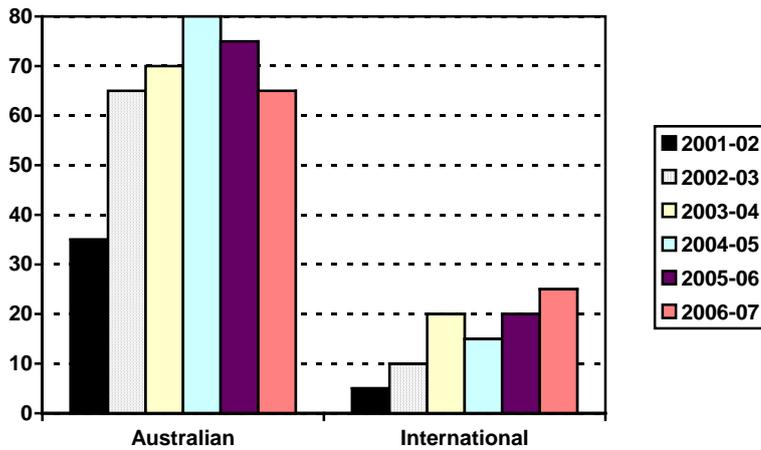


Figure 4 Awards and invited papers

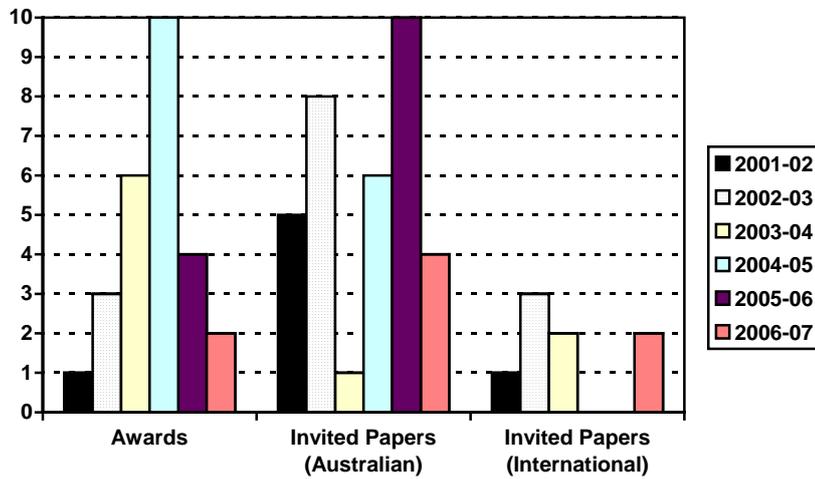


Figure 5 Number of non-university or collaborative staff involved as supervisors

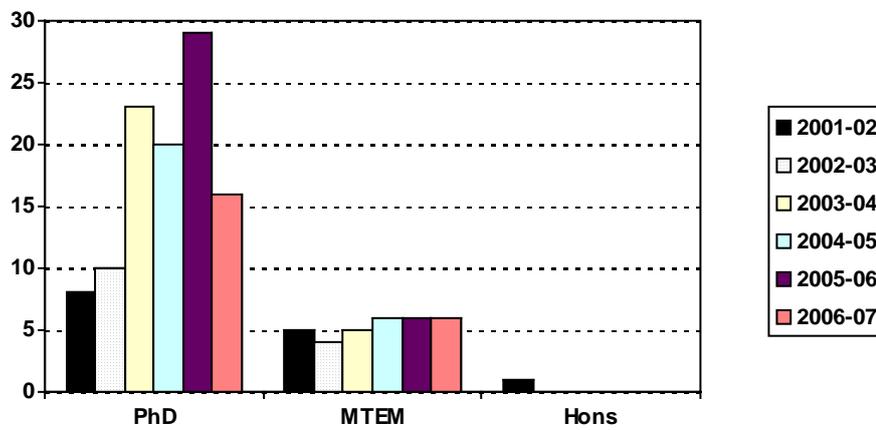


Figure 6 Media Recognition

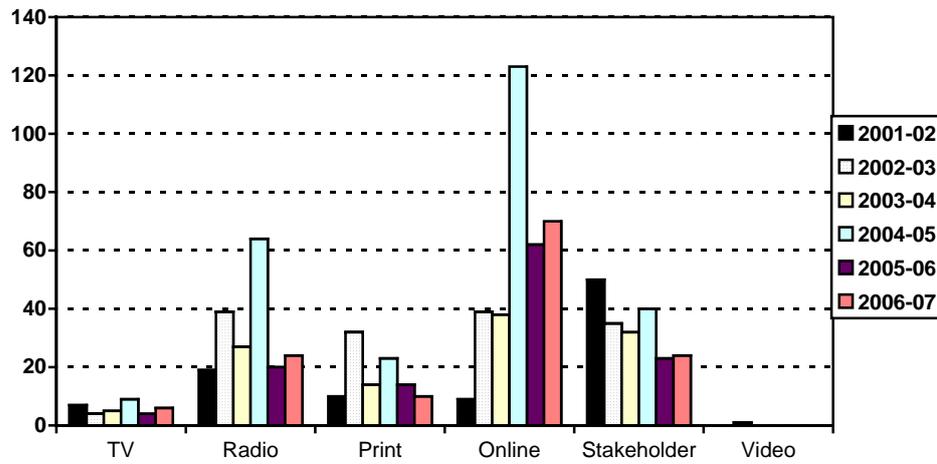
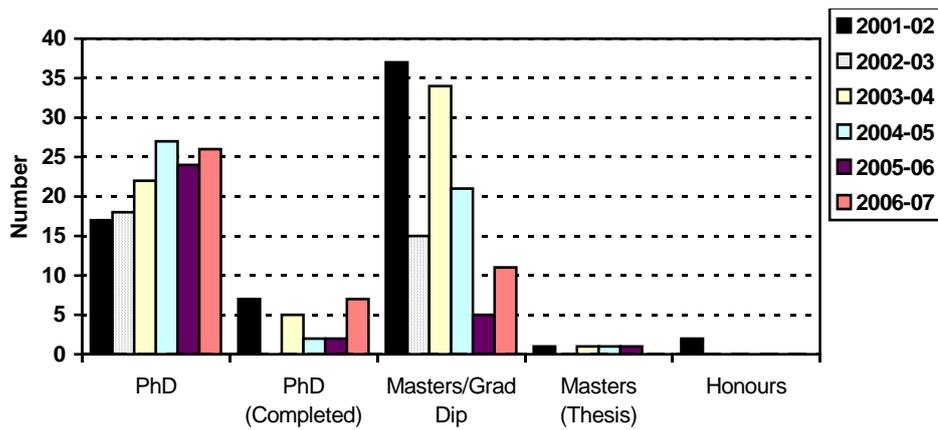


Figure 7 Number of Postgraduate Students \*



\* Masters thesis upgraded to PhD during 2003.

\* Three PhD students withdrew during 2005-06

## **FINANCE**

All financial information was provided to the Department of Education, Science and Training as per annual report instructions via the Internet.

# ABBREVIATIONS AND ACRONYMS

AACo	Australian Agricultural Company
ACIAR	Australian Centre for International Agricultural Research
ADF	Australian Defence Force
AGO	Australian Greenhouse Office
ANU	Australian National University
APA	Australian Postgraduate Award
APCC	Animal and Plant Control Commission of South Australia
ARC	Australian Research Council
ATSE	Australian Academy of Technological Sciences and Engineering
BBN	Bayesian Belief Networks
BCYDC	Balkanu Cape York Development Corporation
BFCNT	Bushfires Council of the Northern Territory
BRAC	Barkly Region Advisory Committee
CALM WA	Department of Conservation and Land Management, Western Australia
CAEPR	Centre for Aboriginal Economic Policy Research (Australian National University)
CARE	Centre for Agricultural and Resource Economics
CFCU	Caring for Country Unit
CDU	Charles Darwin University
CIE	Centre for International Economics
CIFOR	Centre for International Forestry Research
CLC	Central Land Council
CLMA	Centralian Land Management Association
CSIRO	Commonwealth Scientific Industrial Research Organisation
CSIRO L&W	CSIRO, Division of Land and Water
CSIRO SE	CSIRO, Sustainable Ecosystems
CSIRO TERC	CSIRO, Tropical Ecosystems Research Centre
CYP	Cape York Peninsula
CYPDA	Cape York Peninsula Development Association
DAFF	Department of Agriculture, Fisheries and Forestry
DLNG	Darwin Liquefied Natural Gas Pty Ltd
DCC	Darwin City Council
DEH	Department of Environment and Heritage
DK CRC	Desert Knowledge CRC
DoD	Department of Defence
DoGS	Australian Deans of Graduate Studies
DOLA WA	Department of Land Administration, Western Australia
DSS	Decision Support System
DTEM	Doctorate of Tropical Environmental Management
DUBDC	Desert Uplands Build-Up and Development Committee
EA	Environment Australia
ECNT	Environment Centre NT
EFTSU	Equivalent full-time student unit
ERISS	Environmental Research Institute of the Supervising Scientist
GIS	Geographic Information System
GLM	Grazing Land Management
HDR	Higher Degree Research
HERDSA	Higher Education Research and Development Society of Australia
ICAT	(International) Centre for Appropriate Technology
ILC	Indigenous Land Corporation
IPWG	Indigenous Water Policy Group

JCU	James Cook University
KALACC	Kimberley Aboriginal Law and Culture Centre
KAPA	Kimberley Aboriginal Pastoralists Association
KCTWM	Key Centre for Tropical Wildlife Management
KCC	Katherine City Council
KLC	Kimberley Land Council
KNP	Kakadu National Park
KPIAC	Katherine Pastoral Industry Advisory Committee
LCNT	Landcare Council of the NT
LWA	Land & Water Australia
MODSIM	International Congress on Modelling and Simulation
MIM	Mount Isa Mines Pty Ltd
MLA	Meat & Livestock Australia
MTEM	Master of Tropical Environmental Management
NABRC	North Australian Beef Research Council
NAFMF	North Australia Fire Managers' Forum
NAILSMA	North Australian Indigenous Land & Sea Management Alliance
NAPCO	North Australian Pastoral Company Pty Ltd
NASA	National Aeronautics and Space Administration (USA)
NASDA	Japanese Space Development Agency
NGRMG	Northern Gulf Resource Management Group
NCRM	Natural and Cultural Resource Management
NHT	Natural Heritage Trust
NLC	Northern Land Council
NLC CFCU	Northern Land Council Caring for Country Unit
NLWRA	National Land and Water Resources Audit
NRM	Natural resource management
NTCA	Northern Territory Cattlemen's Association
NT DBIRD	Northern Territory Department of Business, Industry and Resource Development
NT DEET	Northern Territory Department of Employment, Education and Training
NT DIPE	Northern Territory Department of Infrastructure, Planning and Environment <b>NOW:</b>
NT DPIF&M	Northern Territory Department of Primary Industries, Fisheries and Mining
NT NRETA	Northern Territory Department of Natural Resources, Environment and the Arts
PAN	Parks Australia North
QCC	Queensland Conservation Council
QDPIF	Queensland Department of Primary Industries and Fisheries
QDNRM&E	Queensland Department of Natural Resources, Mines and Energy
QEPA	Queensland Environmental Protection Agency
QFRA	Queensland Fire and Rescue Authority
QPWS	Queensland Parks and Wildlife Service
RGSQ	Royal Geographic Society of Queensland
RIRDC	Rural Industries and Research Development Corporation
RS	Remote sensing
SAC	Savanna Advisory Committee
SME	Small to Medium Enterprises
SPAG	Scientific Program Advisory Group
SSABSA	Senior Secondary Assessment Board of South Australia
TEM	Tropical Environmental Management
TRARC	Tropical Rapid Appraisal of Riparian Condition
TS-CRC	Tropical Savannas Management Cooperative Research Centre
TSRA	Torres Strait Regional Authority
UKSW	Satya Wacana Christian University
UNDANA	University of Nusa Cendana

UNU – IAS	United Nations University Institute of Advanced Studies
UQ	University of Queensland
VET	Vocational Education and Training
VRD	Victoria River Downs / District
VRDCA	Victoria River District Conservation Association
WA FESA	Western Australia Fire and Emergency Services Authority
WALFA	West Arnhem Land Fire Abatement
WRA	Weed Risk Assessment
WRM	Weed Risk Management
WWF	World Wide Fund for Nature

# APPENDIX 1 FINANCE

**Table 6 Consultancies and Research Contracts**

	Type	Consultant	Consultancy	Funding Source	Amount
1	Government	J Russell-Smith, TS-CRC	Fire Management in Northern Australia	LWA	\$240,000 Dec 06 – Dec 09
1	Community	J Morrison TS-CRC	Hold Indigenous Forums	Christensen Fund	\$262,255 Sep 05 – Aug 06
1	Government	J Morrison TS-CRC	Fund Enterprise Development Officer	NRMB	\$246,000 July 06 – June 08
1	Government	R Kennett TS-CRC	Indigenous Management of Dugong and marine Turtles	Environment & Heritage	\$60,000 June 06 – June 08
1	Government	J Morrison TS-CRC	Indigenous Participation in National Water Initiative	LWA	\$234,763 June 06 – May 07
1	Government	P Jacklyn TS-CRC	Web based Mapping of Biodiversity and Feral Information	NRMB	\$279,000 July 06 – June 08
1	Community	ANU, TS-CRC	Indigenous Involvement Plan	Australian Conservation Foundation	\$40,000 Sept 06 – Dec 06
1	Government	J Russell-Smith TS-CRC	Estimating Greenhouse Gas Emissions	NHT	\$135,000 Jan 06 – Dec 07
1	Government	J Woinarski TS-CRC	Defining Successional Patterns & Biodiversity Values of North Australian Eucalypt Forests	LWA	\$143,900 June 06 – Dec 07
1	Government	J Woinarski TS-CRC	Maintaining Ecosystem Systems in Tropical Agricultural Landscapes	LWA	\$455,825 June 06 – Sept 09
1	Government	J. Russell-Smith TS-CRC / NT BFC	Improving Greenhouse emissions estimates associated with savanna burning in the Northern Territory	Greenhouse Office	\$400,000 May 05–Jun 08
1	Industry	J. Russell-Smith	Fire Management of Woody Vegetation in Gulf Region	MLA	\$380,000 Oct 02–Sept 06

**Table 6 Consultancies and Research Contracts cont.**

	Type	Consultant	Consultancy	Funding Source	Amount
1	Government	G. Duff, TS-CRC	Dugong and marine turtle management	NHT	\$3,800,000 Jan 05–Jun 07
1	Government	J. Morrison TS-CRC	Development of Indigenous Knowledge capacity across Northern Australia	LWA	\$292,860 May 04– April 07
1	Government	D. Garnett TS-CRC	Dugong and Marine Turtle Supplementary Funding for TSRA	NHT	\$700,000 Nov 06 – Sept 08

1. Consultancies administered by TS-CRC 2. Grants administered by TS-CRC Partner

## APPENDIX 2 EDUCATION

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
<b>(A) CANDIDATES WHO HAVE SUBMITTED</b>						
Adele Acton (Vagg)	UQ	19/03/01	01/07/01	31-Mar-06	O Bosch (UQ) H Ross (UQ) D Walker (CSIRO)	Integrating on-ground actions that contribute to regional and property goals for sustainable land management
John Guenther	CDU	01/09/02	01/02/03	19-Oct-05	I Falk (CDU) A Arnott (CDU) G Ramsay (ICAT)	VET as a tool for regional planning and management in savanna communities
Allyson Lankester	JCU	21/07/03	03/03/04	31-Oct-06	P Valentine (JCU) M Fenton (JCU) R Landsberg (Trafalgar Station)	Social investigation into the knowledge and management practices of riparian areas by landholders in the upper Burdekin catchment region
Ron Firth	CDU	31/03/00	06/02/01	31-Dec-06	R Noske (CDU) P Whitehead (CDU) T Griffiths (CDU) J Woinarski (NT DIPE)	Ecology and conservation status of the Brush-tailed Rabbit-rat ( <i>Conilurus penicillatus</i> )
Leasie Felderhof	JCU	01/07/03	01/06/03	01-Apr-07	D Gillieson (JCU) J Ludwig (CSIRO) G Cook (CSIRO)	Fire management in Queensland's North West Highlands
Euan Ritchie	JCU	01/07/02	01/07/02	01-Nov-06	C Johnson (JCU) A Krockenberger (JCU) S Garnett (ex QPWS, nowCDU)	The ecology and conservation status of a tropical kangaroo: the Antilopine Wallaroo ( <i>Macropus antilopinus</i> ) on Cape York Peninsula

**Table 7 Details of HDR student progression**

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
<b>(A) CANDIDATES WHO HAVE SUBMITTED</b>						
Leonie Valentine	JCU	24/03/02	26/10/00	10-Dec-06	C Johnson (JCU) L Schwarzkopf (JCU) T Grice (CSIRO) J Ludwig (CSIRO)	Impacts of burning for weed management on bird and reptile assemblages in grazed open woodlands
Lionel Pero	UQ	17/03/03	03/03/03	01-Nov-06	G McDonald (UQ/CSIRO) T Smith (CSIRO) C McAlpine (UQ) P Lawrence (Q DNR&M)	An analysis of regional NRM priority setting processes and approaches for achieving sustainable NRM in the Queensland tropical savannas NRM regions
AnnaMarie van Doorn	Florida	31/03/01	31/03/01	01-Dec-06	B Brook (CDU) J Woinarski (NT DIPE) P Werner (U Florida)	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District
<b>(B) CANDIDATES WHO ARE YET TO SUBMIT</b>						
Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
Jenny Brazier	CDU	17/06/03	03/03/04	30-Nov-07	D Parry (CDU) N Munksgaard (CDU) H Hejnis (ANSTO) A Bollhoefer (erriss)	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia
Kristine Brooks	CDU	03/03/04	03/03/04	30-Sep-07	S Setterfield (CDU) M Douglas (CDU) B Grace (NT NRETA)	Evaluating exotic grass management in terms of native vegetation restoration

**Table 7 Details of HDR student progression**

Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
<b>(B) CANDIDATES WHO ARE YET TO SUBMIT</b>						
Nicole Cranston	CDU	14/03/03	14/03/03	01-Nov-07	M Douglas (CDU) A Fisher (NT DIPE) S Setterfield (CDU)	The effectiveness of riparian fencing for biodiversity conservation
Gillian McCloskey	CDU	05/03/04	05/03/04	31-Jul-07	G Boggs (CDU) M Douglas (CDU) J Ludwig (CSIRO) B Wasson (CDU)	Indicators of riparian health in tropical savannas: impact of domestic livestock
Eva McRae-Williams	CDU	27/07/05	27/07/05	01-Jul-08	Kate Senior (Menzies, CDU), Rolf Gerritsen (TS CRC) David Mearns (CDU)	Obligations, Opportunities and Outcomes of Training Programs: A Ngukurr Case Study
Natalie Rossiter	CDU	04/03/02	09/02/04	Nov-3--07	M Douglas (CDU) S Setterfield (CDU) L Hutley (CDU) G Cook (CSIRO)	The impacts of invasive grasses on ecosystem processes in Australia's savannas
Colin Trainor	CDU	30/04/03	30/04/03	31-Jul-07	R Noske (CDU) J Woinarski (NT DIPE)	Responses of wildlife to environmental variation and land use in Lautern District, Timor-Leste (East Timor)
Michelle Watson	CDU	05/02/01	05/02/01	30-May-07	P Whitehead (CDU) J Woinarski (NT DIPE)	Faunal responses to alteration in plant community structure in tropical savannas
Caroline Chong	JCU	01/04/03	31/03/04	30-Aug-07	M Waycott (JCU) W Edwards (JCU) R Pearson (JCU) G Morgan (QEPA)	Regeneration dynamics of Melaleuca in a disturbance-prone riparian environment

**Table 7 Details of HDR student progression**

Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
<b>(B) CANDIDATES WHO ARE YET TO SUBMIT</b>						
Christopher Holloway	JCU	04/02/04	01/07/04	01-Jun-08	D Gillieson (JCU) P O'Reagain (QDPI) I Gordon (CSIRO) P Valentine (JCU)	Hierarchy, distribution and spatial utilisation of patches by cattle in a semi-arid tropical savanna
Peta-Marie Standley	JCU	21/03/05		01-Apr-08	D Gillieson (JCU) P Novelly (AgWA)	Kuku-Thaypan fire management research project. The importance of campfires to effective conservation.
Mark Ziembecki	UAdel.	31/03/01	01/07/02	30-Novr-07	D Paton (Uni. of Adelaide) J Woinarski (NT DIPE)	Ecology and conservation of the Australian Bustard ( <i>Ardeotis australis</i> ) in northern Australia
Aaron Petty	UC Davis	15/09/99	03/03/04	31-Jul-07	M Douglas (CDU) D Bowman (UTAS) R Kennett (NAILSMA)	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park
Kasper Johansen	UQ	02/02/04	01/07/04	31-Jul-07	S Phinn (UQ) M Douglas (CDU) J Lowry (eriss)	A framework for riparian zone mapping over local to regional scales in Australian tropical savannas
Steve Johnson	UQ	02/07/01	01/07/02	01-Jul-07	D Hafner (UQ) J Bradley (UQ) P Cooke (Northern Land Council)	Culture as process: Correlativity, contest and tourism on Yanyuwa Country/ Tourism and two laws on the Gulf Savanna (NT): an examination of the interrelationship between social and environmental well being on the savanna lands of the southwest Gulf of Carpentaria
Jenny Moffatt	UQ	05/02/01	01/07/01	31-Jul-07	H Ross (UQ) G Lawrence (UQ) J Taylor (Rangelands Australia)	Graziers' perceptions of sustainable development and what this means for policy

**Table 7 Details of HDR student progression**

Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
<b>(B) CANDIDATES WHO ARE YET TO SUBMIT</b>						
Elizabeth Poon	UQ	17/03/03	03/03/03	31-Jul-07	S Schmidt (UQ) J Ludwig H Possingham (U. of Adel.)	Impact of tree clearing on nutrient dynamics in low nutrient tropical savannas
Kathy Seton	UQ	02/07/02	01/07/02	TBA	J Bradley (UQ) D Hyndman (UQ) P Cooke (Northern Land Council) B Hocking (QUT)	"Li-Yanyuwa li-nhanawayaya li-murndangumara": Yanyuwa women, land rights and relations to country
Katherine Witt (nee Taylor)	UQ	11/02/02	03/03/04	31-Jul-07	W Carter (UQ) D Cameron (UQ) R Greiner (River Consulting)	Rights and responsibilities in land ownership and natural resource management

**Table 8 Employment status for Round 2 TS–CRC supported research students**

Name	Institution	Project Title	Employment
Jenny Brazier	CDU	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia	Contract position with CDU as research associate. Now in a permanent position with ERISS as an environmental chemist
Nicole Cranston	CDU	The effectiveness of riparian fencing for biodiversity conservation	Part-time position in research administration at CDU
Ron Firth	CDU	Ecology and conservation status of the Brush-tailed Rabbit-rat ( <i>Conilurus penicillatus</i> )	Consultant wildlife ecologist, trading as Indicus Consulting. Now working as a scientist with EWL Sciences Pty Ltd, Darwin.
John Guenther	CDU	VET as a tool for regional planning and management in savanna communities	Education & training research consultant, based in Tasmania
Natalie Rossiter	CDU	The impacts of invasive grasses on ecosystem processes in Australia's savannas	Position as Weeds Risk Assessment Research Officer, NT NRETA
Colin Trainor	CDU	Responses of wildlife to environmental variation and land use in Lautern District, Timor-Leste (East Timor)	Consultant, Environmental Impact Assessment for the proposed Iralalalo Hydropower project in the Los Palos area, East Timor (consultancy now completed)
Michelle Watson	CDU	Faunal responses to alteration in plant community structure in tropical savannas	Threatened Species Officer, South Australian Arid Lands Natural Resources Management Board
AnnaMarie van Doorn	Florida	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District	Lecturer, Batchelor Institute of Indigenous Tertiary Education, January 2005 - December 2006.
Leasie Felderhof	JCU	Fire management in Queensland's North West Highlands	Contracted position with Queensland Rural Fires
Christopher Holloway	JCU	Hierarchy, distribution and spatial utilisation of patches by cattle in a semi-arid tropical savanna	Studying part-time while employed full-time as a research associate, CSIRO
Allyson Lankester	JCU	Social investigation into the knowledge and management practices of riparian areas by landholders in the upper Burdekin catchment region	Social Scientist, Australian Centre for Tropical Freshwater Research, James Cook University.
Euan Ritchie	JCU	The ecology and conservation status of a tropical kangaroo: the Antilopine Wallaroo ( <i>Macropus antilopinus</i> ) on Cape York Peninsula	Scientist, Victorian Museum (Melbourne) working on the molecular systematics and phylogeography of dragons
Leonie Valentine	JCU	Impacts of burning for weed management on bird and reptile assemblages in grazed open woodlands	Lecturer, School of Marine and Tropical Biology JCU. Now with EPA for a short-term contract as a Senior Project Officer in the Savanna District.
Mark Ziembicki	UAdel.	Ecology and conservation of the Australian Bustard ( <i>Ardeotis australis</i> ) in northern Australia	Research Associate, Indigenous Knowledge of savanna mammals, ANU/ NT NRETA. Project Officer, Conservation biology in French Polynesia.
Aaron Petty	UC Davis	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park	Research Associate, School for Environmental Research, CDU.
Steve Johnson	UQ	Culture as process: Correlativity, contest and tourism on Yanyuwa Country/ Tourism and two laws on the Gulf Savanna (NT): an examination of the interrelationship between social and environmental well being on the savanna lands of the southwest Gulf of Carpentaria	Land and Sea Ranger coordinator, Borroloola

**Table 8 Employment status for Round 2 TS–CRC supported research students Cont.**

Name	Institution	Project Title	Employment
Jenny Moffatt	UQ	Graziers' perceptions of sustainable development and what this means for policy	Project Officer, Centre for Social Responsibility in Mining, Sustainable Minerals Institute, UQ. Senior Review and Evaluation Officer, Strategic Review, Evaluation and Research Branch, Department of Communities, Queensland
Kathy Seton	UQ	"Li-Yanyuwa li-nhanawayaya li-murndangumara": Yanyuwa women, land rights and relations to country	Consultant research anthropologist

**Table 9 Enrolments ( individuals and \*EFTSL) in the Tropical Environmental Management program at CDU, for the last seven financial years.**

	2000/ 01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Graduate Certificate	Not offered	Not offered	-	3	4	1	1
Graduate Diploma	12	15	23	12	8	4	4
Master	20	21	23	29	32	30	33
Grand Total	32	36	46	44	44	35	38
EFTSU	10.38	13.75	19.25	17.75	10.62	11.13	10.25

\*Equivalent Full Time Student Unit

**Table 10 Completions (graduations) from the Tropical Environmental Management Program at CDU.**

	2000/ 01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
*Graduate Certificate	Not offered	Not offered	1	4	5	0	2
Graduate Diploma	1	3	6	4	4	2	2
Master	5	2	5	10	12	3	7
Grand Total	6	5	12	14	21	5	11

\*This includes students transferring from the Graduate Diploma or Master, in order to exit the program.

## APPENDIX 3 COMMUNICATION

**Table 11 Presentations—Staff Outreach Activities**

<i>Outreach Type</i>	<i>Pastoral Industry Sectoral/Resource management</i>	<i>Conservation Interest Groups</i>	<i>Mining Industry Sector</i>	<i>Aboriginal Community Groups</i>	<i>Tourism Industry Sector</i>	<i>Researchers</i>	<i>Education; schools &amp; tertiary</i>	<i>General Public/Politicians</i>
Workshop	1			2			1	
Seminar						8		
Field days	2	1						
Open Day	1							
Presentations at Meetings	14	17	3	12	1		2	4

In 2006–07 the Centre hosted, or co-hosted workshops on fire management, riparian research and management issues, NRM & Education in Indonesia, and forums on Indigenous young leaders and Indigenous water policy through NAILSMA. Centre project staff were active in outreach activities with a range of end-users and the Centre also gave various presentations to stakeholders associated with its re-bid in late 2006.

**Table 12 Public relations and communication: Media coverage**

<b>Topic/subject</b>	<b>TV</b>	<b>Radio</b>	<b>Print</b>	<b>Online</b>	<b>Stakeholder newsletter</b>
Tropical Savannas CRC Re-bid		2	1	5	2
NAILSMA, Indigenous research, Turtle and Dugong research; Weeds on Aboriginal lands		4		12	8
Fire knowledge project; North Australian Fire Information website; Fire research, national and international	4	6	4	19	3
Biodiversity in northern Australia: Research, impacts and management	2	1	1	13	4
Threatening processes; Impacts of weeds				3	1
Soil biota, nutrients and landscape health		9	2	11	1
Graziers' views on sustainable land management, decision making, sustainable grazing research			2	3	3
Knowledge building in northern Australia, Tropical knowledge for schools		1		3	2
Resources, economic health and ecosystem services of Northern Australia ad		1		1	
<b>Total</b>	<b>6</b>	<b>24</b>	<b>10</b>	<b>70</b>	<b>24</b>

# APPENDIX 3 COMMUNICATION

## Publications

### Refereed papers

Collins J., Hutley L.B., Williams R.J., Boggs G., Bell D., Bartolo R., 2007, 'Estimating landscape-scale vegetation carbon stocks using airborne multi-frequency polarimetric synthetic aperture radar (SAR) in the savannas of north Australia', *International Journal of Remote Sensing*.

Firth, R.S.C., Woinarski, J.C.Z., & Noske, R.A. 2006, 'Home range and den characteristics of the brush-tailed rabbit-rat *Conilurus penicillatus* in the monsoonal tropics of the Northern Territory, Australia', *Wildlife Research*, 33(5) 397–407.

Firth, R.S.C., Woinarski, J.C.Z., Brennan, K.G. & Hempel, G. 2006, 'Environmental relationships of the brush-tailed rabbit-rat, *Conilurus penicillatus* and other small mammals on the Tiwi Islands, northern Australia', *Journal of Biogeography*, 33 (10) 1820–1837.

Fisher, R., Bobanuba, W.E., Rawambaku, A., Hill, G.J.E., Russell-Smith, J.R.S. 2006, 'Remote sensing of fire regimes in semi-arid Nusa Tenggara Timur, eastern Indonesia: current patterns, future prospects', *International Journal of Wildland Fire* 15 (3): 307–317

Hannah, D., Woinarski, J.C.Z., Catterall, C.P., McCosker, J.C., Thurgate, N.Y., & Fensham, R.J. 2006, 'Impacts of clearing, fragmentation and disturbance on the bird fauna of eucalypt savanna woodlands in central Queensland, Australia', *Austral Ecology*.

Kuchling, G, Rhodin, A, Ibarrondo, B. R., & Trainor, C.R. 2007, 'A new subspecies of the snakeneck turtle *Chelodina mccordi* from Timor-Leste (East Timor)', *Chelonian Conservation & Biology*.

Kutt, A.S., & Woinarski, J.C.Z., 2006, 'Vegetation and the vertebrate fauna assemblage pattern in response to grazing and fire in a tropical savanna woodland in north-eastern Australia', *Journal of Tropical Ecology*.

Lambert, F. R, Trainor, C. R., & Xavier, A. F. 2006, 'Observations of Wetar Ground-dove *Gallinolumba hoedtii* from Timor-Leste (East Timor)', *Forktail* 22, 165–170.

McAlpine, C.A., Heyenga, S., Taylor, B., Peterson A. & McDonald, G. 2007, 'Regional Planning in Queensland's Rangelands: Challenges and Prospects for Biodiversity Conservation', *Geographical Research*, 45 (1), 27–42.

Price, O., Edwards, A., Russell-Smith, J. 2007, 'The efficacy of permanent firebreaks and aerial prescribed burning in western Arnhem Land, Northern Territory, Australia', *International Journal of Wildland Fire* 16: 295–307.

Russell-Smith, J.R.S., Djoeroemana, S., Maan, J. & Pandanga, P. 2006, 'Rural livelihoods and burning practices in savanna landscapes of Nusa Tenggara Timur, eastern Indonesia', *Human Ecology*, 35:3, 345–359.

Russell-Smith, J. 2006, 'Recruitment dynamics of the long-lived obligate seeders *Callitris intratropica* (Cupressaceae) and *Petraeomyrtus punicea* (Myrtaceae)', *Australian Journal of Botany*, 54 (5): 479–485.

Russell-Smith, J., Edwards, A.C. 2006, 'Seasonality and fire severity in savanna landscapes of monsoonal northern Australia', *International Journal of Wildland Fire* 15: 541–550.

Russell-Smith, J., Karunaratne, N.S., Mahindapala, R. 2006, 'Rapid inventory of wild medicinal plant populations in Sri Lanka', *Biological Conservation* 132 (1): 22–32.

Russell-Smith, J., Setterfield, S.A. 2006, 'Monsoon rain forest seedling dynamics, northern Australia: contrasts with regeneration in eucalypt-dominated savannas', *Journal of Biogeography* 33 (9): 1597–1614.

Russell-Smith, J., Yates, C.P., Lynch, B. 2006, 'Fire regimes and soil erosion in north Australian hilly savannas', *International Journal of Wildland Fire* 15: 551–556.

Trainor, C. R. & Leitão, P.J. 2007, 'Further significant bird records from Atauro Island, Timor-Leste (East Timor)', *Forktail* 23: 155–158.

Trainor, C. R. 2007, 'Birds of Damar Island, Banda Sea, Indonesia', *Bulletin British Ornithologists' Club*. 127, 8–28.

Trainor, C. R., Benstead, P., Martin, K., Lesmana, D., Agista, D., Benstead, M.C., Drijvers, R. & Setiawan, I. 2006, 'New bird records for Nusa Tenggara Islands: Sumbawa, Moyo, Sumbawa, Sumba, Flores, Pulau Besar and Timor', *Kukila* 13: 1–18. Woinarski, J.C.Z., Hempel, C., Cowie, I., Brennan, K., Kerrigan, R., Leach, G., & Russell-Smith, J. 2006, 'Distributional patterns of plant species endemic to the Northern Territory, Australia', *Australian Journal of Botany*.

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Ziembicki, M., & Woinarski, J., 2006, 'Monitoring continental movement patterns of the Australian Bustard through community-based surveys and remote sensing', *Pacific Conservation Biology*.

## Books and chapters

Fleming, M. & Woinarski, J.C.Z. 2006, 'Arnhem Rock-rat', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Johnson, K., & Woinarski, J. 2006, 'Carpentarian Antechinus', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Kerle, J.A., Kutt, A.S. & Read, J.L. 2006, 'Desert Mouse, *Pseudomys desertor*', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Kutt, A.S., Milne, D.J., M. & Richards, G.C. 2006, 'Northern Freetail-bat *Chaerephon jobensis*', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

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Moro, D. & Kutt, A.S. 2006, 'Lakeland Downs Mouse, *Leggadina lakedownensis*', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Parnaby, H., Law, B., Pennay, M., & Kutt, A.S. 2006, 'Eastern Cave Bat *Vespadelus troughtoni*', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Pavey, C.R. & Kutt, A.S. 2006, 'Large-eared Horseshoe-bat *Rhinolophus philippinensis*.', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

Puckey, H., Palmer, C., Woinarski, J.C.Z., & Churchill, S. 2006, 'Carpentarian Rock-rat', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

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Trainor, C.R., Santana, F., Rudyanto, Xavier, A., Pinto, P., & de Oliveira, G.F. 2007, *Important Bird Areas of Timor-Leste*, BirdLife International Asia Division.

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Woinarski, J.C.Z. 2006, 'Kakadu Pebble-mound Mouse', in *The Australian Museum Complete Book of Australian Mammals, Revised edition*, ed. S. Van Dyck., Australian Museum, Sydney.

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Rossiter, N.A., Setterfield, S.A., Douglas, M.M., Hutley, L.B. & Cook, G.D. 2006, 'The impact of exotic grass invasions of nitrogen cycling: A mini-review', in *Proceedings of the 15th Australian Weeds Conference*, eds. C. Preston, J.H. Watts and N.D. Crossman, Weed Management Society of South Australia, Adelaide, pp. 815–818.

Setterfield, S.A., Douglas, M.M, Barratt, J. & Brooks, K. 2006, 'Reproductive phenology of *Pennisetum pedicellatum*', in *Proceedings of the 15th Australian Weeds Conference*. Eds. C. Preston, J.H. Watts and N.D. Crossman, Weed Management Society of South Australia, Adelaide, pp. 272–274.

Brooks, K., Setterfield, S.A. & Douglas, M.M. 2006, 'Seasonal timing of glyphosate application: impacts on native plant communities in a north Australian tropical savanna', in *Proceedings of the 15th Australian Weeds Conference*, Eds. C. Preston, J.H. Watts and N.D., Crossman, Weed Management Society of South Australia, Adelaide, pp. 223–226.

Douglas, M.M., Setterfield, S.A, O'Connor, R.A., Ferdinands, K., Rossiter, N.A., Brooks, K., Ryan, B. & Parr, C. 2006, 'NT Different weeds, different habitats, same effects: Exotic grass invasion in tropical woodlands and wetlands', in *Proceedings of the 15th Australian Weeds Conference*, eds. C. Preston, J.H. Watts and N.D. Crossman, Weed Management Society of South Australia, Adelaide, pp. 811–814.

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Setterfield, S.A., Beilby, A., Douglas, M.M, Clarkson, J., Barratt, J., Ferdinands, K., Grace, B., & Wirf, L. 2006, 'A weed risk management system for the Northern Territory', in *Proceedings of the*

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