



TROPICAL SAVANNAS CRC

Cooperative Research Centre for Tropical Savannas Management

Annual Report 2007–08



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.

For more information on the Tropical Savannas CRC contact:

Dr Peter Jacklyn, Communication Coordinator

Charles Darwin University, Darwin, NT 0909

Tel: (08) 8946 6285 Fax: (08) 8946 7107

Email: peter.jacklyn@cdu.edu.au

Website: <www.savanna.cdu.edu.au>

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CONTENTS

Centre Objectives	1
Executive Summary.....	2
Context and major developments during the year	4
National Research Priorities.....	4
National research priority goals.....	4
Governance and management	5
Structure.....	5
Specified Personnel	7
Research Programs	8
Research activities and achievements.....	8
Research collaborations	23
Commercialisation and Utilisation	24
Intellectual Property Management.....	29
End-User Involvement and CRC's Impact on End-Users	30
Education and Training	45
Performance measures	46
Finance.....	50
Abbreviations and acronyms.....	51
Appendix 1 Finance	54
Appendix 2 Education	55
Appendix 3 Communication	60
Publications	61
Tables	
Table 1 National Research Priorities.....	4
Table 2 Specified Personnel.....	7
Table 3 Research Outputs and Milestones	21
Table 4 End user involvement in CRC activities.....	32
Table 6 Consultancies and Research Contracts	54
Table 7 Details of HDR student progression.....	55
Table 8 Public relations and communication: Media coverage	60
Figures	
Figure 1 TSM–CRC organisational structure.....	5
Figure 2 Number of Publications that acknowledge the CRC	47

Figure 3	Extent to which researchers are attracted to visit the Centre.....	48
Figure 4	Awards and invited papers.....	48
Figure 5	Number of non-university or collaborative staff involved as supervisors	48
Figure 6	Media Recognition.....	49
Figure 7	Number of Postgraduate Students	49

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 started with a focus on production and implementation of the Tropical Savannas CRC's wind-up strategy and plan, but ended with renewed hopes that there may yet be a chance that the activities of a northern CRC can continue for some time to come. At a time when there is continued heightened interest in both the potential and the challenges of northern Australia it is particularly encouraging to think that north Australian cooperative research is in a key position to continue to contribute to greater understanding of the north and its peoples. This follows strong support for the concept of public-good CRCs from the Rudd Government. In the case of the Tropical Savannas CRC, this was taken further with the offer of additional support, which will fund the TS-CRC to the end of 2009, and allow it to put together a bid for further funding for a successor CRC in the next funding round. This timing for this round will be decided during 2009.

With the extension of the life of the CRC, it was felt that it was important to continue to engage with the research community over the next 18 months, since they would be vital contributors in a new CRC. Consequently, a series of relatively short-term pilot projects were proposed. These will all be completed by the end of 2009.

The change in direction for the CRC came too late in the year to allow revision, and possible extension, of existing internal research projects. These were all planned to finish in June 2008, as part of the on-going wind-up process, and were all successfully completed. This also marked the termination of the commitments of the Theme 2 and 3 leaders, Dr Paul Novelly and Dr Peter Whitehead respectively. Our thanks go to them for their diligence and commitment in overseeing Themes 2 and 3.

Water, soil and carbon were all targeted in Theme 1 projects. Water is a key factor in north Australian ecosystems and the increased ability to assess and understand riparian health will be a lasting legacy of the savanna riparian health project. The critical role of both perennial vegetation and soil invertebrates in maintaining the health of savanna soils has been highlighted, and will be of value to graziers when attempting to assess sustainable stocking rates. There remains much to be understood about these soils, particularly with the desire in some quarters to stimulate further agricultural development in the north. Accurate measurement of soil carbon in local and regional landscapes remains a real challenge but the savanna carbon dynamics project provided a firm base on which to build. The project has focused not only on soils but on the whole savanna ecosystem—the carbon stocks, carbon dynamics, impact of rising CO₂ levels and the influence of land management on these patterns and processes

Research into fire management for savanna communities has proved to be one of the great successes of this CRC, and will culminate in a major publication on fire management. The Western Arnhem Land Fire Abatement (WALFA) project has led the world in demonstrating that it is possible to achieve economic sustainability through a commercial greenhouse gas offset program, at the same time forging effective partnerships between the knowledge traditions of Indigenous land managers, scientists and policy makers. The culmination of this success was the award to the WALFA team of the prestigious Australian Museum Eureka Prize for Innovative Solutions to Climate Change. The potential exists for many more such projects in the future, on fire-prone land under all tenures.

Different land tenures are subject to a range of environmental pressures, in addition to fire. The project on off-reserve conservation of biodiversity highlighted one of the challenges of the north: to build reliable databases. Without these there is no way of demonstrating that management actions have made a difference. The project compiled a near-comprehensive database of the known locations for vertebrate and plant species across the tropical savannas and much of this information is now available in forms suitable for land managers via the new *Infonet* website. It also highlighted the need to put this understanding into a broader context, taking into account pressures from cattle, impacts of clearing and fragmentation, and thickening or thinning of vegetation cover. Separate projects focused more specifically on grazing management and management of woody vegetation dynamics in the savannas. The former has developed a range of tools to assist agencies and land managers establish sustainable grazing systems, while the legacy of the latter will be a book that will review the nature, extent, causes, impacts and treatments of woody vegetation change across the northern gulf region in Queensland, the Victoria River District in the Northern Territory and the Kimberley region in Western Australia.

In recent years the Tropical Savannas CRC has placed an increasing emphasis on regional planning and management, particularly with respect to isolated communities. The highlights of the current projects were:

- completion of development of knowledge synthesis and decision-support models capable of adaptation by regional users to improve management of land condition
- completion of a major study of economic multipliers in the savannas and
- completion of a conceptual and analytical model of the choices available to pastoralists and other residents to improve viability of their businesses and regions.

Greater emphasis on research into regional planning and management would be a central theme in a new CRC.

The great majority of our PhD students have successfully completed their research, and in the process made a significant and lasting contribution to our knowledge of Australia's savannas and the people who live in them. It is essential, however, that research is not seen as an end in itself. Research findings and local knowledge must be translated into effective land management tools and concepts, and the Theme 4 focus on human capability development has been an essential component in achieving this aim. This has involved delivery of tropical savannas knowledge for schools, development of broader communications resources for a variety of end-users, and Indigenous capacity building. The *EnviroNorth* website and the interactive *Savanna Walkabout* Module, both launched early in 2007, have now been supplemented by the next module, *Burning Issues*, which was circulated to all Northern Territory schools. It is encouraging to note that neighbouring jurisdictions in Queensland and Western Australia also adopted the *EnviroNorth* resources in a range of ways, and that the site is attracting attention in other Australian states.

The North Australian Fire Information (NAFI) website continued to be a vital tool for fire managers in the north. The site has increased in popularity each year, with the 2007 fire season returning the highest figures to date. In addition to NAFI, the need for reliable information in land management has led to the development of two further web tools. The *Infonet* web technology allows Northern Territory land managers to create planning reports and data summaries for any area in the Northern Territory, drawing on the clearinghouse of information on the *North Australia Land Manager* website.

The successful completion of a range of projects and partnerships has resulted in a number of new publications this year supported by the Tropical Savannas CRC. Demand for these, and earlier CRC publications, has remained at a high level, both as hard copy and as downloads from the website. These publication downloads have increased significantly in the last year.

Undoubtedly one of the greatest achievements of the Tropical Savannas CRC has been the successful establishment of the North Australian Indigenous Land and Sea Management Alliance (NAILSMA). The CRC hosted NAILSMA in its formative years and continues to provide some administrative support to it, but NAILSMA now receives substantial funding from other sources. It has grown to a point where it is widely recognised as a major representative body which aims to improve coordination, collaboration and collegial engagement between Indigenous land managers and owners across northern Australia.

The year started with plans for winding up the CRC. It is encouraging, at the end of the year, to look forward to the possibility that the networks and skills built up by the Tropical Savannas CRC over the last 13 years may yet be put to good use in the service of the whole of northern Australia.

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

Context and major developments during the year

The Rudd Government re-affirmed its strong support for public-good CRCs and in that context encouraged the Tropical Savannas CRC to review its decision not to re-bid in the next CRC funding round. Furthermore, it offered financial support to extend the activities of the CRC for sufficient time to allow that bid to be made. This generous offer was accepted by the Board of the TS-CRC.

The Garnaut Interim Report on Climate Change was released in February 2008, highlighting the need for reductions in greenhouse gas emissions. This carries with it the need for improved accounting of those emissions, and for greater understanding of the sources, sinks and residence times of the various elements and compounds which are responsible for these emissions. The award-winning West Arnhem Land Fire Abatement Project has been a world leader in demonstrating practical solutions to at least some of these challenges. This was complemented by the successful completion of the savanna carbon dynamics project, which will inform and underpin future work on greenhouse gas related issues in the savannas of northern Australia.

The North Australian Indigenous Land and Sea Management Alliance (NAILSMA), which until recently was hosted by the TS-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. The long-term future of NAILSMA was secured during the year with the transfer of most of its administrative responsibilities to Charles Darwin University. The TS-CRC's range of websites and web tools continued to expand, reflecting the vital role of knowledge acquisition and transfer in the management of northern Australia.

NATIONAL RESEARCH PRIORITIES

National research priority goals

Transformation of existing industries in a sustainable manner by improving understanding of underlying processes has been an important aim of the CRC. The tools developed by the TS-CRC to achieve greater understanding of soil health, how it can be assessed and the factors which may affect it will all lead directly to improved management practices in the cattle industry. They will also be beneficial in minimising soil loss. Soils are also important as a store for carbon. The TS-CRC's rigorous work on savanna carbon dynamics is timely in view of the heightened urgency to understand drivers of climate change. The project focused not only on soils but on the entire savanna ecosystem—the carbon stocks, carbon dynamics, impact of rising CO₂ levels and the influence of land management on these patterns and processes. In addition, substantial community-based fire management projects in all three northern jurisdictions have demonstrated, *inter alia*, that it is possible to develop economically sustainable fire management solutions for savanna land managers. Reduction of greenhouse gas emissions and improved biodiversity are two of the benefits of these solutions.

The CRC continues to commit significant resources to its websites and other communication media, in the belief that efficient information acquisition and transfer is absolutely vital in the widely spread and thinly populated regions of northern Australia.

Table 1: National Research Priorities

National Research Priorities	CRC Research (%)
An Environmentally Sustainable Australia —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	5
Responding to climate change and variability	25
Promoting and Maintaining Good Health —Promoting good health and well-being for all Australians	
Preventive healthcare	2.5
Frontier Technologies For Building and Transforming Australian Industries —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

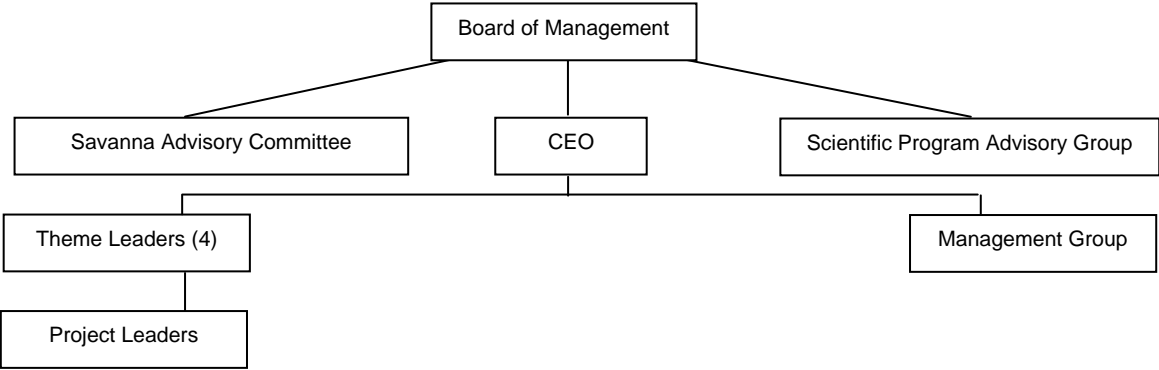
The sustainable use and conservation of northern Australia is the focal point of the TS–CRC. The Centre is an unincorporated joint venture between the Commonwealth and the partner agencies listed below:

- 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 (NAILSMA)
- 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.

Membership as at 30 June 2008

Representatives from the TS–CRC partner agencies

Ms Diana Leeder , Northern Territory of Australia	Dr Greg Robbins , State of Queensland
Mr Roger O'Dwyer , State of Western Australia	Prof. Bob Wasson , Universities
Dr Brian Keating , CSIRO	Ms Anne-Marie Delahunt , Parks Australia

Stakeholder representation

Mr Darryl Pearce (Chair, Savanna Advisory Committee)	Ms Jann Crase ACF (Conservation sector)
NAILSMA (Indigenous sector) Vacant following the resignation of Mr Peter Yu	(Mining sector) Vacant following the relocation and resignation of Mr Craig Stewart
Mr John Courtenay , Probe (Tourism sector)	Mr Tom Stockwell , Sunday Creek Station (Pastoral sector)

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.

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 or 2007–08.

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 2007–08.

Specified Personnel

Table 2 Specified Personnel

Title and Name	Contributing Organisation	% of total working time in CRC	Role in Centre
D Garnett	CRC	95	CEO/Contracts Manager
P Jacklyn	CRC	100	Communication Coordinator and Theme Leader 4
K Boakes	CRC	100	Business Manager
D Garnett	CRC	5	Theme 1 Leader
P Novelly	CRC/WA	50	Theme Leader 2
P Whitehead	CRC/Northern Territory Govt	20	Theme Leader 3
J Morrison	CRC/CDU	5	Theme Leader 4

RESEARCH PROGRAMS

Research activities and achievements

THEME 1: LANDSCAPE ECOLOGY AND HEALTH

Leader: Dr David Garnett, Tropical Savannas CRC, Darwin

Overview

The three remaining projects in Theme 1 have now been completed successfully. They feed into the growing demand for information on underlying processes which are important drivers in the savannas of northern Australia. Maintenance of healthy river systems and soils is essential if these environments are to be managed sustainably, while greater understanding of carbon cycling, and the ability to quantify it, are becoming increasingly important as we attempt to increase our knowledge of carbon sinks, sources and opportunities for sequestration.

Progress

Project 1.2.1 Savanna Riparian Health, Leader: Dr Michael Douglas, CDU, Darwin

The three remaining student projects have now been completed and these in turn mark the completion of the Savanna Riparian Health Project.

Aaron Petty submitted his PhD and graduated in May 2008, Caroline Chong submitted her PhD in May 2008 and is awaiting examiners' reports.

Chapter 2 of Aaron Petty's thesis was submitted as a paper titled 'Characterisation of riparian vegetation in Kakadu National Park' and is in review in the *Journal of Tropical Ecology*. A report on the 'Indigenous values and management of riparian vegetation in Kakadu National Park' forms the fourth chapter of Aaron Petty's thesis and is currently in preparation as a paper that will be submitted by the end of 2008.

The trials of the Tropical Rapid Assessment of Riparian Condition (TRaRC) are now complete. The final trial in Queensland, funded by the Northern Gulf NRM Group and Land and Water Australia, produced its final report in August 2008.

A user-friendly field manual for applying the TRaRC (printed on waterproof paper) was printed in August 2007 and was widely distributed. The TRaRC method is being widely used in these regions and a number of training workshops were run for educational training groups in the Northern Territory.

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

This project is now completed.

Project 1.1.3 contributed to key knowledge gaps in the area of soil health through examination of how vegetation patches and their associated soil macro-invertebrates interact to influence water infiltration, vegetation, runoff and nutrient cycling; and the impact of grazing management on these relationships. The research focused on the existing, instrumented runoff catchments in two treatments (heavy stocking and light stocking) at the Wambiana grazing trial, south-east of Charters Towers, Queensland.

The project established that patches of perennial vegetation play a critical role in the capture and retention of water (as rainfall and runoff), nutrients (e.g., nitrogen and phosphorus) and carbon (e.g., litter and seeds). Vegetation patches with healthy soils have greater water availability and tighter control of nutrient availability, so act as 'conserving' elements in the landscape. In contrast, runoff of water is greater from the inter-patch areas, which act as 'leaky' elements in the landscape, as water and nutrients are transferred to the richer perennial patches or are lost out of the system. Invertebrate activity is critical to the maintenance of fertile vegetation and soil patches. The activities of termites, earthworms and other soil macrofauna in areas of high biological activity greatly increase water infiltration rates and nutrient cycling in perennial patches, enhancing plant production. Understanding the relationships between patch functionality, eco-hydrology,

plant production and grazing is central to achieving the maintenance, or restoration, of long-term soil health and landscape productivity in northern Australia's tropical savannas.

Some work was also done in an ungrazed paddock not far from the trial, for comparative purposes. Patch functionality was measured in terms of volumetric soil water contents, organic matter input and turnover, nutrient fluxes and the diversity, abundance, activity and functional group composition of soil macrofauna. Pasture production, utilisation, rainfall, and water, soil and nutrients lost in runoff were also measured at the landscape scale on existing one hectare runoff sites and related to patch functionality.

A remote automated soil water data measuring and monitoring system was installed to monitor soil water content at different soil depths in each patch. The system comprised soil moisture probes with sensors at various depths, installed across different patch types and grazing treatments. The probes were connected to solar-powered data loggers, rainfall gauges and overland flow measurement sensors. In contrast to previous methods used to estimate soil water relations, the system allowed real-time spatial measures of effective rainfall.

The data acquired provided a mechanistic understanding of soil ecohydrological function at the local patch-scale, within the context of soil health, landscape patchiness, grazing impacts, productivity and run-off.

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

This project is now completed.

The objectives of the project were to:

- determine the carbon stocks, distribution of carbon, and carbon sequestration potential of Australian savanna ecosystems,
- assess the impact of rising CO₂ levels on carbon dynamics in Australian savannas
- examine the influence of land management on these patterns and processes.

This research was of national significance, because savannas account for around 33% of Australia's terrestrial carbon stores and they may offer significant potential as a carbon sink to offset greenhouse gas emissions. Grazing management, clearing, fire and climate change can significantly alter the amount of carbon stored in tropical savannas so it is important that we quantify how these disturbances affect carbon dynamics in order that a range of land management options/scenarios for carbon sequestration can be developed. An improved understanding of woodland dynamics in response to disturbance is therefore necessary so that sound management recommendations can be developed.

There were two components of this project:

1. Estimation of carbon stocks and sequestration potential at landscape scales in savannas and
2. Experimental investigations of the effects of grazing and climate change on soil carbon dynamics, via a CO₂ elevation experiment.

Carbon stocks were estimated by allometry. The allometric studies examined above and below-ground stocks of carbon. In conjunction with the Greenhouse Accounting CRC, the efficacy of generalised allometric equations for predicting above ground biomass that could be used across species in different savanna types was examined. It was concluded that a general equation could be thus used. With respect to below ground biomass, the Australian Greenhouse Office harvest protocols to examine the stocks of coarse roots, finer roots, and soil organic carbon were applied. Allometric equations for predicting these stocks, and estimates of stocks in different savanna types (mesic and semi-arid) were developed. Regional estimates were generated, based on remote sensing combined with ground-based allometry. It is estimated that the sequestration potential of the mesic savannas of the Darwin region is about 1 tonne of carbon per hectare per year.

To address the issue of climate change in savannas, and responses to elevated CO₂ in particular, a Free-Air Carbon dioxide Enrichment (FACE) experiment was established at Townsville, north Queensland. Atmospheric CO₂ levels were raised experimentally, and responses of plant growth and soil carbon to increased CO₂ were measured. Three levels of CO₂ were used: 370 ppm (current ambient); 460 ppm and 550 ppm. Transplanted seedlings of both eucalypts and acacias showed evidence of enhanced growth under elevated CO₂, with a stronger response in the acacia (nitrogen-fixer) than the eucalypt. Measures of soil respiration (the rate at which below ground carbon is returned to the atmosphere) showed that efflux of carbon from the soils into the atmosphere increased in response to increases in atmospheric CO₂, soil moisture and nutrient levels. There were indications of rising soil moisture levels under elevated CO₂, which

might be due to increased water use efficiency of vegetation. There is as yet no indication of any increase in the pool of new, labile carbon in the soil carbon pool under elevated CO₂.

Promoting healthy carbon cycling and improved carbon storage in savanna soils is strongly linked to improving overall ecosystem health. There are thus likely to be strong overlaps between carbon sequestration in savanna soils and other natural resource management issues relating to sustainable land management.

Savanna carbon dynamics is a fruitful research area, and further work examining the impact of land use on carbon stocks, and overlap between desirable land management outcomes and carbon sequestration in savannas would be a sound investment. Strategies promoting carbon sequestration may best be delivered by integration into existing efforts to improve land management in savannas.

THEME 2 INDUSTRY AND COMMUNITY NATURAL RESOURCE MANAGEMENT

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

Summary

During 2007–08, the Industry and Community NRM Theme continued to demonstrate the benefits of the CRC concept through constructive relationships between staff and many of the numerous organisations, agencies and individuals responsible for land management in the savannas.

A significant number of scientific publications were produced, substantial material was prepared for various websites—including the *North Australian Land Manager* website and the *North Australia Fire Information* (NAFI) website—and numerous extension publications and activities demonstrated the strong involvement of the end users in the Theme’s outputs.

The theme encouraged, coordinated and integrated management projects which included significant stakeholder participation. Project boundaries were frequently and deliberately blurred by sharing information, expertise, study sites and personnel to ensure that the values of integration could be developed. This was a particularly important feature of the theme’s operation.

With most of the theme’s projects and activities winding up in 2007, this report is as much a retrospective look at the projects as a review of activities over the past 12 months.

Project 2.1.4 FIREPLAN: Fire management for savanna communities, Jeremy Russell-Smith, BFCNT, Darwin

While significant fire research and investigation continues, the TS–CRC Fireplan projects wound up in this financial year, with all external milestone reporting requirements satisfactorily met and all reports completed.

The project team saw early that the challenge was to develop a coordinated approach to fire management research across the north, inclusive of and relevant to extensive landholders, rural fire agencies and fire researchers. That they were successful is demonstrated by such outcomes as:

1. The development and undertaking of substantial community-based fire management projects in all three northern jurisdictions, many co-funded with NHT, other government and non-government agencies and community resources.
2. The development of knowledge-based resources including websites (e.g. NAFI, www.firenorth.org.au), informative texts for land managers (e.g. *Savanna burning: understanding and using fire in northern Australia*), and research symposia (e.g. the International Journal of Wildland Fire publication, *Fire and savanna landscapes in northern Australia – regional lessons and global challenges*).
3. Sponsoring and chairing of the North Australia Regional Fire Manager’s Forum, an industry body involving all the fire agencies with responsibilities in the north.

An allied task was to address the fundamental problem of how to develop economically sustainable fire management solutions for savanna landscape managers. While such issues are most obvious in Indigenous lands and communities, they also apply to fire-prone lands under all tenures.

The Western Arnhem Land Fire Abatement (WALFA) project was singularly important in this regard, and would not have been possible without the commitment and support of the Tropical Savannas CRC. Not only was the project successful in offering economic sustainability as a commercial greenhouse gas offset program, it demonstrated that effective partnerships can be forged between the knowledge traditions of indigenous land managers, scientists and policy makers. In recognition, the WALFA Project team won the inaugural Eureka Prize for Innovative Solutions to Climate Change in August 2007. Special congratulations go to Peter Cooke (Wardekken Land Management Limited) and Traditional Owner Lofty Bardayal Nadjamerrek AO.

WALFA project: <www.savanna.cdu.edu.au/information/arnhem_fire_project.html>

Ongoing fire and land management-related opportunities on the horizon include accounting for an increased set of greenhouse gases other than emissions of the two gases (methane and nitrous oxide) currently allowed

for; the potential for carbon sequestration in above- and below-ground stores; and associated potential for developing 'avoided deforestation' and 'biodiversity credit' instruments and markets. Each of these issues will provide substantial and significant research and policy development challenges.

Project 2.4.2 Refining methods for off-reserve conservation of biodiversity, Leaders: Alaric Fisher, CSIRO SE, Darwin, John Woinarski NT NRETA Darwin, and Alex Kutt, CSIRO SE, Townsville

This project is now completed.

This project began in 2004–05, evolving from a set of three previous disparate CRC biodiversity-related projects, and was completed in 2007. The general objectives were to increase basic knowledge of the distribution and conservation status of savanna biota, to investigate the impacts of a range of land management regimes on biodiversity, to better incorporate consideration of biodiversity conservation into land management planning and decision-making, to develop robust techniques for assessing and monitoring biodiversity 'health' and to provide information about biodiversity in useful forms to a wide array of land managers and other stakeholders.

These objectives were largely achieved, resulting in a significant increase in understanding and appreciation of the tropical savanna biodiversity, incorporating a range of tenures and stakeholder groups. The project group compiled near-comprehensive databases of the known locations for vertebrate and plant species across the tropical savannas. A large number of systematic biodiversity surveys have addressed substantial gaps in this baseline information or, where they have resampled areas where historical data exists, been fundamental in highlighting changes in biota, particularly declines in small mammals and birds. Research projects have clarified the impacts on biodiversity of grazing pressure from cattle, impacts of clearing and fragmentation, and thickening or thinning, of vegetation cover, the spread of introduced pasture grasses and changes in fire regimes.

The information is now available to land managers and the general public via the Land Manager and Biodiversity Info-Net websites <www.landmanager.org.au> and <www.infonet.org.au>. Additionally, this program has been associated with more than 200 scientific papers, reports and books relating to savanna biodiversity and sustainable land management, which have extended to a national and international audience. Like Fireplan, the project team was very successful in attracting external funds, from such sources as Land and Water Australia, the Natural Heritage Trust and Meat and Livestock Australia.

Recently, Drs Fisher and Kutt, together with other CSIRO, Queensland EPA and NT Natural Resources, Environment and the Arts staff, were awarded a contract by the Australian Collaborative Rangeland Information System (ACRIS) to address issues associated with monitoring biodiversity in the rangelands (savannas and more arid areas). Consequently, while not TS–CRC activities *per se*, activities of interest to the CRC's stakeholder base will continue.

Project 2.1.1 Developing grazing management tools to improve savanna condition, Leader: Neil MacDonald, NT DPIF, Katherine

This project set out to extend the capability to manage grazing land in the tropical savannas, particularly linked to tools to assist in the objective estimation of safe cattle carrying capacity.

The project comprised interlinked activities associated with the development of grazing management tools, and sought to promote implementation of better decision-making by producers / land managers by assisting them to better manage their properties in different regions in the tropical savannas.

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), a Carrying Capacity Estimator for the Northern Territory and Grazing Land Management packages (in conjunction with Meat & Livestock Australia (MLA)). This has been a very well integrated and linked project, incorporating staff from three State agencies (Northern Territory Department of Primary Industries & Fisheries, Queensland Department of Primary Industries & Fisheries and the Department of Agriculture and Food, Western Australia), and producer groups in Queensland, the Northern Territory and Western Australia, as well as MLA and Heytesbury Beef.

The new products are being actively communicated to stakeholders (many of whom were involved in product and tool development).

Project 2.4.1 *The dynamic savanna: Assessing and managing structural change in woody vegetation in northern Australian savannas*, Leaders: Prof. David Gillieson, James Cook University, Cairns, and Dr Garry Cook, CSIRO SE, Darwin

This project began in February 2005 (the last of the Theme 2 projects to begin), with a series of activities the overall objective of which were 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 north Australia.

The project focused on assessing a widespread ecological phenomenon in tropical Australia using a consistent and comparable methodology. It also brought together a disparate group of people interested in the ecology and productivity of woodlands, creating synergies and lasting collaborations between individuals.

This project aimed to develop better methods for quantifying woody vegetation change, then applying those methods to selected case study areas to investigate the nature, extent, causes, impacts and treatments of woody vegetation change. The case study areas were the Northern Gulf Region in Queensland, the Victoria River District (VRD) in the Northern Territory and the Kimberley region of Western Australia.

Dr Tom Vigilante from the Kimberley Land Council carried out fieldwork in the north Kimberley region of Western Australia during late 2006 to record Indigenous attitudes to vegetation change.

This project continued during 2007–08, with both field sampling and data analysis. The air photo analysis of more than 400 sites in the Kimberley and the VRD involved developing new technique for stereo photo analysis using an anaglyph image on the computer screen. A stereo pair is scanned and converted to a single stereo image viewed with red and green glasses (like 3D movies). This avoids using a mirror stereoscope, is easier on the eyes and can be done with much less training and expense. From the air photo data, it was interesting to see a general increase in woody cover, although there was some variation between sites, with cover at one site actually declining.

A major output from this project will be a manuscript integrating the output from all activities and illustrated with historical landscape photographs, aerial photographs, scientific and oral history information collated for the case study regions, entitled *Trees in Savanna landscapes*. This will complement the book *Slower than the Eye Can See* written by Daryl Lewis on the VRD in 2002.

General comments

- Continued success in attracting significant amounts of external funding to all projects. This funding success is also reflected in the significant integration both within the theme and with other themes,
- The quality and continued commitment of staff,
- Very strong involvements and contributions by PhD and Honours students,
- A continued high rate of publication in a variety of journals, proceedings and monographs, and requests from various media groups for interviews and reports.

THEME 3 REGIONAL PLANNING AND MANAGEMENT

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

Background

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 other 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.

Most projects within this theme were completed during 2006–07, so activity during 2007–08 was confined to a number of products promoting synthesis, refinements of existing products, or appearance of related publications. No new funds were made available for Theme 3 projects during 2007–08.

Regional dynamics

Two projects are done in conjunction 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*, Leader: Dr Rolf Gerritsen, Tropical Savannas CRC (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, Tropical Savannas CRC, Darwin**

The broad goals of these projects are to:

- Improve understanding of cultural, social and economic issues affecting outback communities and their linkages with ecological issues
- Provide products and processes to assist community discourse and decision making on alternative futures and investment priorities
- Understand the Government and community interface and how it can be improved
- Use the key insights from this understanding to better inform regional policy and processes
- Develop social and economic indicators of regional health and socio-economic resilience to complement existing ecological indicators.

During 2007–08 field work was completed for a study at Ngukkur, Northern Territory in innovative service delivery. 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 affects realisation of economic opportunity. The latter is illustrated through development of a business model, centred on outstations, for commercial fire management services which will mitigate greenhouse gas emissions. A final report on this project and associated publications will be submitted in late 2008 or early 2009, as part of a book by Professor Rolf Gerritsen tentatively titled *The Other Australia: A political economy of the Northern Territory*.

A CRC-supported PhD thesis on the nature of employment in remote Indigenous settings (Eva McCrae-Williams, *Understanding Work in Ngukurr: A remote Australian Aboriginal community*) was submitted for examination.

Diverse regional economies

Project 3.3.6 *Multiple use in savanna regions*, Leader Dr Tim Lynam, CSIRO SE, Townsville

Work was completed in 2006–07.

Regional planning

Project 3.3.5 *Healthy savanna planning systems*, Leader: Dr Cathy Robinson, CSIRO SE, St Lucia.

A final report titled *Collaborator perspectives on outcomes delivered from savanna regional natural resource management programs*, was received in December 2007. Primary conclusions for assessing success of regional natural resource management projects were:

- Expect resource condition target-setting to rely on testing links between actions and outcomes adaptively. This will need to recognise that the achievement of specific actions will need to be accepted as surrogate measure for achieving outcomes in many instances.
- Successful collaborative frameworks that enable the integration of natural resource use, planning and management through the alignment of government, community and industry effort are just as critical to achieve long term outcomes as on-ground actions.
- Existing monitoring and evaluation frameworks make it difficult for government and other investors to access the full (environmental, social, cultural, and institutional) impact of regional NRM. Support for a framework that enables local, regional and policy levels of this regional initiative to monitor and report on the performance of management actions and partnerships are required.

Some of the outputs from this project appear to have influenced project evaluation strategies now used by the Australian Government in regard to its Natural Heritage Trust programs.

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.

A final report summarising work completed throughout the project was submitted in June 2007. However, during 2007-08 work continued on developments of web-based implementations of BBN models and links to these models will be placed on the TS-CRC website.

Other Activity

Although not funded under the Theme, contributions were made to another cross-disciplinary project to produce a book on fire management in western Arnhem Land. The book melds issues in anthropology, linguistics, fire ecology and interactions with the customary and mainstream economies. All chapters have been drafted, and a number are under review. Final submission of all manuscripts is expected by October 2008.

Highlights and Challenges

Highlights during 2007–08 were:

- receipt of final reports under the Regional Planning sub-theme and evidence of some of the outputs being applied by the Australian Government in its evaluation processes;
- completion of manuscripts for a volume on Indigenous fire management and its socio-economic significance in western Arnhem Land

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 NRM activities and user groups associated with the TS–CRC’s participative projects so that the tools and information developed are more likely to be used.

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, Darwin

See Education and Training section, p 45.

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

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> continues to be a vital tool for north Australian fire managers and continues to be improved in response to user feedback. The site is used by Indigenous fire managers in the West Arnhem Land Fire Abatement Project, it is extensively used by pastoralists in the Northern Territory and across western Queensland and is being used in the Kimberley region in the new *EcoFire* Project to reduce the incidence of wildfire. 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.

Whereas the NAFI site is useful for day-to-day fire management there has been a growing need for access to spatial data that allows north Australian natural resource managers to better evaluate and monitor their management practices over the longer term. Consequently the TS-CRC was contracted to develop the Infonet web technology for the NT NRM Board and the initial website <www.infonet.org.au> allows NT land managers to create planning reports and data summaries for any area in the NT. The Infonet website makes use of the clearinghouse of NRM information on the *North Australian Land Manager* website <www.landmanager.org.au>.

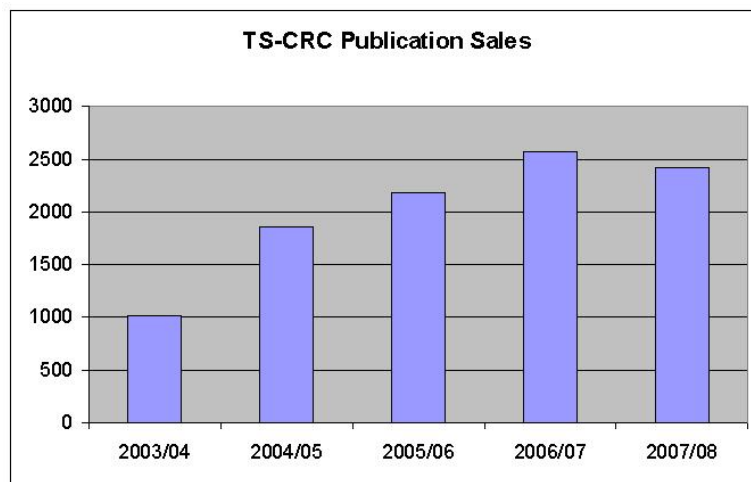
A number of new TS–CRC supported publications were produced this year.

- A practical users’ field guide for the Tropical Rapid Appraisal of Riparian Condition (TRARC) method to assess riverbanks was published and distributed to hundreds of land managers and planners.
- A weatherproof, species deck with practical guidelines on managing special plants and animals (threatened species) for land managers of Cape York Peninsula was published and distributed through local NRM groups to land managers in Cape York Peninsula. The Centre helped produce

Talking Fire - Burning for pastoral management in the Desert Uplands a booklet for pastoralists that addressed the pros and cons of burning for pastoral management in the Desert Uplands region of Queensland. It outlines the existing knowledge of burning in the hope that graziers and other land managers will continue to use fire and develop a better understanding of its merits and consequences.

- The Centre also helped produce *Lost from our Landscape* a comprehensive compendium summarizing the conservation status and management advice for all threatened species in the Northern Territory.
- The Centre helped produce *The Nature of Northern Australia*.

The high sales and distribution figures for publications of the previous year were maintained in 2007–08 with more than 2400 hard-copy publications being sold and more than 3000 distributed free (excluding Annual Reports and newsletters)—see below. However many more publications were downloaded from the CRC’s websites and these downloads have increased steadily over the past few years. More than 820 publications (a variety of reports, articles, newsletters and information sheets) were downloaded from our websites—*Savanna Explorer*, *North Australian Land Manager*, *EnviroNorth*, *NAILSMA*, and the *Tropical Savannas CRC* site—with the number of downloads reaching more than 80,000. This represents an increase of 250% over the 2006-07 figures, (536 publications with downloads of around 32,000).



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, Darwin

This project is providing resources and materials for school curricula that enhance and improve the understanding of Australia’s tropical savannas.

The project involves the TS–CRC (its partners) and the Northern Territory Department of Employment, Education and Training (NT DEET), teachers and schools who have developed 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 and the Department of Education and Training, Western Australia in collaborative efforts to produce curriculum support materials according to their identified needs.

The *EnviroNorth* website and the interactive *Savanna Walkabout* Module were launched in February 2007 and in 2007-08 the next module, *Burning Issues* was launched with a CD version distributed to all NT schools with a letter of endorsement from the NT Department of Employment, Education and Training’s CEO. Neighbouring jurisdictions in Queensland and Western Australia have also adopted the *EnviroNorth* resources in a range of ways:

Queensland

- Primary Connections Program (National – Australian Academy of Science) especially Indigenous perspectives aspects of the *Savanna Walkabout* and *Burning Issues* modules and supporting teachers’ notes and resources.

- Queensland Science Teachers Association
- Department of Natural Resources Management and Water

Western Australia

- Association of Independent Schools of Western Australia teacher workshop – Broome (April 2008) for Aboriginal Independent Community Schools in WA
- *Ecofire* Project Community Schools (Kimberley region, WA)
- Department of Conservation and Environment – included as key resource for teachers and distributing *Burning Issues* CD through outreach program.

Northern Territory

- *EnviroNorth* has been included as key resource in Northern Territory Curriculum Framework Pilot Renewal for Science
- *Mainstreaming Sustainability into Pre-service Teacher Education Across Australia* (Pilot Project NT) – *Savanna Walkabout* and *Burning Issues* learning modules have been incorporated at least two pre-service teacher education units at Charles Darwin University.

Project 4.4.2 Indigenous capacity building (NAILSMA), Leader: Mr Joe Morrison, TS–CRC

This project, which covers the operation of the North Australian Indigenous Land and Sea Management Alliance (NAILSMA), aims to improve coordination, collaboration and collegial engagement between Indigenous land managers and owners and 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.

NAILSMA now receives substantial funding independent of the TS–CRC and will continue as a significant Indigenous capacity building organisation after the TS–CRC winds down at the end of 2009.

Two significant meetings occurred this year

Following collaboration between the NAILSMA and the United Nations University – Institute of Advanced Studies Traditional Knowledge Initiative (UNU–IAS TKI), a meeting of the International Expert Group Meeting on Indigenous Peoples and Climate Change was held in Darwin, April 2008. The Secretariat of the United Nations Permanent Forum on Indigenous Issues (UNPFII) were also key collaborators of this experts' meeting. The meeting brought together experts from around the world to consider:

- effects of climate change on Indigenous peoples;
- adaptation measures to climate change;
- carbon projects and carbon trading; and
- factors that enable or obstruct Indigenous peoples' participation in the climate change processes.

The Dugong and Marine Turtle Management Project (DMTP) led by Dr Rod Kennett and supported by Joshua Kitchens, is ongoing with Indigenous communities in the Kimberley, Top End of the Northern Territory, Gulf of Carpentaria, Cape York and the Torres Strait. A highlight of the year was the Symposium on Sea Turtle Biology and Conservation, a week-long international celebration of Indigenous cultural practices and management of marine turtles, held in Mexico. The symposium was attended by a delegation of Indigenous land and sea managers involved with the DMTP Project. Significant progress was made throughout the year in developing management activity plans and engagement with communities, with several sea ranger groups joining the program. The project also released its second *Message Disk*, an informative and entertaining DVD showcasing the work of community groups involved in the project. A DMTP newsletter was initiated this year focusing on Indigenous Sea Rangers, Officers and Partners.

Samara Erlandson, Project Officer for NAILSMA's newsletter, *Kantri Laif*, released a fourth edition of in August 2007, which reaches around 3000 readers nationally and internationally and highlights stories from Traditional Owners reporting on land and sea management activities on their own country across northern Australia. As the scholarships officer she also assisted with awarding the Nykina Mangala Rangers of Jarlmadangah Western Australian an Exchange scholarship to visit and exchange knowledge with the Bardi Jawi Rangers at One Arm Point in Western Australia.

Honorlea Massarella and Melissa Bentivoglio worked with Indigenous groups on small to medium sized community-based management enterprise development projects. Twenty-five participants from across the Top End came to Darwin to attend a Bodyshop Marketing Workshop. The workshop presented ideas and ways to package and sell products, and also provided a great opportunity for Aboriginal people to talk to each other about business enterprise. A new initiative that started this year and is run by Darwin Regional CDEP and supported by NAILSMA Enterprise Development staff, is the Aboriginal Bush Traders. The Aboriginal Bush Traders set up a stall at the Mindil Beach Markets in Darwin and provides Aboriginal businesses with an opportunity to showcase their products and develop their business skills.

Lorrae McArthur is the Coordinator of the Indigenous Water Policy Group (IWPG). The IWPG had a landmark Strategic Planning Workshop meeting early in 2008, that brought key Indigenous representative bodies together with major state and territory government water agencies and discuss water reform policies for an Indigenous Integrated approach. The IWPG has convened a further two meetings since then.

Key Case Studies and other publications commissioned by the IWPG include:

- David Cooper and Sue Jackson March 2008, Preliminary Study on Indigenous Water Values and Interests in the Katherine Region of the Northern. NAILSMA & CSIRO, Darwin.
- Jon Altman assisted by Virginie Branchut April 2008, Fresh Water in the Maningrida Region's Hybrid Economy: Intercultural Contestation over Values and Property Rights. NAILSMA & ANU, Canberra
- Melanie Durette May 2008, Indigenous legal rights to freshwater: Australia in the international context. NAILSMA and ANU, Canberra.
- Rachel Armstrong 2008, An Overview of Indigenous Rights in Water Resource Management. NAILSMA and Lingiari Foundation Inc., Darwin June 2008.
- Sue Jackson 2007, Indigenous Interests and the National Water Initiative (NWI): Water Management, Reform and Implementation, CSIRO, Darwin October 2007

Six new staff members were employed during the year.

David Wise is the Project Officer for the Inter-generational Transfer of Indigenous Ecological Knowledge Project. The project aims to support Elders and knowledgeable people to teach younger and less informed people about Indigenous Knowledge relevant to looking after the health of country. To do this funding is available in the form of grants to conduct activities that assist the transfer of Indigenous Knowledge. The project extends until the end of 2009 and is supported by funding from the Australian Government.

Janely Seah is the Financial Officer and she provides support and information on financial matters to the Executive of NAILSMA and its Board of Management, Associated Committees, the Operations Manager and the NAILSMA projects team.

Jessica Lew Fatt is responsible for providing high-level assistance to the Chief Executive Officer and general administration support to the alliance staff in its Darwin offices. The position will manage the diary, travel and other requirements of the Executive Officer from day to day and provide relevant support to the Operations Manager, Finance Officer and the NAILSMA team as required.

Lyndall McLean is the Bush Heritage Australia's (BHA) Indigenous Partnerships Officer for North Australia. Lyndall's main roles are to work with NAILSMA and Indigenous people to support the purchase of ecologically and culturally significant country, to support conservation management on land already owned and managed by Indigenous people; and to support the participation of Indigenous people in the management of Bush Heritage reserves. Lyndall's initial focus is on regions and projects where Bush Heritage already has partnerships (Cape York and North West Queensland, Kimberley and West Arnhem), but her role is also to work on development of new project areas in collaboration with NAILSMA staff.

Hugh Wallace Smith is the coordinator for the Indigenous Community Water Facilitator Network (ICWFN). His principle responsibilities include establishing a community based network of six facilitators to advance Indigenous engagement in research and management of tropical rivers, water use and conservation across northern Australia. The aims of the ICWFN are to act as a catalyst to ensure that Indigenous interests are articulated, encouraged and incorporated into water policy decisions, management plans and water allocations. Facilitators will be placed in the Ord and Fitzroy River catchments in Western Australia, Daly River Catchment in the Northern Territory and Gregory, Mitchell and Wenlock River catchments in Queensland.

Christine Michael is a Project Officer supporting the Tropical Rivers and Coastal Knowledge (TRaCK) research program and the Carbon Abatement Project. Her principle responsibilities include supporting the coordination of research activities under Theme 6 (Sustainable Enterprises) of the TRaCK research program. The TRaCK research program has been developed to acquire the knowledge needed to sustainably use and manage the north's river and coastal resources. Theme 6 of the TRaCK research program is investigating opportunities for sustainable enterprises, based around river resources and will include a number of case studies focused on the issues and impediments for sustainable water-based developments that exist for Indigenous communities, as well as analysis of water markets and property rights in relation to water.

Christine is also supporting NAILSMA's Carbon Abatement Project which is pursuing opportunities for Indigenous people to participate in the emerging carbon economy through strategic fire management activities which reduce greenhouse gas emissions. It is anticipated that the Carbon Abatement Project will also have significant biodiversity conservation outcomes as well as social, cultural and economic outcomes for Indigenous people in remote communities.

Future Directions

In 2008–09, the Communication Resources project will help produce the final outputs of the Centre, such as the major publications on fire management and vegetation management emerging from Theme 2. 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, Infonet, Land Manager and Savanna Explorer websites can be continued beyond 2009.

The Tropical Savanna Knowledge in Schools project will be producing further interactive modules for schools in 2008–09, which will cover topics like cattle country and Indigenous land management. This project will also be looking to secure funding arrangements so it can continue beyond the end of the CRC.

NAILSMA will complete the move from being administered by the TS–CRC to being administered by Charles Darwin 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

Output Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestones
Theme 1: Landscape Ecology and Health					
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		
Theme 2: Industry and Community Natural Resource Management					
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	Yes		
6.	Decision support systems are available to managers for strategic and tactical situations	30/06/2008	Yes		

Table 3 Research Outputs and Milestones Cont.

Output Milestone Number	Description	Contracted Achievement Date	Achieved (Yes or No)	Reasons why not achieved (if applicable)	Strategies to achieve unmet milestones
Theme 3: Regional Planning and Management					
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	Yes [in part]	A pathway for integration of various case studies and testing conceptual and decision-making models has been mapped.	Two integrating volumes will be completed during 2008/9. Their completion is not dependent on continued CRC funding.
Theme 4: Human Capability Development					
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	Yes		
6.	Capacity development opportunities are being utilized by indigenous people	30/06/2008	Yes		

Research collaborations

In 2007–08 most projects 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.

Collaboration with national bodies such as Land and Water Australia, Meat and Livestock Australia and the former Natural Heritage Trust is extensive and many draw on the Centre’s role as a major umbrella organization for NRM across a major part of the continent.

Collaboration with international bodies such as various Universities and The Nature Conservancy continues to be significant.

Collaboration between researchers and end users allows relationships to develop and learning to occur that ultimately enables research to be used effectively – this latter function being particularly important in 2007-08.

- A meeting of the North Australian Fire Managers Forum was held in May 2008 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.
- In February 2008 the Centre hosted a major forum on future management of the tropical savannas. It was the Tropical Savannas CRC’s final forum, to which all members — past and present — and friends of the Tropical Savannas CRC were invited. More than 160 people from across Australia attended the event, with representatives from the Centre’s stakeholders, partner agencies and researchers. This forum reviewed the lessons learned over the last 13 years from both rounds of the Centre and also assessed how this knowledge could be applied in the years ahead. <www.savanna.cdu.edu.au/news/futures_forum.html>
- In May 2008, The Centre held a symposium on *Managing fire regimes in north Australia’s savannas: Ecology, culture, economy*, presented draft chapters for a forthcoming book focusing particularly on the Western Arnhem Land fire project. The forum featured a number of presentations covering the social and ethnographic history of the region; fire and carbon sequestration; fire and biodiversity; fire, fuels and greenhouse gas emissions; the policy environment and ecological thresholds associated with fire impact. <www.savanna.cdu.edu.au/news/fire_forum_may08.html>
- 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.

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

Strategies and activities

The year 2007–08, the seventh year of the Centre, saw various commercialisation and utilisation highlights: continued growth in the use of research-based tools for fire management developed by the TS–CRC; significant prospects for employment opportunities abating GHG emissions across north Australia using these tools; uptake of tools for managing marine turtles and dugong; uptake of new tools used to manage biodiversity and riparian areas; continued uptake of tools used to manage grazing and weeds; growth in the uptake 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 can make a difference by enhancing 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.

Strategies

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.

Strategy 1: Build critical mass and end-user engagement by 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.

Strategy 2: Develop practical tools

One of the most effective ways of making research useful is to convert it into practical tools as suggested by research users. For example, the Centre's NAFI fire-tracking website <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.

Strategy 3: Invest in access to information and knowledge

Simple access to relevant Natural and Cultural Resource Management information and options is needed in many parts of remote and regional north Australia. In 2007–08 the Centre’s *North Australian Land Manager* website <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 TSM–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.

Strategy 4: Develop better education and training resources

Savanna researchers also need additional skills, such as the ability to engage more effectively with Indigenous communities and pastoral enterprises. The TS–CRC helped establish the Masters, Graduate Diploma courses and professional Doctorate in Tropical Environmental Management, which will continue after the CRC has closed. It not only allows agency staff enrolled in the courses to learn about the latest NRM research, but also exposes them to the issues and concerns of the varied group of research users in the savannas. The Professional Doctorate of Tropical Environmental Management, established at Charles Darwin University in 2006, offers those already working in tropical environmental management to gain a professional doctorate in their area of expertise. The doctorate has a research component, coursework, and a professional placement at one of the CRC’s partner agencies where candidates can conduct their research on the ground.

Over the course of the Centre’s life, its PhD program will produce more than 25 new researchers in tune with research users’ needs. Refer to the Education section, p. 45.

Strategy 5: Ensure access to information and knowledge resources is sustainable

CRCs have limited lives and it is important to ensure that the products and processes that are developed through the CRC and that are highly valued by end-users do not die with the CRC. Under normal circumstances 2007–08 would have been the final year of the TS–CRC, and although we have an extension until the end of 2009 strategies have already been put in place to ensure the core outputs of the CRC will continue.

- It is intended to set up a Savanna Communication Unit based at Charles Darwin University, and this unit will continue to maintain and develop web-based tools based on the *NAFI*, *Infonet* and *Land Manager* website technology. These sites already receive substantial funding from external sources and it is anticipated that
- This Unit will also maintain the *Environorth* and *Savanna Explorer* websites for schools and the general community, the CRC legacy site and distribute remaining publications.

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 2007–08

- The CRC has developed an innovative website for NRM planners in the Northern Territory which will be extended to applications in other jurisdictions. The *Infonet (NRM snapshot)* website <www.infonet.org.au> allows users to quickly generate material relevant to an area of their choice such as fire histories and associated graphs, management guidelines for threatened species likely to be found in their area, weeds lists and feral animal lists.
- The NAILSMA Turtle and Dugong Project helped develop *I-Tracker*, a network of Indigenous Land and Sea Managers and researchers who are working together to collect and share information for better land and sea management. *I-Tracker* is developing new tools, such as hand-help GPS units with suitable software for Indigenous land and sea managers, and training and support group to help

Indigenous Rangers and Traditional Owners to collect and manage information about natural and cultural resources across remote north Australia.

- A new module on north Australian bushfires for the *EnviroNorth* schools' website was launched in May 2008. *Burning Issues* features animation, engaging graphics and mini-movies on one of the most important forces that shapes the tropical savannas. It offers north Australian school students the opportunity, for the first time, to learn about the bushfires they see around them in a detailed, authoritative and stimulating format. See www.environorth.org.au/learn/burning_issues_learning_module.html

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

- A practical users' field guide for the Tropical Rapid Appraisal of Riparian Condition (TRARC) method to assess riverbanks was published and distributed to hundreds of land managers and planners.
- A weatherproof, species deck with practical guidelines on managing special plants and animals (threatened species) for land managers of Cape York Peninsula was published and distributed through local NRM groups to land managers in Cape York Peninsula.
- The Centre helped produce *Talking Fire - Burning for pastoral management in the Desert Uplands* a booklet for pastoralists that addressed the pros and cons of burning for pastoral management in the Desert Uplands region of Queensland. It outlines the existing knowledge of burning in the hope that graziers and other land managers will continue to use fire and develop a better understanding of its merits and consequences.
- The Centre also helped produce *Lost from our Landscape* a comprehensive compendium summarizing the conservation status and management advice for all threatened species in the Northern Territory.

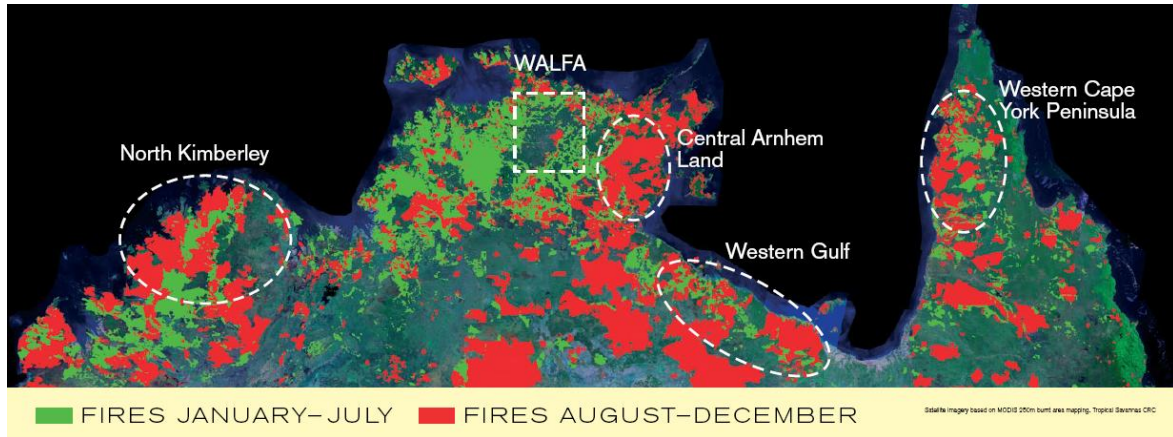
Outcomes

Continued success of the West Arnhem Land Fire Agreement and prospects for expanding this approach across north Australia

Now in its fourth year, this \$20M, 17-year agreement between the Darwin Liquefied Natural Gas (DLNG) consortium and Indigenous fire managers has dramatically reduced the incidence of wildfire across the Arnhem Land Plateau with consequent benefits to the significant natural and cultural values of this region. The fire managers have done this by implementing patchy burns across the landscape early in the fire season to reduce the fuel available for wildfires.

The project has also reduced greenhouse gas emissions equivalent to 420,000 tonnes of carbon dioxide. This equates to removing the emissions of around 28,000 cars from the roads for each of the last three years, making this one of the largest greenhouse gas abatement operations in Australia and it has been largely achieved by Indigenous rangers from some of the most disadvantaged communities in Australia.

In a significant development for north Australian Indigenous communities and their country, the model whereby payment for environmental services are gained through better management of bushfires, developed in the West Arnhem Land Fire Abatement Project (WALFA), is to be extended across far northern Australia. Indigenous land management groups, major companies and governments are investigating the feasibility of entering into similar Greenhouse Gas offsets agreements in five areas in the fire-prone savannas shown below.

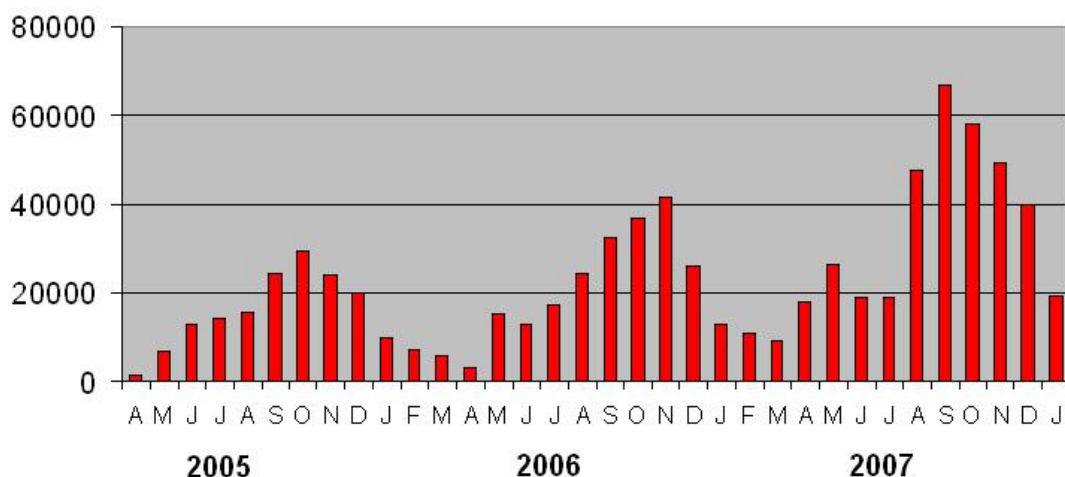


Like the WALFA project, these future projects will be underpinned by research and verification monitoring developed by the TS-CRC and partners like CSIRO, and the fire-tracking website <www.firenorth.org.au> also developed within the CRC which is used by the WALFA fire managers daily during the fire season.

Increased uptake of fire management tools across north Australia

Beyond the WALFA project, 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. The TS-CRC’s North Australian Fire Information (NAFI) fire-tracking website <www.firenorth.org.au> now plays a key role in improving fire management, being used by fire managers across the Kimberley, the NT and outback Queensland. The site has seen a consistent growth in use since its launch in 2004 as shown below.

Monthly map downloads for NAFI site



The latest example of how the NAFI website is being used to produce important NRM outcomes comes from the *EcoFire* project in the Kimberley. In this project, pastoral land managers from a range of cattle stations in the central Kimberley region are collaborating to reduce the incidence of destructive wildfires by putting in coordinated networks of fire breaks early in the northern fire season. The project, funded by the Rangelands

NRM groups and coordinated by the Australian Wildlife Conservancy, uses fire scars mapping from the NAFI site to plan its burning each year. See

<www.savanna.cdu.edu.au/publications/savanna_links_35.html?tid=592249>

Uptake by fire management policy-makers

The Federal Government's forthcoming *Carbon Pollution Reduction Scheme* (CPRS) and the associated Emissions Trading Scheme (ETS) is likely to have the most significant potential impact on fire management in north Australia, as the way fire management is treated by an ETS will affect the income generated by good fire management. The success of the WALFA Project and submissions and briefings by the TS-CRC and NAILSMA on fire management have produced a clear acknowledgement in the Draft Garnaut Climate Change Review and the CPRS Green Paper of the importance of savanna burning as a potential income source for Indigenous fire managers in the future.

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, which is run by the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) 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. For a summary of the project's progress in 2007–08 see p. 18.

Continued growth in use of Rapid Assessment techniques for Riverbank Monitoring

The Tropical Rapid Assessment for Riparian Condition (TRARC), developed by the TS-CRC supported Riparian Health Project, in increasingly being used across northern Australia and is being recognised nationally:

- The TRARC was recognised by the National Framework for the Assessment of River and Wetland Health as a suitable methodology for reporting on river health in the Northern Territory.
- The Aquatic Health Unit (NRETA, NTG) used TRARC to establish monitoring sites in the Fenton River Catchment, NT.
- The TRARC was used for ground surveys in the Gilbert and Mitchell River catchments, Queensland: *Development of a Riparian Condition Assessment Protocol for Northern Gulf Rivers using Remote Sensing and Ground Survey*. July 2008 Report prepared by Andrew Brooks and Jon Knight, Griffith University
- The Coastal Research and Management Project Marine and Coastal Environment Group, Geoscience Australia, conducted a TRARC survey in the Prince Regent Nature Reserve (Kimberley Region, WA) to record impacts from feral animals and weeds.
- Greening Australia NT trained CDU Conservation and Land Management students to perform TRARC in Darwin's rural area.
- TRARC is now included as a practical activity for Year 12 Sustainable Futures students at Casuarina Senior College.

Uptake of techniques and options for managing biodiversity

A range of guidelines for managing biodiversity are now available through the north Australia Land manager website <www.landmanager.org.au> and these are now being used by NRM groups and land managers across north Australia. Use of the land manager website has grown consistently in 2007–08, particularly by regional NRM groups and NRM agencies and on-ground land managers. Web statistics show that one of the most used areas of the site are the management guidelines and information links the site provides for all problem weeds, pest animal species and threatened species in north Australia. A deck of management guidelines for "Healthy Country Indicator Species" (rare or threatened species) in Cape York Peninsula, produced by the TSCRC, The CYP Landcare Program and the Cook Shire in 2007-08 is now being used by Cape York land managers.

Uptake of techniques and options for sustainable grazing management

Two tools that assist grazing land management in the savannas, *Veg Machine* (a computer based savanna cover change analysis tool), and a *Carrying Capacity Estimator for the Northern Territory* are now being used by pastoral managers in the Northern Territory, many of whom were involved in the development of these tools, which has been supported by the TS-CRC. The TS-CRC continues to provide information for Grazing Land Management packages, collaborating with Meat & Livestock Australia, which are delivered in workshops across north Australia. For example, hundreds of copies of the TS-CRC *Perspectives on Managing grazing country* publications have been used in these workshops.

Use of findings from the Healthy Savanna Planning Systems Project

In planning for the third implementation of the Natural Heritage Trust, the Caring for Our Country Program, the Commonwealth, States and Territories will draw heavily on reviews of performance and already some of the outputs from the TS-CRC *Healthy Savanna Planning* Project appear to have influenced project evaluation strategies.

Use of Educational Material in schools

Use of the *EnviroNorth* website and interactive learning modules (*Savanna Walkabout* and *Burning Issues*) by primary and lower secondary schools throughout the Northern Territory continued to grow in 2007–08. The interactive modules have now been included in pre-service teacher training education units at Charles Darwin University. These modules have also been included as resources in teachers' networks in Queensland (particularly through the *Primary Connections* science program) and Western Australia (including Katherine and the Kimberley Schools of the Air). The site also attracted interest from other Australian states. The website and modules were produced by the *Tropical Savannas Knowledge in Schools* project. 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. 21.

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 commercialisation are premised on the research and adoption achieved through participative projects. For example, the TS–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. 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 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

- 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.
- In total the benefits due to the CRC's fire management research total \$120.5 million over the next 20 years.

The CIE Report did not include a thorough assessment of the impact of the more recent WALFA project. This project is supported by TS-CRC research and tools is delivering around \$1M a year to Indigenous ranger groups in Arnhem Land with flow-on social and economic benefits which include facilitating the establishment of Indigenous NRM enterprises; the improvement of English language skills and cross-cultural confidence; the transfer of Indigenous Knowledge between generations; and regional collaboration. The successors to the WALFA project promise to deliver even greater benefits given the greater numbers of Indigenous people involved in some of these new areas and the expected higher returns per unit of greenhouse gas abated compared to that negotiated for the WALFA project.

There are also likely to be long-term benefits for the community, tourism and environmental services from enhancing efforts to conserve of biodiversity

Impact of publications across the savannas – publication downloads more than doubling

The TS-CRC plays a key role in synthesising NRM knowledge from across north Australia and making it easily accessible to end-users. In 2007–08 more than 2400 hard-copy publications based on TS-CRC research were sold and more than 3100 distributed free (excluding Annual Reports and newsletters). The great majority of the CRC's publications, however, are downloaded from our websites. In 2007–08, more than 820 publications (a variety of reports, articles, newsletters and information sheets) were downloaded from websites hosted by the CRC—*Savanna Explorer*, *North Australian Land Manager*, *EnviroNorth*, *NAILSMA*, and the *Tropical Savannas CRC* site—with the number of downloads reaching more than 80,000. This is around two and a half times the downloads in the previous year.

Research findings also available on websites aimed at land managers and schools. These new sites <www.landmanager.org.au> and <www.environorth.au> are showing good growth in usage and are contributing to the growth in publication downloads.

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
Pastoral industry sector								
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
Conservation interest groups								
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				✓				
Mining industry sector								
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
Mining industry sector.								
Ergon Energy				✓				
Nabalco				✓				
Aboriginal community groups								
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
Aboriginal community groups								
Central Land Council				✓				
Torres Strait Regional Authority			✓	✓				
Tourism industry sector								
Northern Gateway Pty Ltd				✓				
Probe	✓			✓				
Tour Guides Association NT				✓				
Savannah Guides Ltd				✓				
Gulf Local Authorities Development Association				✓				
Undara Experience				✓				
Tourism Queensland				✓				
Funding agencies								
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)				✓				
Funding agencies cont.								
Rural Industries Research Development Corporation				✓				
Bureau Resource Sciences				✓				
Australian Research Council				✓				
Natural Heritage Trust				✓			✓	
Government agencies								
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
Government agencies cont.								
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
Government agencies cont.								
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	✓	✓	✓	✓		✓		
Cooperative Research Centres								
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
Cooperative Research Centres								
CRC for Aboriginal and Tropical Health				✓		✓		
CRC for Desert Knowledge			✓	✓				
CRC for Sustainable Tourism				✓				
CRC for Weed Management			✓	✓				
Community groups and professional bodies								
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
Community groups and professional bodies								
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
Community groups and professional bodies								
Victoria River District Regional Bushfire Council Committee				✓				
Roper River Landcare Group				✓				
Coastcare				✓				
Burdekin Rangelands Strategy Implementation Group				✓				
NRM Board of the NT				✓	✓			
Southern Gulf Catchments Inc.				✓				
WA Rangelands Regional Group				✓				
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
Community groups and professional bodies								
Northern Territory Chamber of Commerce				✓				
Centralian Land Management Association				✓				
Karumba Progress Association				✓				
Educational institutions								
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
Educational institutions								
Central Queensland University				✓				
Batchelor Institute of Indigenous Tertiary Education	✓			✓		✓		
Murdoch University	✓			✓				
University of Adelaide				✓				
South Australian Museum				✓				
International collaboration								
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
International collaboration								
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

The Education and Training Program wound up in 2006-07 with the administration of the courses it has developed in Tropical Environmental Management being taken over by Charles Darwin University. Nine PhD students are yet to submit their theses.

Recruiting and supervising PhD and masters students

The TS-CRC is on target with Higher Degree by Research (HDR) student recruitment overall. No new students were recruited in 2006-07 or 2007-08. The TS-CRC recruited 33 new HDR students (above the target). Of these, 17 have now either submitted or lodged their theses and six have withdrawn during the last five years for reasons (including health, other professional and family commitments (Appendix 2, Table 7, p. 55).

Almost all HDR students had been involved in part-time or short-term employment contracts. 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 had at least one industry supervisor (Appendix 2, Table 7,) although in some cases supervisors have moved either to or from academia during the student's candidature.

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. 23.)
- Researchers participating in education and extension project activities. See Figure 5, p. 48 Number of non-university or collaborative staff involved as supervisors.
- Figure 6 p. 49, and Table 8 (Appendix 3) p. 60, 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 2400 hard-copy publications were sold and more than 3,100 distributed free in 2007–08 (excluding Annual Reports and newsletters). In 2007–08, more than 820 publications (a variety of reports, articles, newsletters and information sheets) were downloaded from websites hosted by the CRC—Savanna Explorer, Land Manager, EnviroNorth, NAILSMA, and the CRC site—with the number of downloads reaching more than 80,000.
 - Research findings also available on newly developed websites aimed at land managers and schools. These new sites <www.landmanager.org.au> and <www.environorth.au> are showing good growth in usage and have contributed to the high number of publication downloads.
- Uptake of outputs (for more details see Commercialisation and Utilisation, p. 24):
 - Feedback from users and website usage indicates that the CRC's NAFI website <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 17 years at over \$1M a year.

Education and Training

- The education program is now completed.
- Four enrolled candidates in the Professional Doctorate of Tropical Environmental Management in 2007–08 and several inquiries, including from overseas students.
- A total of 33 research students have received support from the TSM–CRC, as either full scholarships, top-up scholarships or operational support. See Figure 7 (p. 49) and Table 7 (p. 55) on the number of postgraduate students. Of these six have withdrawn, 17 graduated or have theses under examination, with a further 10 expected to graduate over the next few years. Eighteen of these students secured employment related to their studies, almost all in industry-related positions.

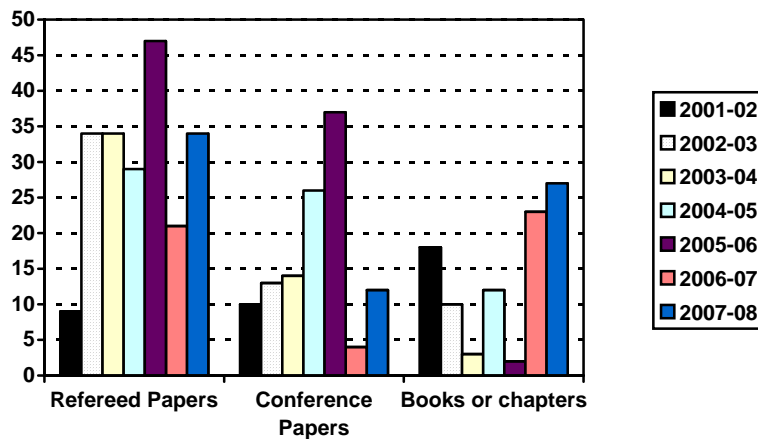
Collaborative Arrangements

- 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 for 2008 included)

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

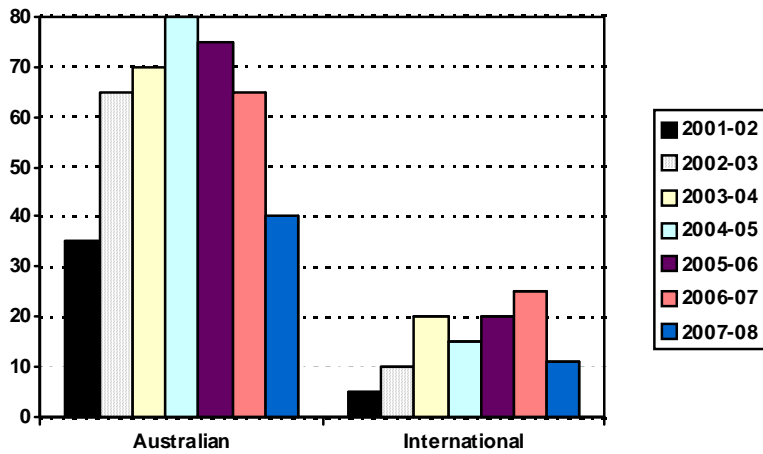


Figure 4 Awards and invited papers

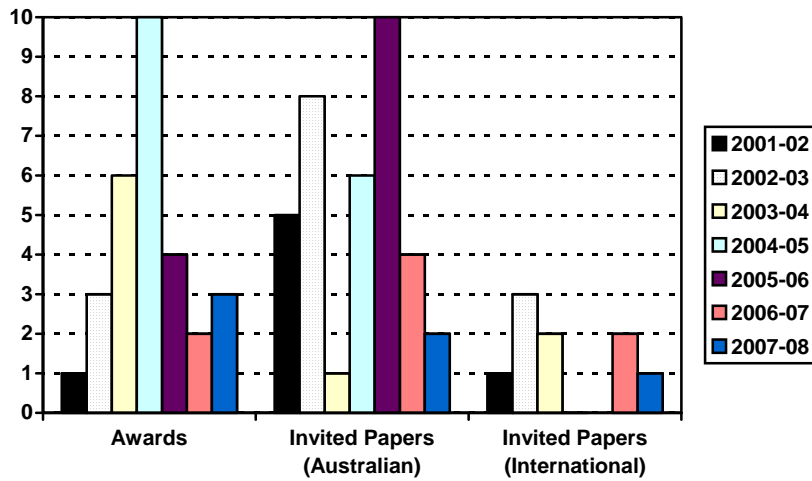


Figure 5 Number of non-university or collaborative staff involved as supervisors Higher education program now completed.

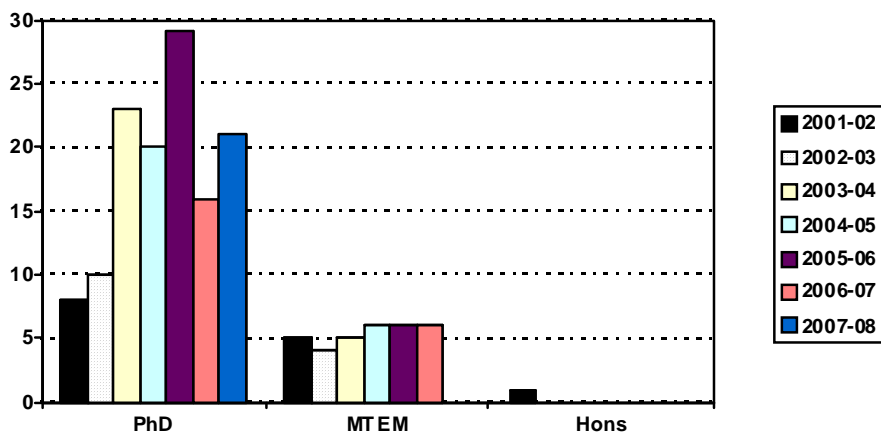


Figure 6 Media Recognition

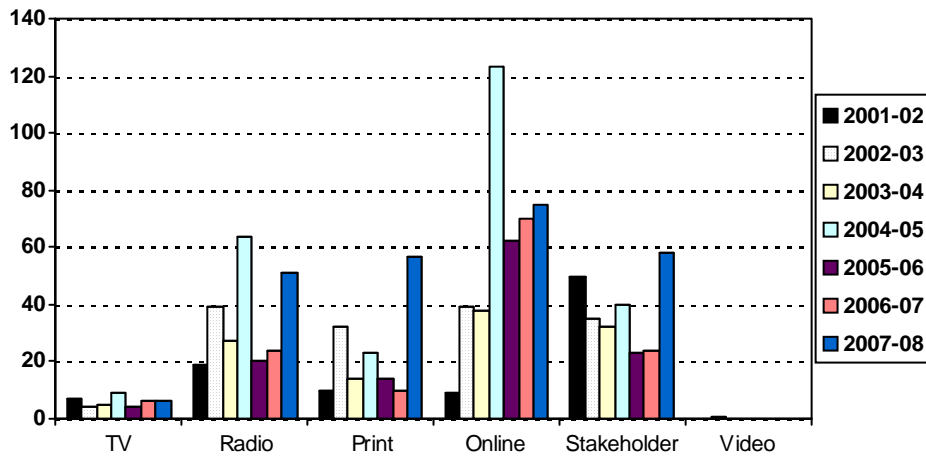
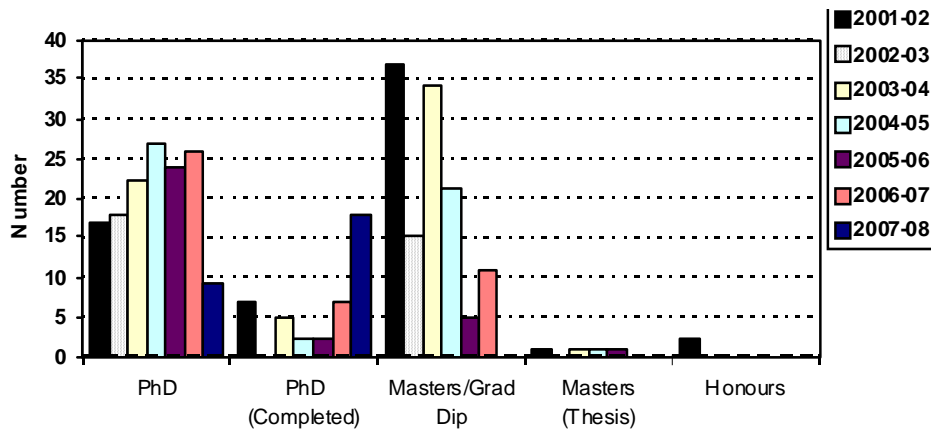


Figure 7 Number of Postgraduate Students *
Higher education program now completed.



* Masters thesis upgraded to PhD during 2003.

* Six PhD students have withdrawn since 2005

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 NOW:
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
TSM-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	\$547,000 Dec 06 – April 10
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 08
1	Government	P Jacklyn TS-CRC	Web based Mapping of Biodiversity and Feral Information	NRMB	\$279,000 July 06 – June 08
1	Government	J Russell-Smith TS-CRC	Estimating Greenhouse Gas Emissions	NHT	\$135,000 Jan 06 – June 08
1	Government	J Woinarski TS-CRC	Defining Successional Patterns & Biodiversity Values of North Australian Eucalypt Forests	LWA	\$143,900 June 06 – March 08
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 TSM-CRC / NT BFC	Improving Greenhouse emissions estimates associated with savanna burning in the Northern Territory	Greenhouse Office	\$400,000 May 05–Jun 08
1	Government	G. Duff, TS-CRC	Dugong and marine turtle management	NHT	\$4,150,000 Jan 05–Dec 08
1	Government	D. Garnett TS-CRC	Dugong and Marine Turtle Supplementary Funding for TSRA	NHT	\$700,000 Nov 06 – Sept 08
1	Government	P Jacklyn, TS-CRC	Web Based Decision Support Tool	NRMB	\$95,000 April 08 – Dec 08
1	Government	P Jacklyn, TS-CRC	Support for Northern NRM Website	NRMB	\$75,000 July 07 – June 08

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

APPENDIX 2 EDUCATION

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
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
Kristine Brooks	CDU	03/03/04	03/03/04	01 Jul 08	S Setterfield (CDU) M Douglas (CDU) B Grace (NT NRETA)	Evaluating exotic grass management in terms of native vegetation restoration
Caroline Chong	JCU	01/04/03	31/03/04	02 Jul, 08	M Waycott (JCU) W Edwards (JCU) R Pearson (JCU) G Morgan (QEPA)	Regeneration dynamics of Melaleuca in a disturbance-prone riparian environment
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
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
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>)

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
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
Kasper Johansen	UQ	102/02/04	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
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
Eva McRae-Williams	CDU	27/07/05	27/07/05	Sept/Oct 08	Kate Senior (Menzies, CDU), Rolf Gerritsen (TSM CRC) David Mearns (CDU)	Obligations, Opportunities and Outcomes of Training Programs: A Ngukurr Case Study
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
Lionel Pero	UQ	17/03/03	03/03/03	01 Nov, 06	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

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
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
Euan Ritchie	JCU	01/07/02	01/07/02	01 Nov, 06	C Johnson (JCU) A Krockenberger (JCU) S Garnett (CDU)	The ecology and conservation status of a tropical kangaroo: the Antilopine Wallaroo (<i>Macropus antilopinus</i>) on Cape York Peninsula
Natalie Rossiter	CDU	04/03/02	09/02/04	10 Dec, 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-08	R Noske (CDU) J Woinarski (NT DIPE)	Responses of wildlife to environmental variation and land use in Lautern District, Timor-Leste (East Timor)
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

Table 7 Details of HDR student progression

(B) CANDIDATES WHO ARE YET TO SUBMIT						
Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
Gillian McCloskey	CDU	05/03/04	05/03/04	31 Jul, 08	G Boggs (CDU) M Douglas (CDU) J Ludwig (CSIRO) B Wasson (CDU)	Indicators of riparian health in tropical savannas: impact of domestic livestock
Jenny Brazier	CDU	17/06/03	03/03/04	TBA	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
Nicole Cranston	CDU	14/03/03	14/03/03	Withdrawn	M Douglas (CDU) A Fisher (NT DIPE) S Setterfield (CDU)	The effectiveness of riparian fencing for biodiversity conservation
Michelle Watson	CDU	05/02/01	05/02/01	LOA	P Whitehead (CDU) J Woinarski (NT DIPE)	Faunal responses to alteration in plant community structure in tropical savannas
Christopher Holloway	JCU	04/02/04	01/07/04	02 Feb, 11	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		26 Jun, 09	D Gillieson (JCU) P Novelty (AgWA)	Kuku-Thaypan fire management research project. The importance of campfires to effective conservation.
Steve Johnson	UQ	02/07/01	01/07/02	TBA	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

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	PROPOSED Submission date	Supervisors	Project Title
(B) CANDIDATES WHO ARE YET TO SUBMIT						
Elizabeth Poon	UQ	17/03/03	03/03/03	31-Jul-09	S Schmidt (UQ) J Ludwig (CSIRO) 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
Mark Ziembicki	UAdel.	31/03/01	01/07/02	TBA	D Paton (Uni. of Adelaide) J Woinarski (NT DIPE)	Ecology and conservation of the Australian Bustard (<i>Ardeotis australis</i>) in northern Australia

APPENDIX 3 COMMUNICATION

In 2007–08 the Centre hosted a major forum on future management of the tropical savannas and a symposium on fire management in the savannas.

The forum on future management was the Tropical Savannas CRC’s final forum, held in February 2008, to which all members — past and present — and friends of the Tropical Savannas CRC were invited. More than 160 people from across Australia attended the event. This forum reviewed the lessons learned over the last 13 years from both rounds of the Centre and also assessed how this knowledge could be applied in the years ahead. What is the future for Australia’s tropical savannas?

The day was organised into four sessions reflecting the research Themes of the Tropical Savannas CRC. Each session featured four talks and slideshows covering a different aspect of that theme. A panel discussion followed each session.

<www.savanna.cdu.edu.au/news/futures_forum.html>

The fire symposium, *Managing fire regimes in north Australia’s savannas: Ecology, culture, economy*, presented draft chapters for a forthcoming book focusing particularly on the Western Arnhem Land fire project.

Held in May 2008, the forum featured a number of presentations covering the social and ethnographic history of the region; fire and carbon sequestration; fire and biodiversity; fire, fuels and greenhouse gas emissions; the policy environment and ecological thresholds associated with fire impact.

<www.savanna.cdu.edu.au/news/fire_forum_may08.html>

The Centre’s annual North Australian Fire Managers Forum was also held in May 2008 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 TSM–CRC, the Bushfires CRC, WA Department of Land Information and Geoscience Australia who are major research providers.

Centre project staff were active in outreach activities with a range of end-users, at field days, open days, seminars and workshops.

Table 8 Public relations and communication: Media coverage

Topic/subject	TV	Radio	Print	Online	Stakeholder newsletter
New publications: Nature of Northern Australia, Lost from our Landscape	5	45*	45*	45*	45*
West Arnhem Land Fire Abatement Project Eureka Prize	1	2	8	14	1
Fire knowledge project; North Australian Fire Information website; Fire research, national and international			1	2	1
Biodiversity in northern Australia: Research, impacts and management		2		5	3
Threatening processes; Impacts of weeds, fire			3	4	1
Soil biota, nutrients and landscape health				2	2
Knowledge building in northern Australia, Tropical knowledge for schools, EnviroNorth website		1		3	2
Resources, economic health and ecosystem services of Northern Australia, carbon		1		4	3
Total	6	51	57	75	58

* The *Nature of North Australia* book received 180 items of media coverage – but breakdown across media was not available, so the breakdown has been evenly allocated.

APPENDIX 3 COMMUNICATION

Publications

Refereed papers

- Barrett, D., Renzullo, L.J., Guerschman, J., Hill, M.J. 2007, 'Multi-sensor model-data assimilation for improved modeling of savanna carbon and water budgets,' *EOS Transactions, American Geophysical Union* 88 (52), Fall Meeting Suppl., Abstract B21B-08.
- Brooke, M, de L., Butchart, S.H.M, Garnett, S.T., Crowley, G.M., Mantilla-Beniers, N.B. & Stattersfield, A.J. 2008, 'Rates of movement of threatened bird species between Red-List categories and toward extinction' *Conservation Biology* 22, 417–427.
- Collins, J., Hutley, L.B., Williams, R.J., Boggs, G., Bell, D., Bartolo, R. 2008, '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* (in press)
- Cook, G.D., Williams, R.J., Stokes, C., Hutley, L.B., Ash, A.J. in press, 'Managing sources and sinks of greenhouse gases in Australia's rangelands and tropical savannas', *Rangeland Ecology and Management*.
- Crowley, G.M. 2008. Cockatoo Grass *Alloteropsis semialata* as a keystone species in northern Australia. *Northern Territory Naturalist* 20, 58–63.
- Crowley, G.M., Garnett, S.T. and Shephard, S. (in press), Impact of storm-burns on *Melaleuca viridiflora* invasion of grasslands and grassy woodlands on Cape York Peninsula, Australia. *Austral Ecology*.
- Dawes-Gromadzki, T. Z. 2008, 'Abundance and diversity of termites in a savanna woodland reserve in tropical Australia', *Australian Journal Entomology*. (in press)
- Dawes-Gromadzki, T.Z. 2007. Short-term effects of low intensity fire on soil macroinvertebrate assemblages in different vegetation types in an Australian tropical savanna. *Austral Ecology* 32, 663–668.
- Drucker, A.G., Garnett, S.T., Luckert, M.K., Crowley, G.M., Gobius, N. (in press). Manager-based valuations of alternative fire management regimes on Cape York Peninsula, Australia. *International Journal of Wildland Fire*.
- Edwards, A.C. & Russell-Smith, J.R.S. 2008, 'Ecological thresholds and the status of fire-sensitive vegetation in western Arnhem Land, northern Australia: implications for management,' *International Journal of Wildland Fire*, in press.
- Garnett, S.T. & Crowley, G.M. (in press), 'The history of threatened birds in Australia and its offshore islands,' *Contributions to the History of Australasian Ornithology. Memoir Series of the Nuttall Ornithological Club*.
- Fensham, R.J., Bray, S.G. & Fairfax, R.J. 2007, 'Evaluation of aerial photography for predicting trends in structural attributes of Australian woodland including comparison with ground-based monitoring data', *Journal of Environmental Management*, 83: 392–401.
- Hannah, D., Woinarski, J.C.Z., Catterall, C.P., McCosker, J.C., Thurgate, N.Y., & Fensham, R.J. 2007, 'Impacts of clearing, fragmentation and disturbance on the bird fauna of eucalypt savanna woodlands in central Queensland, Australia', *Austral Ecology*, 32, 261–276.
- Hunt, L.P., Petty, S., Cowley, C., Fisher, A., Ash, A.J. & MacDonald, N. 2007, 'Factors affecting the management of cattle grazing distribution in northern Australia: preliminary observations on the effect of paddock size and watering points', *The Rangeland Journal*, 29, 167–179.
- Krull, E.N., Bray, S., Harms, B., Baxter, N., Bol, R. & Farquar, G. 2007, 'Development of a stable isotope index to assess decadal-scale vegetation change and application to woodlands of the Burdekin catchment, Australia', *Global Change Biology*, 3(7):1455–1468.

- Kutt, A.S. & Woinarski, J.C.Z. 2007, 'The effects of grazing and fire on vegetation and the vertebrate assemblage in a tropical savanna woodland in north-eastern Australia', *Journal of Tropical Ecology*, 23:95–106.
- Kutt, A.S. & Woinarski, J.C.Z. 2007, '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*, 23, 95–106.
- Lehmann, C.E.R., Prior, L.D., Williams, R.J. & Bowman, D.M.J.S. 2008, 'Spatio-temporal trends in tree cover of a tropical mesic savanna are driven by landscape disturbance', *Journal of Applied Ecology* 45, 1304–1311.
- Liedloff, A.C. & Cook, G.D. 2007, 'Modelling the effects of rainfall variability and fire on tree populations in an Australian tropical savanna with the FLAMES simulation model', *Ecological Modelling*, 201:269–282.
- Lindenmayer, D., Hobbs, R.J., Montague-Drake, R., Alexandra, J., Bennett, A., Burgman, M., Cale, P., Calhoun, A., Cramer, V., Cullen, P., Driscoll, D., Fahrig, L., Fischer, J., Franklin, J., Haila, Y., Hunter, M., Gibbons, P., Lake, S., Luck, G., MacGregor, C., McIntyre, S., Mac Nally, R., Manning, A., Miller, J., Mooney, H., Noss, R., Possingham, H., Saunders, D., Schmiegelow, F., Scott, M., Simberloff, D., Sisk, T., Tabor, G., Walker, B., Wiens, J., Woinarski, J.C.Z. & Zavaleta, E. 2007, 'A checklist for ecological management of landscapes for conservation', *Ecology Letters*, 10.
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* Invited

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