



TROPICAL SAVANNAS CRC

Cooperative Research Centre for Tropical Savannas Management

ANNUAL REPORT

2005–06



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

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

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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

Early in the year we lost a true champion of the CRC with the death of Dr John Vercoe, who was Chair of the Scientific Program Advisory Group (SPAG). His wisdom and vision for the CRC were greatly appreciated and his influence will live on in the achievements of the current CRC.

The year was dominated by continuing success with current projects, both internal and external, coupled with significant effort put into assembling our business case to support funding of the CRC for a third term. Independent reviews were carried out by both SPAG and the Centre for International Economics (CIE). They found that the Tropical Savannas CRC demonstrated its worth in a range of different ways, contributing directly to the economic, ecological and social sustainability of a number of different savanna sectors, and creating strong linkages amongst them. The TS–CRC enjoys an enviable reputation and demonstrable track record, reinforced by successive independent reviews, for its role as a knowledge broker, and for excellent communication and networking. This notable feature has proved critical for the delivery of outcomes to a vast landscape with a sparse and widely scattered population. The continued development of North Australia Indigenous Land and Sea Management Alliance (NAILSMA) has been a highlight, generating new partnerships and leveraging substantial new funding for Indigenous capacity building, enterprise development and natural resource management on Indigenous lands.

Tools and strategies developed by the TS–CRC for the pastoral industry are being adopted at an accelerating rate. Grazing management strategies, remote sensing tools to assess pasture condition, decision support tools for determining carrying capacity and evaluating risk, and promotion of best-practice natural resource management have all contributed and independent evaluation has shown there is a first order, net present value contribution to the industry of \$59 million resulting from these projects in the current term of the CRC. In addition, these activities led to a greater appreciation within the industry of the importance of sustainable natural resource management, and to a wider appreciation of the positive role played by the industry in stewardship of these resources.

The TS–CRC’s role in defining best practice fire management, and delivery of information products such as the North Australian Fire Information website (which provides real-time, satellite derived information on the location of fires across the north), and in building cross-jurisdictional and multi-sectoral networks, has profoundly changed the face of fire management in northern Australia in the past 10 years. The recent CIE analysis conservatively estimates the net present value contribution of these activities at \$108 million, not counting a wide array of second order benefits including biodiversity conservation, Indigenous employment, and substantial cost offsets for State and Territory governments.

TS–CRC research linking wildfire management to greenhouse gas mitigation, biodiversity conservation and Indigenous employment resulted in a \$22 million, 20-year “payment for environmental services” contract between the private sector, government and Aboriginal organisations—the first of its kind nationally, and the first involving fire management in the world. The program also heralds several similar, but potentially larger, programs in the Kimberly, Gulf of Carpentaria and Cape York.

Other TS–CRC products that were adopted and are in current use include: Weed risk assessment tools; tools for assessment of riparian condition; guidelines for regional natural resource management planning; and cost-effective biodiversity monitoring strategies.

It is encouraging to note the conclusions of SPAG, who found that:

Without doubt, the TS–CRC has been the most successful government initiative in the development of northern Australia. It has evolved from a collection of unconnected mainly ecological projects into an integrated R&D program with international stature, the support of many partners who now include the corporate sector, and the respect of stakeholders.

Within the current phase of the TS–CRC, the original goals have been achieved and extended to meet newly defined needs and to energise the research team, including many post graduate students. In doing so, the TS–CRC has a presence in the savannas region that can serve to both progress the economic development of the area, to advance the status of Indigenous people and to provide a structure and network to support and secure Australia’s northern interface with Asia and the world. This is all work that should continue.

Prof. Gordon Duff, Tropical Savannas CRC, Charles Darwin University

Governance, Structure and management

Structure

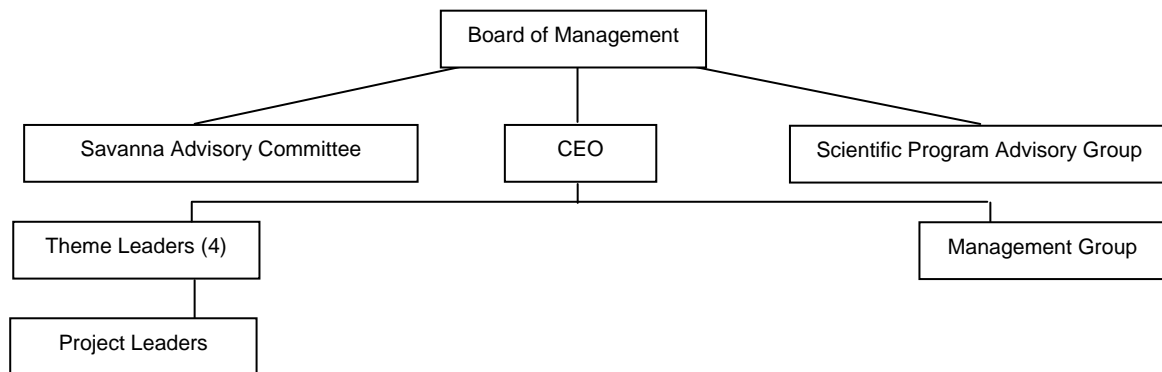
The sustainable use and conservation of northern Australia is the focal point of the TS–CRC. The Centre is an unincorporated joint venture between the Commonwealth and the partner agencies listed below:

- 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.

The Board of Management met three times during the past year. The meetings took place in Cairns in October, in Darwin in March 2006, and in Cairns during June 2006. These meetings were held consecutively with SAC meetings. The independent chair of the Board of Management is **the Hon. John Kerin**.

Membership as at 30 June 2006

Representatives from the TS–CRC partner agencies

Dr David Ritchie , Northern Territory of Australia	Dr Greg Robbins , State of Queensland
Dr Renata Paliskis-Bessel , State of Western Australia	Prof. Bob Wasson , Universities
Dr Andrew Johnson , CSIRO	Dr Anne-Marie Delahunt , Parks Australia North

Stakeholder representation

Mr Darryl Pearce (Chair, Savanna Advisory Committee)	Dr Barry Traill TWS (Conservation sector)
Mr Peter Yu , NAILSMA (Indigenous sector)	(Mining sector) Vacant following the relocation and resignation of Mr Craig Stewart
Mr John Courtenay , Probe (Tourism sector)	Mr Tom Stockwell , NABRC (Pastoral sector)

Savanna Advisory Committee

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 formally contribute to strategy and program development through the SAC. This Committee is established by, and reports to, the Board of Management. The Committee met three times during the past year in Darwin and Cairns.

Membership as at 30 June 2006

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

Scientific Program Advisory Group

The Scientific Program Advisory Group (SPAG) conducted part of the Fifth year review of the CRC in February 2006, and provided a report to the Board on the CRC's achievements, challenges and future directions.

Membership as at 30 June 2006

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

Management Group

After 2004, the research portfolio for the CRC was largely finalised and consolidated, so the important project development and review role played by the Management Group became 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. Members of the Management Group continued to participate in CRC wide planning and communication meetings such as the annual meeting and review conducted in February 2006.

Membership as at 30 June 2005:

Prof. Stephen Garnett CDU, Darwin, NT	Dr Mick Quirk , QDPI, Brisbane, Qld
Prof. Gordon Duff CEO TS-CRC, Darwin, NT	Dr Paul Novelly , Dept. Agriculture WA, Kununurra, WA
Mr Brent Williams , DNRETA, Darwin, NT	Mr Brian Slatter , TS-CRC, Darwin, NT
Mr Joe Morrison , NAILSMA, Darwin, NT	Prof. Ockie Bosch , UQ, Gatton, Qld
Mr Jim Davis , Balkuna Cape York Development Corporation, Cairns, Qld	Dr Peter Whitehead , DNRETA, NT Govt
Dr Alan Andersen , CSIRO SE, Darwin, NT	Dr John Woinarski , DNRETA, Darwin, NT
Dr Peter Jacklyn , TS-CRC, Darwin, NT	Dr Penny Wurm , TS-CRC, Darwin, NT
Dr John Ludwig , CSIRO SE, Atherton, Qld	Dr David Garnett , TS-CRC, Darwin, NT

Context and major developments during the year

There were three key developments in the TS–CRC’s operating environment in 2005–06:

- Several regional NRM boards in northern Australia started implementing their NRM plans in 2005–06 under the Natural Heritage Trust process. These bodies are key users of the Centre’s outputs and consequently a number of the Centre’s research outputs were incorporated in the NRM plans. The Centre was also contracted to implement aspects of these plans.
- There was an increasing interest by industry and government in Indigenous owned and/or operated pastoral enterprises. The Centre is well placed to capitalise on this development having completed a major project with Land and Water Australia to help Indigenous pastoral enterprises in the east Kimberley develop economically, culturally and environmentally sustainable operations and planning (see page 22). The Centre has now created closer links with bodies like the Indigenous Land Corporation.
- The higher profile of issues around climate change and greenhouse gas offsets in 2005–06 helped the Centre enter into constructive discussions with industry about NRM-based offset arrangements in northern Australia following the example set by Darwin Liquefied Natural Gas Pty Ltd (see p. 7.)

The key staff appointment in the year was that of Dr Rolf Gerritsen, who came to the CRC from the Northern Territory Government in June 2006 to lead two projects in the Regional Planning and Management area, and to contribute economic expertise to group of externally funded projects. Dr Gerritsen’s appointment underlines the increasing importance of social and economic research in the Centre.

Commercialisation, technology transfer, utilisation

Commercialisation / Utilisation Strategies and activities

The year 2005–06, the fifth year of the Centre, saw a major advance in commercialisation with the finalisation of a multi-million dollar fire management and greenhouse gas offset agreement. Major energy consortium, Darwin Liquefied Natural Gas (DLNG), in an agreement with the Northern Territory Government, the Northern Land Council and Aboriginal Traditional Owners will fund Indigenous fire management in the tropical savannas in return for the reduction in greenhouse gas emissions. Such reductions will be offset against the corporation's own emissions. This agreement was underpinned by TS–CRC research and TS–CRC utilisation strategies.

This agreement reflects some key goals of the CRC:

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

To achieve these goals, however, some key challenges in the tropical savannas need 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 SMEs such as pastoral enterprises or indigenous land management corporations, are also isolated and do not have the access to information and expertise that allow them to use new research products effectively.
- This isolation is exacerbated by the cultural gulfs that often exist between researchers and the varied mix of research users.
- Researchers and research users have to deal with new, emerging natural resource management issues which have not been the subject of major research efforts.

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

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

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

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

Investing in access to information and knowledge. Even relevant and practical research findings can end up on the shelf if the users and researchers do not have the capacity to ensure those findings are used effectively—and many savanna communities and researchers lack such capacity. User needs include better access to NCRM (Natural and Cultural Resource Management) options from across the tropical savannas and in 2005–06 the Centre developed a Land Managers' website that will help meet this need.

Often a greater need for research users is the capacity to use their own local knowledge systems more effectively, for example in many indigenous communities there is a desire to have traditional NCRM knowledge more effectively passed on to the younger generation, and in many pastoral SMEs people

want to be able to use their own and other pastoralists' local knowledge more effectively. This means that the TS–CRC uses people skilled in building such capacity in SMEs (for example in the *Indigenous Ecological Knowledge Project*, the *Integrating Research with Land and Sea Management Project* and the *Beef Industry Best Practice Project*) as well as using people skilled in brokering research know-how.

Developing practical tools. One of the most effective ways of making research useful is to convert it into practical tools useful to research users. For example, rather than just publish guides on how to use satellite information in tracking fires, the TS–CRC has created a website that allows users with slower connections to track fires from their own properties and communities (see below). These tools feature integrated research findings and knowledge that could not be created easily by individual partner agencies.

Developing better education and training. Savanna researchers also need additional skills, such as the ability to engage more effectively with indigenous communities and pastoral enterprises. The TS–CRC offers Masters and Graduate Diploma courses in Tropical Environmental Management that not only allows agency staff to learn about the latest NRM research, but exposes them to the issues and concerns of the varied group of research users in the savannas. The Centre's PhD program aims to produce new researchers in tune with research users' needs. Refer to the Education section, p. 35.

Outcomes

West Arnhem Land Fire Agreement

This is a ground-breaking commercialisation arrangement in which research coordinated by the TS–CRC underpinned a contract between the NT Government and the Darwin Liquefied Natural Gas (DLNG) consortium in which DLNG will pay over \$1M a year over the next 17 years to Indigenous land managers in western Arnhem Land to manage fire more effectively. By implementing patchy burns across the landscape the aim of the funding is to better protect the Arnhem Land plateau from the wildfires that occur late in the year by breaking up the fuel available for these destructive fires—limiting wildfires will in turn reduce the emission of greenhouse gases from that landscape which will offset greenhouse gas emissions from the Darwin LNG plant.

The TS–CRC will be contracted to monitor and report on greenhouse gas emissions during the agreement. Research coordinated by the TS–CRC and involving CSIRO, Bushfires NT, AGO, DNRETA, and WA DLI has underpinned the feasibility of the agreement, as has the uptake of fire management tools and techniques developed by the TS–CRC and its partners.

Limiting wildfires will also help conserve environmental and cultural values of the Plateau that are equivalent to those in the adjacent World Heritage-listed Kakadu National Park. Among the most significant outcomes of the agreement should be the economic and social benefits for the indigenous communities involved in the fire management.

Knowledge-based fire management

Each year around 80% of the area burnt by bushfires in Australia occurs in northern Australia—and better fire management is a crucial factor in sustaining productivity and biodiversity in the north. This NHT-funded project is working with land managers across northern Australia to bring together practical fire management options, guidelines and information to help manage fire better. The project has developed interim fire management guidelines for Western Australia, the Northern Territory and Queensland and a range of fire management options have been gathered from extensive consultation with stakeholders.

The project is developing a suite of three websites and other media driven by these stakeholder networks:

- Land Managers' website in which fire management information can be integrated with information on biodiversity management, and vegetation dynamics with links to other aspects of land management. The website will be online in late 2006 at <www.landmanager.org.au>
- Website on bushfires for the general community is being developed with a particular focus on schools. The project is liaising with other website information providers in this area such as

the State Governments and the Bushfires CRC to ensure we develop information resources that complement rather than duplicate the efforts of other information providers.

- Fire mapping website that helps fire managers locate fires. <www.firenorth.org.au> “The North Australian Fire Information website has been the single most important improvement in fire management technology in the NT in the past 10 years. It has given land managers accurate daily information on location and extent of fires, and has proven an invaluable tool in both strategic fire management planning and monitoring, and in tactical fire fighting responses.” —Brent Williams, CEO Bushfires NT
- Links were established with training providers and workshops are being conducted to help fire managers use web-based and digital information sources to their full potential.

Rapid Riverbank Assessment

Land managers in northern Australia now have a standard, practical method for rapidly appraising the condition of one of the most vital—and vulnerable—areas of savanna landscapes: the vegetation surrounding their rivers, creeks and streams.

Riparian zones—the habitats alongside rivers, waterholes and streams—are critical elements of the savanna landscape. They help maintain water quality, the shape and form of streams as well as biodiversity in streams and surrounding savanna, thereby making major contributions to biodiversity, cultural values and the economy. However, savanna riverbank zones are highly vulnerable to the effects of disturbances such as weed invasion, feral animals, fire and overgrazing.

Methods to appraise riverbank condition rapidly have been developed for other regions in Australia but no method has been developed and tested for use across the savannas—until now. By working closely with land managers—particularly those in agencies that are responsible for landscape monitoring, the TS-CRC’s Savanna Riparian Health Project has developed a practical and quick method of assessing northern riverbanks—the Tropical Rapid Appraisal of Riparian Condition (TRARC).

This tool was successfully trialled with a range of users and has continued to be refined jointly with JCU and with Land and Water Australia. The team was successful in involving the Department of Environment and Heritage in further adoption and development of the TRARC which has now been adopted under the National NRM Monitoring and Evaluation Program.

The TS-CRC’s commercialisation/utilisation milestones were incorporated in the research Theme milestones in Schedule 1 of the Commonwealth Agreement and are shown in the milestone tables in the Research Activities and Achievements section starting on page 11.

IP 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.

End-user involvement and CRC’s impact on end-users

In 2005–06 the Centre for International Economics (CIE) assessed the impacts of the Centre’s research on the industries that were end-users of that research. They made the following findings:

- The net value to the pastoral industry of pastoral research taking place in this round of the TS-CRC is \$25.8 million due to higher stocking rates in some regions; higher productivity due to better pasture management and lower management costs. This assessment did not take into account the potential for establishing “green” credentials for marketing.
- The net present value of the fire management tools produced by the TS-CRC to the pastoral industry through improved grazing productivity was estimated to be \$39.0 million over the 20

years from 2001. The industry would also benefit from reduced infrastructure losses, resources used for fighting major fires and health impacts due to smoke haze.

- As a result of fire management tools such as NAFI, mining operators are likely to have fewer shutdowns due to better preparation for fires and fewer electricity outages. The value to mines in terms of the potential reduction in shutdowns less their implementation costs is estimated as \$6.5 million over a 20-year period. In addition, benefits of \$10.7 million from reduced loss of infrastructure were identified.
- There are significant public returns on investment in CRC research. For example, health benefits of the reduction in smoke haze due to better fire management. These have been estimated to have a present value of \$42.8 million in the reduced health costs of asthma associated with smoke irritation. These costs include costs of lost work as well as medical costs for treatment.
- In total the benefits due to the CRC's fire management research total \$120.5 million over the next 20 years.

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

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

Impact of CRC publications across the savannas

The TS-CRC plays a key role in synthesizing NRM knowledge across northern Australia and making it easily accessible to end-users. In 2005-06 the TS-CRC saw a further increase in publication sales with more than 2170 TS-CRC books, booklets, CDs or reports on sustainable land management sold (compared to 1850 in 2004-05). Another 267 publications on NRM were distributed free of charge. These figures do not include the Centre's newsletters.

Research collaboration

Research activities and achievements

THEME 1: LANDSCAPE ECOLOGY AND HEALTH

Leader: Dr John Ludwig, CSIRO Sustainable Ecosystems, Atherton, Qld

Summary

The Landscape Ecology and Health theme included four core projects in 2005–06, although many of the projects grouped in other themes also contribute to improving our understanding of what makes a healthy savanna landscape.

Research progress in 2005–06 by each of the four projects follows this theme summary, thus I only list some project highlights.

I also note that all four projects in this theme now largely focus on management outputs, communication and achieving outcomes. They all build on at least four years of previous research. Projects into soil health and carbon dynamics will continue as major activities into 2006–07, whereas the research into exotic grasses and riparian health projects will be submitting reports documenting their progress over the past three years, though some activities will remain.

Progress

Project 1.1.3: Soil health in savannas—Leader: Dr Tracy Dawes-Gromadzki, CSIRO SE, Darwin
Indicators of soil health are being incorporated into the Queensland Department of Primary Industries and Fisheries' Grazing Land Management package through collaboration with Tracy Dawes-Gromadzki and others in this project. Simple measures of soil macro-invertebrate activity, such as the presence and abundance of earthworm castings and termite surface sheetings, indicate the potential for soils to infiltrate water during rainfall and runoff events. This project is also closely aligned with Meat and Livestock Australia's Wambiana grazing trial, located near Charters Towers, Queensland, where vegetation and soil health are being monitored as affected by different livestock grazing strategies.

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

This project continued to improve ways of estimating carbon stocks across savanna regions using relationships derived from plot data. The potential for applying radar imagery for this purpose was successfully trialed in the Mary River Catchment near Darwin. Field trials using gaseous flux towers are helping to quantify the effects of fire on carbon stocks and dynamics; these data also help build simulation models to explore how different fire regimes affect carbon dynamics. Much of this field and modelling work is in collaboration with the Greenhouse Accounting and Bushfire CRCs. Recent findings on savanna carbon stores and dynamics were published in a special issue of the *Australian Journal of Botany* (Issue 7, Vol. 53, 2005). Co-leader Dr Dick Williams was a guest editor for this issue. Project results were also presented at national and international conferences, including Greenhouse 2005 (Dick Williams, Melbourne), and Biocomplexity in Savannas (Lindsay Hutley, South Africa)

With the help of University of Western Australia students, co-leader Chris Stokes finalised his work at the Free-Air CO₂ Enrichment (FACE) site near Townsville. The OzFACE site was decommissioned and this project activity is now complete. Dr Stokes presented recent findings from OzFACE at the meeting of the Ecological Society of Australia held in Brisbane in December 2005.

Project 1.1.5 Exotic Grasses in Savannas—Leaders: Dr Samantha Setterfield, CDU and John Clarkson, EPA (Qld)

Dr Samantha Setterfield, project co-leader with John Clarkson, now chairs an Inter-agency Technical Committee that is drafting a new Weed Risk Assessment (WRA) tool for the Northern Territory. This tool is being designed to complement a National Weed Risk Assessment framework and tool. To advance this development, the project held a two-day workshop in Darwin in September 2005. The main aims of this workshop were to review current frameworks for weed risk assessments and to develop a national framework that is suited to northern Australia. Eighteen weed experts participated, with most of these being from state and territory government departments that deal with assessing plants for the risk of their becoming environmental and agricultural weeds.

John Clarkson and others have used research summaries and videos to inform people of the negative impacts of exotic grasses outside pastoral properties. In Queensland, an assessment using the WRA tool has nominated gamba grass for listing as a potential weed risk.

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

This project continues its work to refine and expand its Tropical Rapid Assessment of Riparian Condition (TRARC) system. This was facilitated by a DEH Riparian Assessments Workshop held in Darwin in March 2006. Experts from around Australia participated in the workshop contributing their knowledge and ideas on how to advance the assessment of riparian health and the TRARC tool.

Future Directions

As of 30 June 2006, the Theme 1 Leadership position concluded. As noted above, all projects within this theme are building on years of previous experience, and hence do not require further leadership. They are also in a ‘winding-down’ phase as we move towards our rebid, which will strongly focus on social and economic aspects of savanna health, management and future development.

As a former TS–CRC theme leader, I will continue collaborating with other CRC theme leaders, and the Chief Executive Officer, to revise and update our Savannas CRC booklet on what defines a healthy savanna. The concept of savanna health has served us well for over five years, but it is time to review and refine what a healthy savanna means to us and stakeholders in the Australia’s savannas.

I will also continue working with John Courtenay, a member of the TS–CRC Board, on drafting a book aimed at informing tourists about the landscapes they experience as they travel across northern Australia—along the highways designated as the ‘Savannah Way’, which goes between Cairns and Broome. We are aiming for a small book that would be attractive, informative and inexpensive.

Ending on a personal note, I have greatly enjoyed working the past 10 years with the Tropical Savannas CRC—undoubtedly the most enjoyable in my 37-year career.

Table 1 Theme 1 Milestones

Year	Milestone	Achieved	Progress
2	1. Integrated and coordinated suite of projects established to enable modelling of landscape function.	Yes	In the first two years of the TS–CRC, a suite of five projects were developed to improve our models on how healthy savanna landscapes function. These projects included studies on soil health, carbon dynamics, riparian health, exotic tropical grasses, and biodiversity. New findings from these projects were integrated into savanna models, for example, responses of savanna trees to rising CO ₂ were incorporated into the FLAMES model to improve our predictions on savanna responses to climate change.
5	2. Validated models of landscape function and process available	Yes	Building on knowledge gained from TS–CRC projects, three models are available on how healthy savannas function. These models are being used to explore ecological and socio-economic trade-offs at different spatial and temporal scales: (1) Savanna.au at hillslope to paddock scales over years to decades, (2) Arena at property to sub-catchment scales over multiple decades, and (3) Flames at sub-catchment to region-catchment scales over centuries. An example application is how the Flames model was used to demonstrate how different fire regimes affect carbon stocks and rates of carbon sequestration in savannas, which significantly contributed to the successful funding of the NAFA (North Australia Fire Abatement) project by the Australia Greenhouse Office.
5	3. Validated monitoring methodologies available	Yes	A number of TS–CRC projects have contributed methods and indicators for monitoring savanna health. For example, the Riparian Health project has developed the Tropical Rapid Assessment of Riparian Condition (TRARC) system, which contributes to a national system for monitoring the health of Australian rivers. Another example is the Soil Health project which has developed simple measures of soil macro-invertebrate activity, such as the presence and abundance of earthworm castings and termite surface sheetings, to indicate the potential for soils to infiltrate water during rainfall and runoff events. These indicators are being incorporated into the QDPIF Grazing Land Management extension package.
7	4. Tested models for landscape and biodiversity restoration available	On track	Restoring the health or the functionality of damaged savanna landscapes is a goal of the TS–CRC, which requires tools to predict the costs and benefits of rehabilitation procedures. A number of modelling tools are available to assist with landscape restoration. For example, the Savanna.au model predicts how landscapes can be better managed to reduce runoff and erosion to improve landscape condition, which in turn leads to improved biodiversity as established in studies by the Savanna Biodiversity project.
7	5. Models of adaptive management of savanna landscapes available	On track	Managing savanna landscapes within an adaptive framework to continually improve land management practices requires the application of modelling tools. For example, the Arena and Flames models were linked to a forage production model (GRASP) and a cattle herd and economics model (i.e., HerdGRASP) to explore the longer-term impacts of different grazing strategies and fire regimes on property economics and regional viability, which contributed to a NHT project on tropical savannas management.

THEME 2 INDUSTRY AND COMMUNITY NATURAL RESOURCE MANAGEMENT

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

Summary

Theme 2 concentrates on the Key Result Area concerned with sustainable management systems. Although TS–CRC research activities are grouped into projects, project boundaries are frequently and deliberately blurred by sharing information, expertise, study sites and personnel. This is a particularly important feature of Theme 2's operation. This is achieved by bringing together savanna researchers and land managers to develop practical tools and strategies for managing natural resources in ways that are both ecologically sustainable and contribute to economically and socially viable enterprises and communities.

Progress

Project 2.1.4: FIREPLAN: Fire management for savanna communities—Leader: Dr Jeremy Russell-Smith, BFCNT

The tropical savannas have the largest and most frequent fires on the Australian continent. This project works with savanna communities to help develop and implement regionally appropriate initiatives to improve sustainable fire management practices on savanna lands under all tenures, particularly in northern Australia, but also in the South East Asian region, as opportunities permit.

Greenhouse emissions

The overall project has developed well, with a significant move away from the more operational aspects of fire management to include the entire spectrum of carbon accounting, greenhouse gas abatement and carbon offsets. Significant contracts have been signed with the Australian Greenhouse Office and Conoco Phillips in this regard, and interest is also being shown by BP. In particular Project 1.1 (Improving estimates and management of savanna burning emissions) and Project 1.2 (Estimating greenhouse emissions from savanna fires—with funding from the Northern Territory Natural Heritage Trust program) which aim to further refine national greenhouse emissions inventory from savanna burning and focusing on Arnhem Land are progressing particularly well.

Fire Management

The project also has a series of activities in the area of fire management. One of the prime outputs of this work has been the successful continuation of the North Australia Fire Information (NAFI) web site. This site is proving to have a real role in the assessment and management of fire in North Australia, and is continuing to generate considerable interest.

Projects in this area have also managed to gain significant external funding, including Project 1.4 (Fire management in northern Australia: Integrating ecological, economic and social outcomes) which has received project funded through LWA, and Project 2 (Community-based fire management projects) funded principally through NHT.

Finally, the Fireplan project continues to support several PhD students, including Peta Standley and Leasia Felderhof through James Cook University, although Leasia's program is currently on hold due to family matters.

Project 2.4.2: Refining methods for off-reserve conservation of biodiversity—Leader: Dr Alaric Fisher, NT DIPE

This project began in 2004–05, evolving from a set of three previous disparate CRC biodiversity-related projects. Highlights included:

- Activity 1 of the project (*A review of stakeholder needs for biodiversity information*) produced a detailed report on this activity and this will be produced as a TS–CRC publication. Currently, the author (Dr Gay Crowley) is awaiting comments from reviewers. The report provides a very good idea of what is required and what needs to be done differently. Dr Crowley’s work is also contributing to the structure and content of the Land Manager website being developed by the TS–CRC. The website brings together a large range of articles references, links, documents and images pertinent to sustainable land management in northern Australia.
- Activity 2 is examining biodiversity response to a range of pastoral stocking rates and regimes, at Pigeon Hole station (Heytesbury Beef) in the Victoria River District continues. This project, supported by additional external funding from Meat & Livestock Australia and Heytesbury Beef, is assessing pastoralism–biodiversity options, trade-offs and impacts, and is particularly notable for its well-developed collaboration between a major pastoral company, government and other biodiversity agencies. Funding for part of the activities ceases in 2006, while the remainder go through until 2007.
- Dr Stephen Garnett, in conjunction with Drs John Woinarski and Alex Kutt, produced a chapter (‘Biodiversity Conservation in Savanna Grasslands in Australia’) in a book originating from the Edinburgh International Grasslands Conference. The manuscript is currently in review.
- Activity 3 (*Collation and synthesis of existing information relating to savanna biodiversity*) is ongoing and well developed. It is now focused around the Info-Net project (funded by the NHT) which will develop a website that displays maps of biodiversity, weeds and feral data in the Northern Territory. It will provide tools for land managers and planners to help them manage biodiversity, weeds and ferals. Currently most of this data is held in various Northern Territory Government databases. Maps provide one of the most effective means of making NRM information more useful to land managers. The Northern Territory is being used as a test case (because the NHT funding is NT-based). The trial version of the web system is well advanced.
- Activity 5 of this project (*Baseline conservation assessment of key areas*) continues. The biodiversity inventory begun of Groote Eylandt NT is well under way, as is the work in Queensland’s northern Gulf of Carpentaria. This activity will continue into 2007 (no additional funding will be required) because of the difficulties in linking with the Anindilyakwa Rangers for the Groote Eylandt biodiversity survey. These rangers are proving to be most useful but it is difficult to engage them at times because of their other commitments. Dr Alex Kutt is continuing the Brooklyn Station work in Cape York, supported by NHT funds.

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

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

Highlights include:

- Activity 1 (*Estimation of stock carrying capacity*) has been through a very busy phase of data collection, concentrating on the Sturt Plateau in the NT. While the original completion date was 2007 and although most of the work will be complete by then, there will be a few sites still operating in 2008 because of hold-ups due to poor seasonal conditions in the south and in some cases unplanned fires. The data are already being used as it is collected and is attracting considerable attention, particularly from the NT Pastoral Land Board. This project also includes the second year research grant from Meat & Livestock Australia: *Developing sustainable carrying capacities in the NT*.
- Activity 2 deals with decision support / risk management tools and is being conducted in collaboration with Heytesbury Beef. It also has progressed well, with further work required to make it user friendly and of greater value to producers. A proposal for a new business model for the product was prepared, and it will be incorporated into a delivery system being prepared by another consultancy group sponsored by DAFF.

- Activity 3, (*Assessment of MODIS and comparison with Landsat data*) undertaken by Kate Richardson was completed and final report submitted. The report noted that while MODIS data were of value; their value was greatest on the open black soil savanna plains, where overstorey (tree) species were not a problem.
- Meat & Livestock Australia provided funding to support the development of a Grazing Land management (GLM) package for the Kimberley region, to be completed by September 2007. This follows on from the development of the GLM package for several regions in both Queensland and the Northern Territory, and which is proving to be immensely popular with savanna land managers.

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

This project began in February 2005, with a series of activities. Highlights include:

- Activity 1 (*The Dynamic Savanna*) and Activity 2 (*Synthesis of existing information*) have now been essentially combined, with a preliminary website established <www.dynasav.org.au>. While there continues to be a need to add further information, this should be straightforward. An interactive web GIS was created, spatial data were entered and content is being finalised. Both these activities are in final production.
- Activity 3 (*Calibration of aerial photography*) was completed, and Drs Rod Fensham and Russell Fairfax published a paper on their work. The main findings were that, as expected, if photography from different dates is being compared then they must either be at the same scale or account must be taken of the differences in resolution. The good news is that the new digital aerial photography has a far better resolution than the previous system, with 1:25 000 scale photos allowing a resolution of less than 10 cm.
- Activity 4 (*Using landscape and aerial photography to document historical woody vegetation change*) saw significant work in the Kimberley and VRD regions, which continued through the 2006 dry season. Data were collected on 11 properties, with more than 400 individual sites and 100 km of vegetation transects.
- Activity 5 (*Landholder experiences and perceptions of the extent, onset and causes of woody vegetation change*), a survey by Allison Lancaster is now complete. Results reveal a diversity of opinions, the most common difference being between those (predominantly Queenslanders) who relate vegetation thickening to the 1970s, and others who believe that critical changes only really occurred in the past 10 to 15 years. The other result is that if resources were to be allocated or control, the control should be concentrated on the black soil areas to combat such species as prickly acacia, gutta percha, rosewood and baubinia.

Theme highlights

- 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.
- Quality and continued commitment of staff.
- Very strong involvements and contributions by PhD and Honours students.
- Continued high rate of publication in a variety of journals, proceedings and monographs, and requests from various media groups for interviews and reports,

The theme continues to demonstrate the benefits of the CRC concept through constructive relationships between staff and a number of organisations, agencies and individuals responsible for land management in the savannas.

Table 2 Theme 2 milestones

Year	Milestone	Activities
2	Coordinated and integrated management projects in place and they included participation of stakeholders	Achieved. Examples include: Range of projects developed and functioning including “Grazing Tools (3 State agencies, MLA and producer groups in Qld, NT and WA), Savanna Biodiversity (2 State agencies, MLA, Heytesbury Beef), and Fireplan (3 State agencies, Conoco Phillips, NAILSMA, NHT, LWA, AGO, Kimberley Fire Management Group).
5	Management guidelines and tools are developed and tested by managers and service agencies	Achieved. Examples include: Range of tools developed including Veg Machine (savanna cover change analysis), Carrying Capacity Estimator for the NT, Grazing Land Management packages (in conjunction with MLA), the Savanna Biodiversity Database and the North Australia Fire Information (NAFI) website, which is proving to be of tremendous value to both government agencies and land managers, and which has become an “everyday” management tool.
5	Environmental codes of practice are tested and available to the grazing industry	Achieved. Examples include: A series of booklets on NRM Best Practice for the Pastoral Industry are available for Cape River and the Northern Gulf in Queensland and the Sturt Plateau and Victoria River District regions in the NT. These were developed in conjunction with the savanna pastoral industry.
5	Indigenous land management planning principles and guidelines are documented and used in co-management planning.	Achieved. Examples include: The INCRM (Integrated Natural & Cultural Resource Management) project has developed both fire management plans and land management / property development plans for indigenous managed land, while the Kimberley Fire project and the traditional fire management in Cape York project (a PhD) have further documented and used indigenous fire management information and brought it into broader usage.
7	Management tools and products are being used in resource management	On track. New products (see above) are being communicated with stakeholders (many of whom were involved in product and tool development).
7	Decision support systems are available to managers for strategic and tactical situations	On track. Tools such as Veg Machine (with support from MLA) are being disseminated, while the decision support / risk management tool being developed in conjunction with Heytesbury beef has now gone as far as the “business concept” phase.

THEME 3 REGIONAL PLANNING AND MANAGEMENT

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

Summary

Theme 3 is concerned with social, economic and institutional influences on the way savanna communities interact with northern landscapes and the natural resources that those landscapes support. 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 ecological sustainability of the use.

Most resources are allocated by statute to particular individuals or groups within the population. Those statutes also set many rules about the types and levels of use and the obligations associated with gaining access. In addition, members of communities may apply many informal (non-statutory) rules to access or about acceptable resource management practice.

Given dramatic changes in landscapes, the size and distribution of human populations, the relative economic value of different resources, and the shifting recognition of many values that have no markets and hence no price, it cannot be assumed that those institutions are well matched to the needs of regional communities or good management practice. Indeed, there is good evidence that both formal and informal institutions often lag well behind obvious needs for change to achieve better economic, social or environmental outcomes.

The projects in this theme grapple with problems of institutional inertia and other socio-economic determinants of the viability of savanna communities. A core goal is to provide information with the sort of content, organisation and presentation that optimises its usefulness for regional decision-makers and policy-makers in government.

This task is challenging in the savannas because critical information is often sparse, human populations are small and dispersed and value different attributes of the landscape. To meet this challenge, the CRC's regional planning and management program is also diverse. In addition to generating some entirely new information, an important focus is to make better use of existing information, through novel syntheses.

Theme 3 comprises four components:

- Status and dynamics of regional communities and economies and dominant influences on them
- Options for diversifying regional economies
- Regional plans for natural resource management and
- Enhanced application of knowledge held by the community and agencies to local and regional management.

Regional dynamics

Two projects 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—identifying and linking key social and economic issues affecting the viability of outback regions; and

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

These projects have now been joined under the leadership of Professor Rolf Gerritsen, previously a senior economic policy adviser in the Northern Territory Department of the Chief Minister, who has now joined the CRC as a professorial research fellow. Broad goals are to:

Broad goals 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 in the three north Australian jurisdictions
- Develop social and economic indicators of regional health and socio-economic resilience to complement existing ecological indicators.

These issues are being addressed through case studies, namely:

1. Upper Burdekin, Queensland – Planning for healthy country
2. Anmatjere, Northern Territory – Employment and well-being
3. Ngukkur, Northern Territory – Innovative service delivery
4. Economic multipliers in different regional settings in the savannas

A proposed Wiluna (Western Australia) case study was dropped due to difficulties in assembling a suitable research team.

The Upper Burdekin and Anmatjere studies are well advanced in documenting and analysing community perspectives. Results of the Upper Burdekin study will be reported to the TS–CRC in late 2006. The Ngukkur study is well under way, and focuses on options to improve delivery of services in remote communities, especially training and employment services. Work includes an examination of the role of outstations, including an analysis of their benefits and costs.

In another component of the study, John Taylor, from the Centre for Aboriginal Economic Policy Research at the Australian National University and D. Brown and M. Bell of the University of Queensland completed a TS–CRC-supported study examining the challenges of providing demographic and related statistical information capable of informing economic, social and environmental policy in the Australian desert and tropical savannas. Important conclusions were:

- There is important variation in demographic patterns across regional Australia (e.g. decreasing populations in the arid zone, increasing in the savannas), and between Indigenous (increasing) and non-Indigenous (often decreasing) populations.
- There are important weaknesses in the present organisation of census records for analysis and presentation of these patterns and assessing implications for policy at relevant spatial scales.
- To direct improvements it is important that a specification of relevant geographies for statistical analysis be developed to inform decisions about government and other investments in economic and social development.
- In particular there is a need to improve understanding of settlement hierarchies and the various functions that settlements in different localities and of different sizes might be expected to perform and the infrastructure and other services they may require to perform them.
- Temporal mobility patterns and influences on them for savanna populations are poorly understood at seasonal and longer timeframes, complicating effective delivery of services.
- Indigenous mobility patterns and influences on them are particularly poorly understood.
- More robust methodologies for estimating “service populations” are required.

- Census undercounts need to be reduced, as well as increased rates of registration of Indigenous vital events.
- To supplement Census data, it may be desirable to, in addition, use approaches like longitudinal samples for improving estimates of demographic parameters and socio-economic status, as has been done in some developing countries
- Population projections are compromised by poor quality data, high mobility, and small starting populations. This means that projections may only be reliable if information is aggregated over large areas, and that projections will require frequent revision. Simplifying assumptions (for example that jurisdiction-wide demographic parameters apply uniformly at regional spatial scales) may produce misleading projections.

The authors propose that some improvement in performance could be achieved through investments in a Demographic Support System (DSS) and describe some elements of it. They acknowledge that substantial investments would be required to establish and then to maintain such a system.

Work already under way is also dealing with some related issues, especially in regard to the development of community typology and the manner in which these communities interact with other parts of the savannas. The utility of the proposed DSS will be examined jointly by the TS–CRC and DK CRC.

The project is expected to provide a much more realistic view of savanna communities and to provide government and communities with the knowledge and tools they need to assess the likely impacts of various investment decisions or other policy interventions. Linkage to environmental outcomes remains a goal. For example, proposals are under development to examine relationships between the level of support for outstations and fire management in the Ngukkur/Numbulwar region.

Joint TS–CRC/DK CRC workshops to bring together and prepare a synthesis of the results of the various studies are planned for 2007.

Diverse regional economies

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

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

This project was originally designed to develop a framework for examining options for multiple uses of savanna landscapes and analysing the trade-offs or synergies that may result from diversification of use. Work was organised into a number of activities:

- development of a conceptual framework for considering the costs and benefits of multiple use
- analysis of institutional issues (including property rights and rights of access to natural resources)

These were to be informed by sectorally focused studies. In 2004–2005 we reported important changes to the project, including case studies on water allocation, pricing and use. Field work for a study of institutional issues in the introduction of markets in water in the Daly River region has now been completed and, at the time of writing, a draft report submitted. Important conclusions from that study are that:

- farmers are sceptical about the utility of markets in water outside the over-allocated systems of southern Australia.
- other mechanisms, especially sharing information about water use decisions and their environmental implications may be effective in influencing water use decisions to reduce risk of environmental damage.
- existing processes for engagement with water users and other interests in the region are hampered by distrust of government, and it may be necessary to develop additional forums that provide for participation in decision-making.

The manner in which these findings can be considered and debated within government are presently being explored.

Development of a broad conceptual framework for understanding and analysing multiple use of savanna lands has been de-emphasised as a distinct activity. It is thought that generalisations will most clearly emerge from a synthesis of the case studies and better understanding of institutional issues. That synthesis will occur on completion of other case studies.

An important interim product, namely a book on Outback Institutions (Smajgl, A and S. Larsen (2006) *Adapting rules for sustainable resource use. CSIRO Sustainable Ecosystems, Townsville*) was completed during 2005–06.

Regional planning

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

Project 3.3.5: Healthy savanna planning systems—Leader: Professor Geoff McDonald, CSIRO Sustainable Ecosystems, Brisbane, Qld.

The main aim of the project is to contribute to improving regional NRM planning and implementation processes in Australia's tropical savannas. The project builds and applies long-term, regionally focused monitoring, evaluation and improvement frameworks for regional planning arrangements and plans. Frameworks are being designed in partnership with regional NRM organisations and agencies across QLD, NT and WA, with the purpose of capturing and sharing lessons to support adaptive management at the regional and State or Territory scales. The project builds on evaluation frameworks designed in earlier 'foundation' regional planning Projects 3.2.2 and 3.2.1.

The project team applied criteria designed specifically to evaluate regional NRM planning arrangements and plans to benchmark the progress made in savanna regions. During the reporting period, the project team completed an important review of a large suite of NRM plans.

Major conclusions are:

The relationship between management actions and the improvement of resource condition is difficult to demonstrate in the short term under conditions in northern Australian. Desirable improvements to current approaches included:

1. refining resource condition target setting through application of adaptive management principles;
 - accepting that in the short to medium term, performance in some areas will need to be based on operational measures (effective completion of agreed tasks);
 - capturing and apply local knowledge and experiences to strengthen understanding of the causal links between action and outcome;
 - supporting efforts by regional bodies to set and deliver on fewer targets designed to achieve multiple outcomes.
2. Successful partnerships and governance are critical to achieve outcomes. Relevant partnerships require:
 - clear incentives for involvement and clear roles for mining, tourism and local government sectors in regional NRM;
 - support for regional bodies as brokers of joint investment;
 - alignment across government programs through commitment to multi-agency structures, such as Queensland's Regional Coordination Groups;
 - maintaining flexibility and diversity of approaches to NRM delivery but recognising that some regions are too large for effective collaboration.
3. Existing monitoring and evaluation (M&E) program frameworks provide weak assessments of the full (environmental, economic and social) impact of regional NRM. Rapid local cycles of improvement need to link with and be supported by cycles of planning and program review in government. A key improvement is to develop region-specific criteria and indicators that:

- recognise contributions to multiple objectives
- use local management knowledge and specialised expertise in indicator design;
- be negotiated with regional stakeholders.

4. Several factors impact heavily on NRM delivery in northern Australia:

- reliance on collaboration between all spheres of government and support from local stakeholders
- transaction costs of bringing groups together can rival likely benefits to both regional bodies and potential partners
- uncertainty created by the dynamic nature of northern landscapes, characterised by multiple uses, climate and ecosystem variability
- high levels of biophysical variability in northern Australia make it difficult to negotiate changes in management practice, predict their utility and apply them effectively.
- remoteness and the diversity of economic, social and cultural values
- many northern stakeholders associate more strongly with obligations to place or local community and consequently may seek to utilise engagement with NRM as vehicle to achieve a mix of social, economic and environmental outcomes.
- insufficient information to set realistic targets and design actions.

The project team is now positioned to undertake, during 2006–07, a major synthesis of the regional planning experience informed by recognition of the challenges outlined above, and addressing two critical questions: “are regional NRM arrangements genuinely capable of delivering the outcomes they seek?”; and, “do government and other investors know the full (environmental, economic and social) impact of regional NRM?”

The team has maintained its high level of engagement with NRM bodies and decision-makers in Government, including input to a national report on use of science in the regional planning and delivery process, and a position paper for policy makers on strategies for cost-effective delivery of NRM in northern regions.

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. The particular approach is well established in a number of disciplines, but the technical details are perhaps less important than the associated process of close engagement of researchers with resource managers. The effort required for participants to articulate and position knowledge and understanding in relation to agreed objectives increases the effectiveness of communication and, ultimately, management capability. In addition to their own research outputs, the projects provide tools used for application of knowledge gained in other components of the CRC program.

During 2005–06 emphasis was placed on taking the lessons learned during individual projects to produce a more ambitious generic model titled “Adaptive management of land condition”. The model incorporates linked modules covering key issues in maintaining land condition and production in the savannas (e.g. fire, grazing pressure, rainfall). Design will permit individual users or user groups to populate the model with data and understanding of process that reflects their local circumstances and so adapt it to variation in regional needs. Design is well advanced and parameterisation using local knowledge and scientific data, including outputs from other (e.g. fire) modelling tools developed within other TS–CRC programs is also underway.

In parallel, developments of web-based implementations of BBN models have continued. It is anticipated that, with continued development, these enhancements will increase the range of users able to apply them to assist decision-making.

The East Kimberley Integrated Natural and Cultural Resource Management Project

An important multi-disciplinary project was completed in the Kimberley with support from Land and Water Australia and the Indigenous Land Corporation. Under the supervision of the Western Australian Department of Agriculture, the TS–CRC has worked with two remote Aboriginal communities (Bow River and Violet Valley) to explore enterprise options available to sustain presence on country and support community capacity to maintain cultural and natural values.

The project involved a detailed inventory of natural and cultural values at both sites, exploration of community aspirations, identification and economic analysis of options for pastoral development, examination of institutional constraints on enterprise development in such remote regions, and identification of opportunities to overcome those constraints. The next steps will involve supporting the communities to develop business plans for their preferred options and find pathways to fund them.

Particularly important research outcomes include clearer recognition of the dependence of such groups on ‘agents’ with the skills and commitment to help navigate the extraordinarily complex institutional landscape that influences viability of initiatives. The project has provided important guidance for framing future CRC research on plausible paths to regional (and especially Indigenous) development.

Highlights and Challenges

The theme comprises a number of ambitious projects, all focused on making information more useful to decision-makers and those engaged in planning at a range of spatial scales and over a number of sectors. During 2005–06 effort has continued to be directed into building individual projects that are achievable with the resources available, yet contribute to the broader conceptual frame laid out in earlier studies and reports.

Highlights include:

- completion of studies of water allocation and the potential performance of water markets in minimising environmental impacts of water use in the Daly River region
- completion of demographic studies setting out the challenges in understanding the dynamics of regional Indigenous and non-Indigenous populations, their implications for policy development and potential responses
- advances in development of knowledge synthesis and decision-support models capable of adaptation by regional users to improve management of land condition
- improved understanding of the regional economic impacts of investments (economic multipliers) in the savannas

Future Directions

As the TS–CRC enters the sixth year of its seven-year span, it is important to bring together research products to produce a synthesis of major findings that is accessible and relevant to Government and non-Government stakeholders. All continuing projects are focusing on this obligation.

Table 3 Theme 3 Milestones

Year	Milestone	Milestone
2	Reviews conducted which provide the information to design appropriate projects	<p>Achieved Reviews completed of:</p> <ul style="list-style-type: none"> the state of knowledge of savanna demography, economy, and society. options for developing appropriate models of regional savanna economies that permit prediction of impacts of local investments or policy interventions. the characteristics and performance of Regional Planning Bodies in northern Australia.
2	Regional stakeholder groups are participating in project development	<p>Achieved Effective participation has been achieved through formal consultative bodies, working directly with stakeholders on individual projects and achieving research objectives through direct participation in regional planning processes.</p>
5	Processes of regional social and economic planning and functioning are understood	<p>Achieved Understanding has improved savanna-wide sufficiently to permit robust design of important and informative studies of major issues for particular sectors (e.g. Indigenous communities), and some of these have been implemented.</p> <p>Conceptual models for improved function of systems for regional NRM planning and resource allocation have been developed</p>
5	Models of regional change are developed for validation	<p>Partly achieved Improved models for engagement of communities in resource allocation decisions, including role of some market-based instruments will be developed during 2006 from recently delivered case studies.</p> <p>Models for facilitating change to best practice have been developed and trialled in fire management and grazing management and will be generalised during 2006–07.</p> <p>Reporting on simple models of drivers of regional economies and levels of community participation in regional economies in case study areas will be completed during 2006.</p> <p>Improved models for delivery of services and community participation in service delivery are scheduled for 2007.</p>
7	Validated models of regional planning and change and resource management are available	<p>On track A pathway for integration of various case studies and testing conceptual and decision-making models has been mapped.</p>

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 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. In 2005–06

Capacity building activities in this theme include working with communities to help them conserve and pass on local knowledge (*Project 4.4.2 Indigenous Capacity-building*) and providing communities and enterprises with tools and information that enhances their NRM capacity (*Project 4.3.1 Communication Resources*). Importantly, capacity building is focused on specific NRM activities and user groups associated with the TS–CRC’s participative projects so that it is more likely to result in actual improvement in NRM outcomes.

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

Promotion of the Centre’s activities and outputs and enhancing communication between Centre staff and raising awareness of tropical savannas issues (*Project 4.3.2 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, NTU

See Education and Training section, pp. 35.

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

This project develops tools, websites, workshops and publications that: help build capacity and enhance adoption of NRM research; enhance collaborative research; and increase awareness of the Centre and savanna issues.

Highlights

The *North Australian Fire Information* website continues to be a vital tool for north Australian fire managers and was assessed by the Centre for International Economics to have already saved northern land managers and fire agencies millions of dollars in fire monitoring costs—many times the cost of establishing the website.

A new *North Australian Land Manager* is largely complete, and when launched late in 2006, should be a major resource for northern land managers.

2439 publications on the tropical savannas including were sold or distributed, with around 90% being sold—a significant increase on 2004–05.

Collaborative research was fostered by the newsletters *Savanna Links* and *Topical Savannas* and support for numerous workshops.

The Centre’s website has become a major source of NRM information with more than 46,000 publications downloaded since 2001.

See also Communication Strategy, pp. 44.

Project 4.3.2: Tropical Savannas knowledge for schools—Leader: Ms. Julie Crough, TS–CRC

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

The project involves:

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

Progress

An *Environorth* website for teachers and students has been developed in collaboration with teachers and the Northern Territory Education Department and is designed to work within the school curriculum and to suit teaching practice. The site has three main sections:

- *Teach Savannas* supports classroom teaching about environmental issues for the middle years by providing access to current information.
- *Learn Savannas* features a number of structured, interactive modules that engage students. These modules are full of animation, engaging graphics and mini-movies that emphasise the remarkable north Australian landscapes and wildlife and the people who manage and know the country. Modules either completed or in planning are Savanna Walkabout (biodiversity); Cattle Country; Burning Issues; and Caring for Country (Indigenous).
- *Savanna Windows* links students and teachers to an educational version of the CRC’s *Savanna Explorer* website

Briefings were held for the Queensland Department of Education; teacher workshops were held in Darwin and Katherine to demonstrate and pilot completed section of biodiversity module.

To facilitate teachers piloting the resources, an E-space course was developed on the DEET LATIS network.

The first interactive module, Savanna Walkabout, which focuses on biodiversity, will be launched late in 2006. Development of the second module, Burning Issues, will also start in late 2006.

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

This project aims to improve coordination, collaboration and collegial engagement between Indigenous land managers and owners, the TS–CRC, its partners and current and future projects. It aims to do this by hosting an annual land and sea management policy forum a regionally based Indigenous leadership forum targeting aspiring Indigenous land managers and owners. The project is also 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.

During the year this project hosted the third land and sea management forum at Yiramalayi on Leopold Downs Station, West Kimberley - deep in Bunaba country - the meeting was shared with the Kimberley Land Council, Kimberley Language Centre and Kimberley Law and Culture Centre's Annual General Meetings. About 350 Traditional Owners (TOs) from across northern Australia attended. The forum provided an opportunity for NAILSMA staff to report back to TOs on what had happened over the year and to seek their further endorsement for the alliance and ongoing NAILSMA strategic direction. A key theme at the forum was the importance of Indigenous Knowledge in underpinning land and sea management and a culture-based economy. Numerous workshops were held to discuss in further detail Marine Turtle and Dugong and Indigenous Knowledge.

The year saw outputs from various recent initiatives. Lisa Binge's Leadership, Scholarship and Communication work (see Kantri Laif below) has created a strong direction for NAILSMA to undertake to concentrate further on Indigenous youth, Steve Johnson is finalising the north Australian Indigenous Knowledge Strategy. Steve also undertook a project for the Natural Resource Management Board for the NT on Indigenous Ecological Knowledge, and how it contributes to NRM outcomes, Rod Kennett's Dugong and Marine Turtle Management Project is building capacity across the north on Marine Turtle and Dugong in five areas while Jean Fenton has almost completed her role in the north Australian knowledge based fire project. Jean's role has now manifested itself into establishing a major new project in the Gulf and Kimberley focusing on greenhouse abatement (payment for environmental services for Traditional Owners). In addition, two new staff were employed - Ms Lorrae McArthur whom is providing communication support to the Marine Turtle and Dugong Project and the Indigenous Water Policy Group commenced as did Ms Honorlea Masserala who is working with low capacity groups on small to medium scale enterprise development.

The second edition of *Kantri Laif* was published with a number of important articles from the bush by Indigenous people talking about their activities and aspirations on their country. With support from the CRC's communication team, a NAILSMA website was developed which provides news of what NAILSMA does and provides access to its various publications.

Table 4 Theme 4 Milestones

Year	Milestone	Activities
2	Comprehensive programs of development of education and learning packages are established	Achieved. Packages in Tropical Environmental Management established at Masters, Diploma and Certificate levels, as well as undergraduate level. A project to develop school curriculum materials was approved. Packages developed for training courses in pastoral industry and Indigenous land management.
2	A program of postgraduate research and education is established	Achieved. PhD program established with 18 students receiving support by Year 2. The Tropical Environmental Management postgraduate program had 34 students enrolled by Year 2.
5	Education and learning packages are available for both formal and informal learning opportunities	Achieved. Formal learning packages well established (see above) and expanded with inclusion of a Professional Doctorate in Tropical Environmental Management offered at CDU. Study assistance for Indigenous Land and Sea Management offered through NAILSMA. Cross-Cultural training course developed. Informal learning opportunities include support for: leadership courses for Indigenous land and sea managers, grazing land management workshops, tour guide schools, weed management workshops, fire management workshops.
5	Web based information is available to all people in the tropical savannas	Achieved. Over the past five years there were 46,000 downloads of NRM publications from the Tropical Savannas CRC website; websites tailored to remote land managers in areas of fire monitoring, vegetation management and general NRM developed. Web-delivered school curriculum material developed.
7	Complete education packages available for all levels of education	On track. Education packages have already been developed for: (1) various levels of post-graduate education linked to end-users ranging from research-based PhDs and professional Doctorates to Masters and Diploma courses (2) undergraduate packages developed for various aspects of tropical NRM (3) school-level curriculum materials focused on tropical environments and people developed (4) training packages and materials developed for a range of less formal training courses for the main end-user sectors. These will be built on over the next two years.
7	Capacity development opportunities are being utilized by indigenous people	On track. The TS-CRC supports a number of initiatives in this area through NAILSMA. For example, study assistance at the certificate, diploma and degree levels in the area of land and sea management has been now taken up by over 60 Indigenous students. Leadership workshops for Indigenous land and Sea managers have also been well-attended. NAILSMA have established an Indigenous business development unit focused on opportunities in the area of land and seas management. These initiatives will be built on over the next two years.

Research collaborations

The year 2005–06 saw some important new collaborations develop and existing collaborative links continue to be used with an emphasis on getting project 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 areas to learn from each other about common land management challenges.

- Table 5 shows that 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.

- A Weed Risk Assessment stakeholder workshop was held in May 2006. Attended by range of stakeholders including Environment Centre NT, NTCA, NT Govt, WWF, and Ted Werren (MLA) and Gerry Wood (MLA) from NT Invasive Species Sessional Committee. Received support from all attendees for development and implementation of a Weed Risk Assessment program for the NT.

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

- The CRC co-hosted an LWA National Riparian Lands Program feedback workshop in February.
- With funding from DEH the TS-CRC's *Savanna Riparian Health* project held a workshop on the future development of TRARC and on reviewing national approaches to riparian condition assessment (May 17–18).
- The CRC also has major contracts with the Natural Heritage Trust to provide capacity and information on fire management and turtle and dugong management to north Australian land managers; it is contracted to provide information on tropical savanna carbon cycles for the Australian Greenhouse Office; four projects on sustainable grazing management receive funding from Meat and Livestock Australia.

Collaboration with international bodies continues to be significant in the areas of fire management.

- In April 2006 a successful workshop, co-hosted by the TS–CRC, was held in Kupang West Timor on Integrated Rural Development in eastern Indonesia (Nusa Tenggara Timur or NTT). A major outcome of the workshop was an agreement with the NTT Governor on the type of projects on rural development that were needed in the future.
- The TS–CRC is now collaborating with NASA to develop robust fire scar mapping techniques.

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

- Two meetings of the North Australian Fire Managers Forum were held in 2005–06 in Perth in August 2005 and in Brisbane in June 2006. These meeting bring together the three bushfire agencies of WA, the MNT and Qld, who are major end-users of fire management research, as well as the TS–CRC, the Bushfires CRC, WA DLI and Geoscience Australia who are major research providers.

- A scan of the Land Managers/Community column in Table 5 shows that most projects in Themes 2 and 3 have direct links with the community that will use their research or through links with a partner agency. This is mostly participative research that actively involves end-users in the project and is an important part of the Centre's technology transfer and utilisation strategy (see page 7).

An important partner in the Centre's collaboration is NAILSMA—the North Australian Land and Sea Managers Alliance—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.

Table 5 Collaborative links

Project (No. Name, Main location, Date Began)	Themes Cooperative Linkages							
	LEH	NRM	RPM	HCD	Overseas Contacts	Land Managers / Community	Other CRC Projects	Other Australian Agencies
1.1.3 Soil biota, nutrients and water in savannas, CSIRO SE & L&W, 2001	✓				Universities of Wurzburg and Ruhr, Germany University of Cape Town, South Africa Natural History Museum of London	Heytesbury Beef EWL Sciences	1.1.4 3.3.7	MLA QDPIF UQ
1.1.4 Savanna carbon dynamics, CSIRO SE, 2001	✓					QLD Nickel Geospatial Consultants Australia	1.1.3 3.3.7	NTU NTDBIRD QDPIF JCU CDU AGO MLA Bushfire CRC Greenhouse CRC
1.1.5 Exotic Grasses in Tropical Savannas, CDU, 2002	✓						3.3.7	Weeds CRC NT DNRETA CSIRO SE QPWS UQ NSW Agriculture APCC (SA) ADO Parks Australia (North)
1.2.1 Savanna Riparian Health, NTU, JCU, 2002	✓				University of California (Davis)	Burdekin Dry Tropics Board	2.1.2	QEPA QPWS QDNRME Parks Australia (North) UWA CSIRO SE CSIRO LW UQ NT DNRETA

Table 5 Collaborative Links cont.

Project (No. Name, Main location, Date Began)	Themes Cooperative Linkages							
	LEH	NRM	RPM	HCD	Overseas Contacts	Land Managers / Community	Other CRC Projects	Other Australian Agencies
2.1.1 Grazing Management Tools, NT DPIF, 2003		✓				VRDCA BRAC Sturt Plateau BPG KPIAC Roper Landcare Group CLMA DUBC NGNRG NAPCO AACo WADA Stanbroke Heyetesbury Beef	2.1.2 2.1.4 2.2.1	NT DNRETA QDPIF QDNRME WA Ag
2.1.4 FIREPLAN, Fire Management for the Savanna Community BFCNT, 2002		✓			Indonesian Fire Managers (through ACIAR) University of Stockholm Japanese Space Development Agency (NASDA) University of California, Irvine NASA European Space Agency Texas A&M University Tropical Research Institute, Portugal	BFCNT VRD regional committee Sturt Plateau Best Practice Group Balkanu KAPA Jawoyn Assoc. Regional NHT groups in north Australia	2.1.1 4.4.2	CSIRO SE CDU JCU BFCNT Murdoch Uni EA ADF NLC PWCNT NTDBIRD EPA (Qld) QNRME QFRA QPWS AGWEST CALM WA WA FESA DOLA WA RIRDC ERIN Melbourne Uni. WWF NAFMF AGO

Table 5 Collaborative Links cont.

Project (No. Name, Location, Date Began)	Themes Cooperative Linkages							
	LEH	NRM	RPM	HCD	Overseas Contacts	Land Managers / Community	Other CRC Projects	Other Australian Agencies
2.3.3 Indigenous ecological knowledge for land management, KLC, NLC, BCYDC 2002		✓			University of London Royal Botanic Gardens, Kew	Various Aboriginal Communities across north Australia KALACC Balkanu NHT CYP Fire project NHT Ang Gnarra Ethnobotany project	1.2.2 4.4.2	NHT NAILSMA Kimberley Land Council University of South Australia University of the Sunshine Coast State Herbarium of South Australia
2.4.1 Woody vegetation Dynamics in Savannas JCU, CSIRO, 2005		✓				NGNRG CYPDA KLC	4.3.1 2.1.4	NTDBIRD QEPA QDPIF WA Ag
2.4.2 Savanna Biodiversity Shopfront DNRETA, 2001				✓	Conservation International, USA	Heytesbury Beef Roper River Landcare Group Regional NHT groups in north Australia	4.3.1 2.1.4 4.3.2	CSIRO SE QPWS QEPA QDPIF QDNRME NLWRA LWA DEH
3.1.3 Participatory knowledge building, UQ, 2002			✓			NGRMG Carpentaria Shire	Various CRC Projects	QPWS BFCNT QDPIF CSIRO SE CDU JCU QDNRME
3.3.4 Outback Livelihoods			✓				3.3.5 3.3.6	

Table 5 Collaborative Links cont.

Project (No. Name, Main location, Date Began)	Themes Cooperative Linkages							
	LEH	NRM	RPM	HCD	Overseas Contacts	Land Managers / Community	Other CRC Projects	Other Australian Agencies
3.3.5 Healthy Savanna Planning Systems CSIRO SE, 2001			✓			NGRMG Various other regional bodies	3.1.6	UQ QNRME NT DNRETA DEH Coastal CRC
3.3.6 Multiple use in Savanna Regions, CSIRO SE, 2003			✓		University of Indiana (USA)	Carpentaria & Burke Shire Councils Gulf Savannah Development Tourism Queensland Karumba progress association Savannah Guides	3.3.7	UQ Tourism CRC QDPI JCU CDU Desert Knowledge CRC
3.4.1 Indigenous Tourism, CDU 2005			✓			NTTC	4.4.2	Desert Knowledge CRC Tourism CRC

Table 5 Collaborative Links cont.

Project (No. Name, Location, Date Began)	Themes Cooperative Linkages							
	LEH	NRM	RPM	HCD	Overseas Contacts	Land Managers / Community	Other CRC Projects	Other Australian Agencies
4.1.1 Provision of Higher Education, TS-CRC Darwin, 2001				✓	Satya Wacana Christian University (Indonesia) through ACIAR project	VRDCA	Various Projects	JCU UQ Batchelor Institute CSIRO SE NT DNRETA CRC for Aboriginal Health Tropical Plant Protection CRC Bushfire CRC
4.3.1 Communication Resources, TS- CRC Darwin & Townsville, 2001				✓		Various Research users and Communities across north Australia (see other groups in this column)	All projects	All Partner Agencies
4.3.2 Tropical Savannas Knowledge for Schools, TS- CRC/NT DEET 2003				✓		Nine schools in the NT AAEE	4.4.2 2.2.1	CDU NT DNRETA CSIRO SE Greening Australia AQIS
4.4.1 Improving Cross-Cultural Engagement, CDU				✓				
4.4.2 Integrating Research with Indigenous Land and Sea Management, TS- CRC, NAILSMA Darwin, 2002				✓	Christensen Fund (USA)	Various Aboriginal Communities across north Australia	2.1.4 2.3.3 4.3.2	Balkanu, NLC CFCU KLC ANU CAEPR NTU KCTWM BFCNT NT DNRETA ILC

Education and Training

Recruiting and supervising PhD and masters students

The TS–CRC is on target with Higher Degree by Research (HDR) student recruitment. The TS–CRC is in rebid mode and has not recruited new students, apart from two students directly funded from projects. The TS–CRC Round 2 recruited 33 new HDR students (above the target). Of these, three have now completed and five have withdrawn during the last five years (see Appendix 2, Table 16). During 2005–06, two PhD and one Masters student completed their theses. However, many of the remaining PhD students from this round are in the final stage of their studies and are writing up their theses.

Almost all current HDR students have been involved in part-time or short-term contracts (Tables 10 and 11). 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 and graduate destinations

Each TS–CRC research student has at least one industry supervisor (see Appendix 2, Table 16).

Available information about graduate destinations for current and Round 1 HDR students is presented in Tables 9 and 10.

Nature of end-user involvement in developing undergraduate courses

TS–CRC researchers have been involved in the development of the new undergraduate and postgraduate coursework units, including the new in Fire Ecology and Management in Northern Australia (2005). These units comprise an opportunity to communicate directly with research users (students and future graduates). They were involved as content providers, videoed demonstrators, guest online and field tutors and critical friends. The universities were also involved in the planning of curriculum, and have incorporated these into their programs.

Nature of seminars/workshops/courses run for industry

Parr K. Rysavy H. & Wurm P. 2006, *Fire ecology and management* Invited speakers at 2006 Teaching & Learning Forum, April 2006, Charles Darwin University.

Postgraduate program in Tropical Environmental Management and opportunities for collaboration. Presented by Penny Wurm at the Faculty of Biology, Satya Wacana Christian University, Salatiga, Indonesia. 23rd June 2004.

Wurm, P.2004, *Tropical environmental management and TS–CRC: an overview*, presented at the Centre for Studies in Eastern Indonesia, Satya Wacana Christian University, Salatiga, Indonesia. 25th June 2004.

Online resource management. Invited presenter at the Academic Induction Workshop. April 2005, Faculty of Education, Health & Science, CDU. <www.cdu.edu.au/ehs/teach&learn/workshop.html>

Wurm P. 2002, The fruits of collaboration: the story of a course-work Masters. Spoken paper presented at the CRC Association annual conference, Sydney, September.

Wurm P. & Jackson W. 2001, *Managing northern landscapes: a unit born of collaborative design, teaching and learning.* Spoken paper presented at HERDSA Conference, University of Wollongong, June.

Contribution to skill development in the industry

The TS–CRC has recently been successful in attracting a grant to fund a small research project investigating the impact of the postgraduate coursework program in Tropical Environmental Management on the professional practice of its graduates. This will be undertaken and reported on in 2006–07.

Table 6: Education and training milestones

Type of Milestone and/or Output	Description of all 2005–06 milestones and/or outputs incl. Past milestones which have not been met (and date)	Achieved	If achieved, progress in 05-06 and planned activities in 06-07	Reasons why milestones and/or outputs have not been achieved	Strategies to achieve milestones which have not been met
Doctorate of Tropical Environmental Management (DTEM)	2. Accreditation at JCU and UQ. 4. MoUs among UQ, JCU and CDU for cross- institutional enrolments	1. Accreditation at CDU 3. Marketing and promotions	One enrolment in DTEM and a number of serious inquiries, several of which will proceed in 2007.	2. JCU and UQ have decided not to proceed 4. MoUs – decided it was not necessary.	
Master of Tropical Environmental Management (MTEM)	3. Course evaluation 4. Update of SBI507 Ecology and management of Tropical Savannas 5. Update of EV5252 Indigenous Environmental Management in Tropical Australia.	1. Marketing & promotions 2. MTEM Project Coordination	Ongoing and operational	3. Course evaluation – external funding received for 2006/7 4. Update of SBI507 - postponed to 2006/7 due to reaccreditation of course and reframing of unit. 5. Update of EV5252 – JCU no longer offering unit.	3. Course evaluation – will be completed in 2006/7 4. Update of SBI507 - will be completed in 2006/7
Undergraduate learning materials	Learning materials integrated in undergraduate program	Yes, for most materials developed. Awaiting home for new unit in fire ecology and management.	none		
Higher Degree by Research Students	1. Workshop in February 2006. 2. Maintenance of employment and enrolment status reports	1. Workshop in February 2006. 2. Maintenance of employment and enrolment status reports	Ongoing and operational		

Table 7 Enrolments (individuals and *EFTSL) in the Tropical Environmental Management program at CDU, for the last 6 financial years.

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

*Equivalent Full Time Student Unit

Table 8 Completions (graduations) from the Tropical Environmental Management Program at CDU.

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

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

Table 9 Employment destinations of TS–CRC supported PhD graduates – Round 1 (where information is available).

Student	PhD Project Title	Uni	Employment
G. Calvert	Effects of grazing on plant biodiversity in the Dalrymple Shire	JCU	Environment Officer, ERISS, Jabiru
A. Dee	Exploitation of Arafura Wetlands and surrounds by Yolngu women	ANU	Community Programs and Volunteer Coordinator, Parks Victoria
F. Fraser	The ecology of the Partridge Pigeon and habitat impacts due to fire and grazing	CDU	Weeds & wetlands Project Officer NLC, Darwin
W. Hillman	Ecotourism in northern Australia—interpretive guided tours	JCU	Tutor, JCU
B. Hoffman	Responses of ant communities to land-use impacts in northern semi-arid Australia	CDU	Entomology research consultant, Darwin
G. Kelley	Soil properties and plant water use of tropical savannas	CDU	Researcher, University of Western Sydney
A. Kutt	Spatial patterns of distribution, abundance and diversity in the vertebrate fauna assemblages of the Desert Uplands bioregion, northern QLD	JCU	Research Officer EPA (Qld), Townsville
H. Khwaja	Study of remote sensing and GIS for the assessment of their capabilities in mapping the vegetation form and structure of tropical savannas in northern Australia	CDU	Remote sensing/GIS researcher, Department of Environment & Heritage, Canberra
C. Macgregor	Achieving sustainable urban communities in the Australian Savanna by ecological planning and community participation	JCU	Bureau of Rural Sciences, then research in UK
C. Menges	The application of radar remote sensing to tropical savannas in the NT	CDU	Researcher, university sector, Canada
C. Mobbs	Regional resource planning: the potential and limits of adaptive and collaborative models	ANU	Integration Manager, Land & Water Australia, Canberra
K. Pfitzner	The use of remotely sensed data, ancillary data and GIS technologies for the evaluation of the rehabilitation of two mine sites	CDU	Remote Sensing Officer with ERISS, Darwin
M. Runcie	The ecology and behaviour of the rock-dwelling possums (<i>Petropseudes dahli</i> and <i>Wyulda squamicaudata</i>)	CDU	Research Scientist, CSIRO, then consultant and now family responsibilities, Sydney
B. Sharp	The roles of fire and grazing in producing long-term landscape-scale vegetation change in an Australian tropical savanna	Oxford, UK	Researcher, Ministry of Fisheries, NZ
T. Vigilante	An ecological study of the North Kimberley landscape	CDU	Project Officer (land and sea management), Kimberley Land Council, Derby
G. Whiteman	The impact of livestock grazing on the genetic diversity of the grass <i>Heteropogon contortus</i> in Queensland tropical savannas	JCU	Researcher, CSIRO Sustainable Ecosystems, Alice Springs+
C. Xiaoyong	Production, structure and carbon balance of a Eucalyptus open forest in tropical savanna, Northern Australia	CDU	Researcher, Department of Earth and Environmental Science, Okanagan University College, Canada
Y. Zhang	Spatial patterning of resources for granivores – developing a model for habitat management	CDU	Spatial Data Management Officer, NT DIPE, Alice Springs

Table 10 Employment of current TS–CRC supported PhD candidates – Round 2.

Student	PhD Project Title	Uni	Employment
Jenny Brazier	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia	CDU	Permanent position as Environmental Chemist, ERISS.
Ron Firth	Ecology and conservation status of the Brush-tailed Rabbit-rat (<i>Conilurus penicillatus</i>)	CDU	Free-lance environmental consulting and fauna survey, as Indicus Biological Consultants P/L
John Guenther	VET as a tool for regional planning and management in savanna communities	CDU	Full time consultant educational researcher
Steve Johnson	Culture as Process: Correlativity, Contest and Tourism on Yanyuwa Country.	UQ	Contract position, Project Officer, NAILSMA
Jenny Moffatt	Graziers' perceptions of sustainable development and what this means for policy	UQ	Contract position, Research Officer for the Centre for Social Responsibility in Mining which is under the Sustainable Minerals Institute, UQ
Aaron Petty	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park	Uni of CA, Davis	Research Associate, Healthy people, healthy country project, School for Environmental Research, CDU
Natalie Rossiter	The impact of grass invasion on ecosystem processes in Australia's savannas	CDU	Weeds Policy Officer, NT NRETA
Kathy Seton	<i>Li-Yanyuwa li-nhanawaya li-murndangumara'</i> : Yanyuwa Women, Land Rights and Relations to Country.	UQ	Anthropological research consultant
Adele Acton (nee Vagg)	Integrating on-ground actions that contribute to regional and property goals for sustainable land management	UQ	To be advised
Annemarie van Doorn	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District	Uni. of Florida	Sessional lecturing position, Batchelor Institute for Indigenous Studies. Now returned to full time study
Michelle Watson	Faunal responses to alteration in plant community structure in tropical savannas	CDU	Contract position, Project Officer, various fauna survey consultancies. Now full tie position with SA government as environment officer.
Mark Ziembicki	Ecology and conservation of the Australian Bustard <i>Ardeotis australis</i> in northern Australia	Uni. of Adelaide	Contract position, Research Officer, School of Resources, Environment & Society, Australian National University and Biodiversity Conservation Unit, NT

Performance measures

Quality and Relevance of the Research Program

- Figure 2 and Table 14: Consultancies and contracts secured by the Centre
- Figure 3: Number of publications that acknowledge the CRC
- Figure 4: Extent to which researchers are attracted to the Centre
- Figure 5: Awards and invited papers

Strategy for Utilisation and Commercialisation of Research Outputs

- The Savanna Advisory Committee is providing direction to the research program.
- Specific issue forums such as the North Australian Fire Managers Forum are well supported (see p. 28.)
- Researchers participating in education and extension project activities. See Figure 6, Number of non-university or collaborative staff involved as supervisors.
- Table 12, 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
 - 2172 publications sold and 267 distributed free. More than 46,000 publications downloaded since 2001.
 - Research findings also available on newly developed websites aimed at land managers and schools.
- Uptake of outputs:
 - The NAFI website <www.firenorth.org.au> maps active fires and previously burned areas was well used by a range of fire managers in the 2004 fire season (several hundred to a thousand intensive visits to the site each week) and is transforming fire management in the north.
 - 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.
- Commercialisation of outputs: TS-CRC research and uptake has underpinned greenhouse offset agreement between NT Government and DLNG in which DLNG will fund Arnhem Land fire managers for next 17 years at over \$1M a year (see p. 7.)

Education and Training

- One enrolment in Professional Doctorate (course newly offered).
- 57 students graduated from the TEM course.
- TS-CRC is collaborating with the Indonesian university Satya Wacana Christian University (UKSW) to build capacity for postgraduate education in savanna management in eastern Indonesia.
- A total of 31 research students receive support from the TS-CRC, as either full scholarships, top-up scholarships or operational support. See Figure 7, Number of postgraduate students.
- More than 60 Indigenous students have taken up special scholarships/study assistance in land and sea management courses (supported by TS-CRC and offered through NAILSMA)

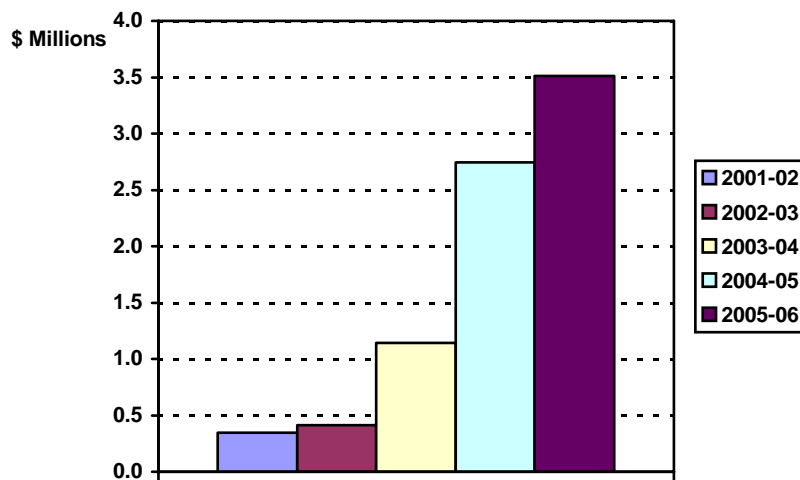
Collaborative Arrangements

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

Resources, Management Structure and Performance Evaluation

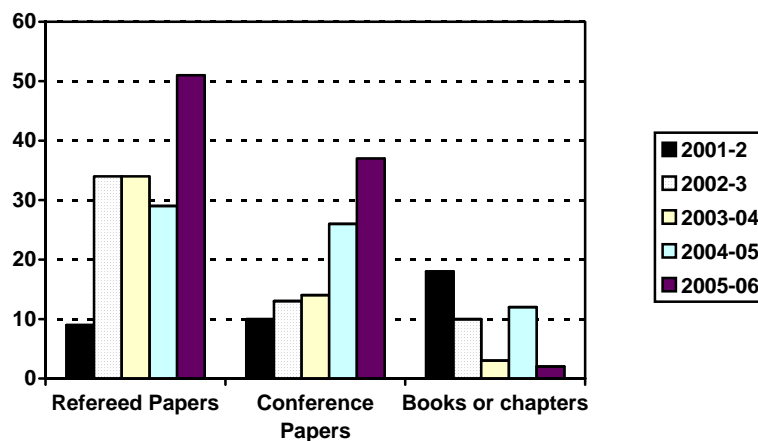
- Effective and efficient project management system.
- Resources committed in accordance with the Commonwealth's agreement under direction of the Board of Management, taking into account input from the Savanna Advisory Committee and the Management Group.

Figure 2 External contracts administered by the CRC *



* Also see Table 14, Appendix 1, for grants administered by other agencies.

Figure 3 Number of Publications that acknowledge the CRC



*(In press publications from previous year included)

Figure 4 Extent to which researchers are attracted to visit the Centre

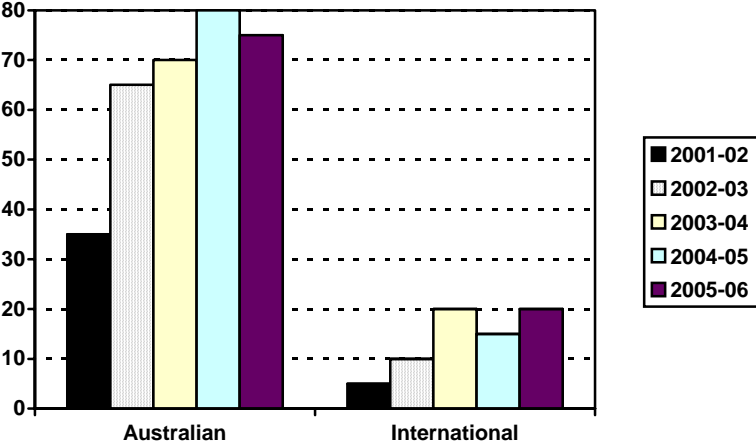


Figure 5 Awards and invited papers

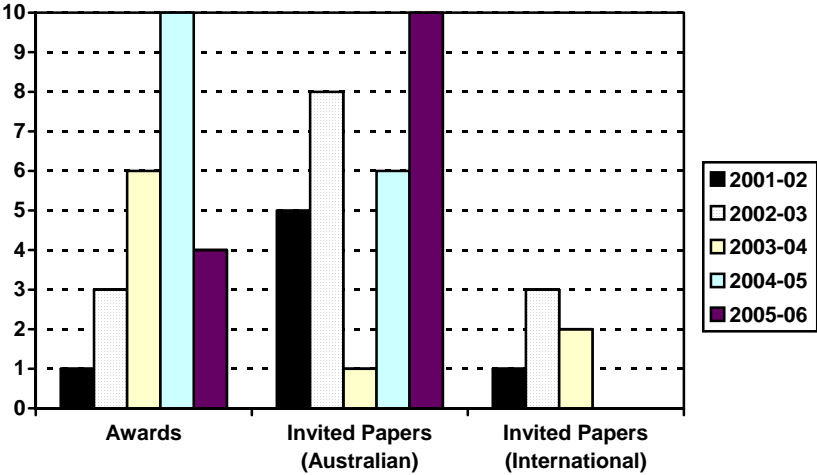


Figure 6 Number of non-university or collaborative staff involved as supervisors

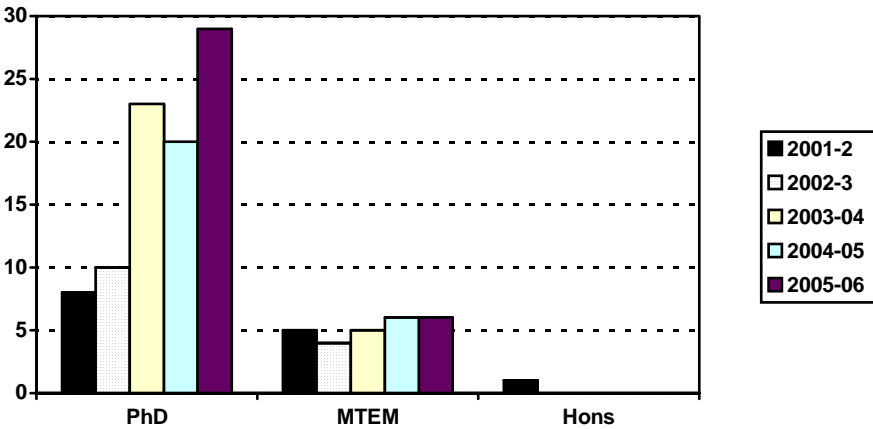
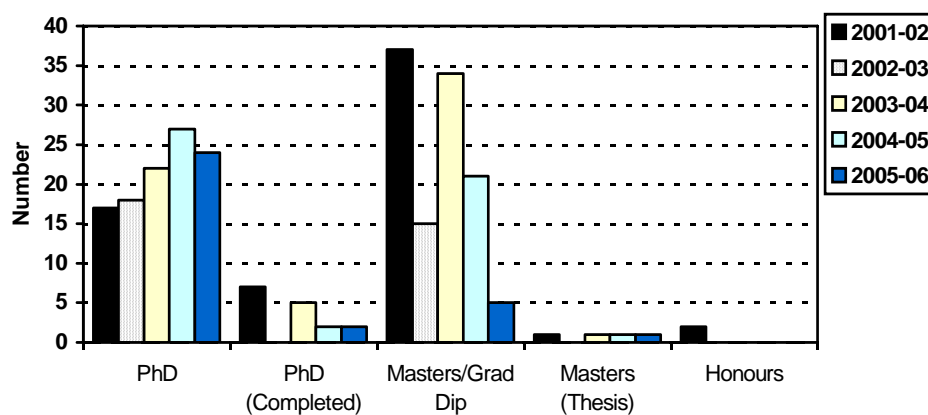


Figure 7 Number of Postgraduate Students



* Masters thesis upgraded to PhD during 2003. *

* Three PhD students withdrew during 2005-06

Communication Strategy

In 2005–06 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 the commercialisation that arises from such links are premised on the research and adoption that has been achieved through participative projects. For example, the CRC’s fire management projects have established a research-based case for reducing greenhouse gases and conserving cultural and biodiversity values through improved fire management on the Arnhem Land Plateau, and the CRC’s projects have seen Arnhem Land fire managers take up techniques and tools that allow them to manage fire more effectively. Against this background the NT Government was able to negotiate a 17 year multi-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 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 *Tropical savannas knowledge for schools* project 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 shows such as *Bush Telegraph*, as well as local print media and radio. The CRC continues to contribute to the Science in Radio series on local ABC radio in Townsville, where CRC researchers regularly discuss their area of research interest. Care is taken not to jeopardise the pathway to adoption strategy above with these awareness raising activities—collaborative links will not be risked for the sake of a high-profile media coverage.

Public presentations

As the TS–CRC sees the education system as being the main vehicle for raising public awareness, rather than public presentations, our public presentations are largely aimed at savanna stakeholders who have an interest in aspects of our work. See Table 11, Staff outreach activities, p. 45. Various displays of the Centre’s activities were shown at local events that attracted audiences interested in sustainable land use and conservation.

Public relations and communication

The biannual newsletter *Savanna Links* reaches around 3000 people across northern Australia interested in the tropical savannas. The newsletter helps raise awareness of the tropical savannas and land management issues in the broader community.

Kantri Laif a twice-yearly newsletter on Indigenous natural and cultural resource management, produced by NAILSMA is providing a key outlet for Indigenous NRM across north Australia. With each issue more than 2700 copies were distributed to Indigenous organizations and communities across north Australia as well as to NRM agencies and groups involved in Indigenous land management.

The Centre’s website continues to be a major path to raising awareness about the tropical savannas and provides an important outlet for access to practical NRM publications (46,000 PDFs were downloaded over the past five years.)

The Centre’s *North Australian Fire Information* website, although aimed at fire managers, continues to receive considerable publicity in the broader NRM community and raised awareness of fire management in the north.

The Centre has had 2439 of its publications, plus thousands of newsletters, sold or distributed in 2005–06 and while these publications are largely aimed at land managers and planners many of them are stocked in public libraries across the savannas and publications such as the natural history publication *Termites of Northern Australia* are greatly appreciated by the general public.

Table 11 Presentations—Staff Outreach Activities

<i>Outreach Type</i>	<i>Pastoral Industry Sectoral/Resource management</i>	<i>Conservation Interest Groups</i>	<i>Mining Industry Sector</i>	<i>Aboriginal Community Groups</i>	<i>Tourism Industry Sector</i>	<i>Researchers</i>	<i>Education; schools & tertiary</i>	<i>General Public/Politicians</i>
Workshop	3			2		1	1	
Seminar	2					12	3	1
Field days	3							
Open Day								
Presentations at Meetings	7							

The CRC hosted its bi-annual project and staff meeting at the end of February 2005. Presentations were given on the progress and findings of research as well as an outline of the CRC's rebid. The Centre also hosted, or co-hosted workshops on riparian research and management issues, weed research and management issues, two vegetation dynamics workshops with project staff from a wide range of agencies and research organisations, and a fire management workshop in Indonesia.

Table 12 Public relations and communication: Media coverage

Topic/subject	TV	Radio	Print	Online	Stakeholder newsletter
NAILSMA, Indigenous research, Turtle and Dugong research; Weeds on Aboriginal lands	3	3	3	12	3
Fire knowledge project; North Australian Fire Information website; Fire research, national and international	1	4	5	21	11
Biodiversity in northern Australia: Research, impacts and management (wallaroos, birds)		2	3	8	3
Threatening processes; impacts of weeds				3	3
Vegetation change; research and impacts of land management				2	2
Soil biota, nutrients and landscape health		2		2	
Graziers' views on sustainable land management, decision making, sustainable grazing research		7	3	10	
Knowledge building in northern Australia, Tropical knowledge for schools		1		2	1
Resources, economic health and ecosystem services of Northern Australia ad		2		2	
Total	4	20	14	61	22

Specified Personnel

The head office of the TS–CRC is at the Charles Darwin University, Darwin, with a second office at James Cook University, Townsville and support from the Department of Agriculture in Western Australia at Kununurra.

The Darwin office has seven staff: the Chief Executive Officer; Communication Coordinator; Business Manager; Contracts Manager; Assistant to the CEO; Tropical Savannas Knowledge in Schools Project Leader; and Assistant to the Business Manager. The Townsville office has one full-time staff member: the Publications and Web Manager and one part-time assistant for this role.

Table 13 Specified Personnel

Title and Name	Contributing Organisation	% of total working time in CRC	Role in Centre
Prof G Duff	CRC	100	CEO
P Jacklyn	CRC	100	Communication Coordinator and Theme Leader 4
B Slatter	CRC	100	Business Manager
D Garnett	CRC	100	Contracts Manager
J Ludwig	CRC/CSIRO	100	Theme Leader 1
P Novelly	CRC/WA	100	Theme Leader 2
P Whitehead	CRC/Northern Territory/CDU	40	Theme Leader 3
J Morrison	CRC/Northern Territory	100	Theme Leader 4

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
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
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
EPA (Qld)	Queensland Environmental Protection Agency
GIS	Geographic Information System
GLM	Grazing Land Management
HDR	Higher Degree Research
ICAT	(International) Centre for Appropriate Technology
ILC	Indigenous Land Corporation
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 DNRETA	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
QFRA	Queensland Fire and Rescue Authority
QPWS	Queensland Parks and Wildlife Service
RGSQ	Royal Geographic Society of Queensland
RIRDC	Rural Industries and Research Development Corporation
RS	Remote sensing
SAC	Savanna Advisory Committee
SME	Small to Medium Enterprises
SPAG	Scientific Program Advisory Group
SSABSA	Senior Secondary Assessment Board of South Australia
TEM	Tropical Environmental Management
TRARC	Tropical Rapid Appraisal of Riparian Condition
TS-CRC	Tropical Savannas Management Cooperative Research Centre
TWS	The Wilderness Society
UKSW	Satya Wacana Christian University
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
WRA	Weed Risk Assessment
WWF	World Wide Fund for Nature

Appendix 1

Table 14 Consultancies and Research Contracts

	Type	Consultant	Consultancy	Funding Source	Amount
1	Government	J. Russell-Smith TS-CRC / NT BFC	Improving Greenhouse emissions estimates associated with savanna burning in the Northern Territory	Greenhouse Office	\$400,000 May 05–Jun 08
1	Government	J. Morrison, TS-CRC	Indigenous engagement in Water Management across Northern Australian Indigenous Estate	LWA	\$69,100 May 05–Dec 05
1	Government	G. Duff, TS-CRC	Integrated natural and cultural resources management in the east Kimberley	LWA / ILC / AgWest	\$1,154,000 Mar 04 – Dec 05
1	Government	G. Duff, TS-CRC	North Australian Fire Information	NHT	\$1,897,277 Apr 04 – Jun 06
1	Industry	J. Russell-Smith	Fire Management of Woody Vegetation in Gulf Region	MLA	\$418,000 Oct 02–Sept 06
2	Industry	A. Fisher, NT DNRETA	Biodiversity conservation in productive grazing systems in northern Australia	MLA—Donor Company scheme	\$116,792 Mar 03–Jun 06
2	Industry	A. Fisher, NT DNRETA	Sustainable development of northern grazing lands	MLA—via sub-contract with CSIRO SE	\$124,145 Mar 03–Sep 06
1	Government	J. Russell-Smith TS-CRC / NT BFC	Estimating Greenhouse gas emissions from Savanna fires	NHT	\$135,000 Jan 06 – Dec 07
1	Government	P. Jacklyn, TS-CRC	Web based mapping of Biodiversity, Weeds and Feral information	NRM Board (NT) Inc	\$279,000 May 06 – Sep 08
1	Government	J. Morrison, TS-CRC	Socio economic study of Indigenous Management of Dugong and Marine Turtles	DEH	\$60,000 Jun 06 – Jun08
1	Government	J. Morrison, TS-CRC	Indigenous ecological knowledge scoping study and support plan	NRM Board (NT) Inc	\$97,725 Jan 06 – Jun 06
1	Government	J. Morrison, TS-CRC	Enterprise Development Officer for low capacity Indigenous Ranger Groups	NRM Board (NT) Inc	\$246,000 May 06 – Sep 08
1	Government	J. Morrison, TS-CRC	Indigenous Knowledge Forums in remote Communities	Christensen Fund	\$200,000 USD Sep 05 – Feb 07
1	Government	S. Winderlich	Nest fate of flat back turtles in KNP	KNP	\$12,270 May 06 – Jun 06

Table 14 Consultancies and Research Contracts cont.

	Type	Consultant	Consultancy	Funding Source	Amount
1	Government	J. Morrison, TS-CRC	Develop institutional arrangements for Indigenous participation in the National Water Initiative	LWA	\$234,763 Jun 06 – May 07
1	Community	J. Morrison, TS-CRC	North Australian Indigenous leadership, scholarship and communication	Christensen Fund	\$115,532 Sep 04–Aug 05
1	Government	G. Duff, TS-CRC	Dugong and marine turtle management	NHT	\$3,800,000 Jan 05–Jun 07
1	Government	J. Morrison TS-CRC	Development of Indigenous Knowledge capacity across Northern Australia	LWA	\$292,860 May 04–Jun 06

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

Table 15 Centre research users and the basis of interaction

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				✓				
Conservation interest groups								
World Wide Fund for Nature				✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Conservation interest groups cont.								
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								
McArthur River Mining Pty Ltd	✓			✓				
ConocoPhillips				✓	✓			
Earth, Water, Life Sciences Pty Ltd				✓				
Queensland Nickel			✓	✓				
Ergon Energy				✓				
Nabalco			✓	✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
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			✓	✓				
Central Land Council				✓				
Torres Strait Regional Authority			✓	✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
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			✓	✓	✓			
Environment Australia (Biodiversity Group)				✓	✓			
Environment Australia (State of Environment)				✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
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				✓				
Department of Agriculture and Food WA	✓	✓	✓	✓				
Department of Land Administration WA			✓	✓				
Department of Conservation and Land Management WA		✓	✓	✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Government agencies cont.								
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		✓	✓	✓				
Queensland Environment Protection Agency		✓	✓	✓		✓		
Australian Greenhouse Office			✓	✓				
North Australia Rural Fire Managers' Forum				✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Government agencies cont.								
National Land and Water Resources Audit				✓				
Western Australia Fire & Emergency Services Authority				✓				
DEH, Director of National Parks	✓	✓	✓	✓	✓			
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				✓				
CRC for Aboriginal and Tropical Health				✓		✓		
CRC for Desert Knowledge			✓	✓				
CRC for Freshwater Ecology				✓				
CRC for Cotton				✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Cooperative Research Centres cont.								
CRC for Sustainable Tourism			✓	✓				
CRC for Catchment Hydrology			✓	✓				
CRC for Greenhouse Accounting			✓	✓				
CRC for Tropical Plant Protection			✓	✓				
CRC for Weed Management			✓	✓				
Community groups and professional bodies								
Desert Uplands Build-up and Development Strategy Committee				✓				
Dalrymple BeefPlan Producer Group				✓				
Sturt Plateau Best Practice Group				✓				
Victoria River District Conservation Association				✓				

Table 15 Centre research users and the basis of interaction cont.

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 cont.								
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				✓				
Victoria River District Regional Bushfire Council Committee				✓				
Roper River Landcare Group				✓				
Coastcare				✓				
Burdekin Rangelands Strategy Implementation Group				✓				
Landcare Council of the NT			✓	✓	✓			

Table 15 Centre research users and the basis of interaction cont.

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 cont.								
Southern Gulf Catchments Inc.			✓	✓				
WA Rangelands Regional Group			✓	✓				
Kimberley Regional Fire Management Project			✓	✓		✓		
Upper Burdekin Landcare Group				✓				
Dalrymple Landcare Committee				✓				
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				✓				

Table 15 Centre research users and the basis of interaction cont.

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 cont.								
James Cook University		✓	✓	✓		✓		
University of Queensland		✓	✓	✓		✓		
Curtin University				✓				
Charles Darwin University	✓	✓	✓	✓		✓		
University of Melbourne			✓	✓				
Australian National University	✓		✓	✓		✓		
Central Queensland University				✓				
Batchelor Institute of Indigenous Tertiary Education	✓			✓		✓		
Murdoch University	✓			✓				
University of Adelaide				✓				
South Australian Museum				✓				
International collaboration								

Table 15 Centre research users and the basis of interaction cont.

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 cont.								
Colorado State University			✓					
University of Virginia			✓					
Indonesian fire managers (through ACIAR)			✓	✓		✓		
University of Ruhr			✓	✓				
University of Florida				✓		✓		
NASA, USA			✓	✓				
Educational institutions								
University of Wurzburg			✓	✓				
Texas A&M University								
University of London				✓				
Royal Botanic Gardens, Kew				✓				
Conservation International, USA				✓				
CSIR, South Africa				✓				
University of Cape Town				✓				

Table 15 Centre research users and the basis of interaction cont.

Organisation	Represented on Board, committees	Partner agency	Collaborative research	Information/ research exchange	Contract research	Cooperative training	Collaborative grants	Contracted by Centre
Educational institutions								
Natural History Museum, London				✓				
Japanese Space Development Agency			✓	✓				
University of California				✓				
European Space Agency				✓				
Institute Superieur d'Agriculture Rhone Alpes				✓				
South African National Park Service			✓	✓				
Satya Wacana Christian University (Indonesia)				✓		✓		

Appendix 2

Table 16 Status of Higher Degree by Research Students

Students recruited 2004	Project Title	Uni	Supervisors	Start	Funding	Status
Jenny Brazier	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia	CDU	D Parry (CDU) N Munksgaard (CDU) H Heijnis (ANSTO) A Bollhoefer (ERRISS)	2004	TS-CRC CDU ANSTO	On track #
Kristine Brooks	Evaluating exotic grass management in terms of native vegetation restoration	CDU	S Setterfield (CDU) M Douglas (CDU) B Grace (NT DIPE)	2004	TS-CRC CDU	On track
Caroline Chong	Regeneration dynamics in a disturbance-prone landscape: population genetics and ecology of tropical riparian <i>Melaleuca</i>	JCU	M Waycott (JCU) W Edwards (JCU) R Pearson (JCU) G Morgan (QEPA)	2004	TS-CRC JCU Australian Centre for Tropical Freshwater Research	On track
Christopher Holloway	Hierarchy, distribution and spatial utilisation of patches by cattle in a semi-arid tropical savanna	JCU	D Gillieson (JCU) P O'Reagain (QDPI) I Gordon (CSIRO) P Valentine (JCU)	2004	TS-CRC JCU QDPI	On track
Kasper Johansen	A framework for riparian zone mapping over local to regional scales in Australian tropical savannas	UQ	S Phinn (UQ) M Douglas (CDU) J Lowry (ERISS)	2004	TS-CRC UQ	On track
Jason Jones	Bioregional planning for biodiversity conservation in the tropical savannas of northern Australia	UQ	C McAlpine (UQ) A Peterson (UQ) G McDonald (CSE) J Woinarski (NT DIPE)	2004	TS-CRC UQ	Withdrawn

Table 16 Status of Higher Degree by Research Students

Students Recruited 2004	Project Title	Uni	Supervisors	Start	Funding	Status
Allyson Lankester*	Social investigation of factors influencing graziers' decision making with regard to riparian management in the upper Burdekin catchment region	JCU	P Valentine (JCU) M Fenton (JCU) R Landsberg (Trafalgar Station)	2004	TS-CRC JCU Australian Centre for Freshwater Research Land & Water Australia	Completed
Gillian McCloskey	Assessment of Riparian Zone Stability from a Geomorphological Perspective in the Victoria River District	CDU	G Boggs (CDU) M Douglas (CDU) J Ludwig (CSIRO) B Wasson (CDU)	2004	TS-CRC CDU CSIRO	On track
Aaron Petty	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park	UC Davis	M Douglas (CDU) D Bowman (CDU) R Kennett (KNP)	2004	TS-CRC NSF Pacific Rim Grant CDU	On track #
Sarah Sheehan	The interactions between grazing and the spread of invasive aquatic grasses	JCU	R Congdon (JCU) P Williams (QNPWS)	2004	TS-CRC JCU Smart state Grant	Withdrawn
Katherine Witt (nee Taylor)	Rights and responsibilities in land ownership and natural resource management	UQ	W Carter (UQ) D Cameron (UQ) R Greiner (CSIRO)	2004	TS-CRC UQ	On track
Students recruited during CRC transition						
Nicole Cranston	The effectiveness of riparian fencing for biodiversity conservation	CDU	M Douglas (CDU) A Fisher (NT DIPE) S Setterfield (CDU)	2003	TS-CRC CDU VRD Conservation Assn	On track – returned from leave of absence

Table 16 Status of Higher Degree by Research Students

Students Recruited during CRC transition	Project Title	Uni	Supervisors	Start	Funding	Status
Leasie Felderhof	Fire management in Queensland's North West Highlands	JCU	David Gillieson (JCU) G Cook (CSIRO)	2003	TS-CRC Ergon Energy QPWS	On leave of absence
Ron Firth	Ecology and conservation status of the Brush-tailed Rabbit-rat (<i>Conilurus penicillatus</i>)	CDU	R Noske (CDU) P Whitehead (CDU) T Griffiths (CDU) J Woinarski (NT DIPE)	2001	TS-CRC	On track #
John Guenther	VET as a tool for regional planning and management in savanna communities	CDU	I Falk (CDU) A Arnott (CDU) G Ramsay (ICAT)	2003	TS-CRC CDU	Completed #
Marilyn-Joy Hubner	Cross-cultural exchange of Indigenous knowledge	UQ	H Ross (UQ) B Carter (UQ) R Beviss (EA)	2003	TS-CRC UQ	Withdrawn
Steve Johnson	Culture as Process: Correlativity, Contest and Tourism on Yanyuwa Country.	UQ	D Hafner (UQ) J Bradley (UQ) P Cooke (Northern Land Council)	2001	TS-CRC UQ	On track #

Table 16 Status of Higher Degree by Research Students

Students Recruited during CRC transition	Project Title	Uni	Supervisors	Start	Funding	Status
Jenny Moffatt	Graziers' perceptions of sustainable development and what this means for policy	UQ	H Ross (UQ) G Lawrence (UQ) J Taylor (Rangelands Australia)	2001	TS-CRC UQ	On track #
Lionel Pero	Combining Theory with Practice: Case Study Lessons and Insights for Improving Community-Based Regional NRM Group Decision-Making	UQ	G McDonald (UQ/CSIRO) T Smith (CSIRO) McAlpine (UQ) P Lawrence (Q DNR&M)	2003	TS-CRC UQ	On track
Elizabeth Poon	Nitrogen distribution and landscape function in grazed and ungrazed semi-arid savanna, north Queensland	UQ	S Schmidt (UQ) J Ludwig (CSIRO) H Possingham (CSIRO)	2003	TS-CRC UQ	On track
Euan Ritchie	The macroecology and conservation of the antilopine wallaroo (<i>Macropus antilopinus</i>).	JCU	C Johnson (JCU) A Krockenberger (JCU) S Garnett (CDU)	2002	TS-CRC JCU Australia & Pacific Science Foundation Australian Geographic Cape York Peninsula Development Association	On track
Natalie Rossiter	The impact of grass invasion on ecosystem processes in Australia's savannas	CDU	M Douglas (CDU) S Setterfield (CDU) L Hutley (CDU) G Cook (CSIRO)	2003	TS-CRC CDU CSIRO	On track #

Table 16 Status of Higher Degree by Research Students

Students Recruited during CRC transition	Project Title	Uni	Supervisors	Start	Funding	Status
Kathy Seton	<i>Li-Yanyuwa li-nhanawaya li-murndangumara</i> : Yanyuwa Women, Land Rights and Relations to Country.	UQ	J Bradley (UQ) D Hyndman (UQ) P Cooke (Northern Land Council) B Hocking (QUT)	2001	TS-CRC UQ	On track #
Colin Trainor	Responses of wildlife to environmental variation and land use in Lautem District, Timor-Leste (East Timor)	CDU	R Noske (CDU) J Woinarski (NT DIPE)	2003	TS-CRC CDU UK Parrot Society BirdsLife International	On track #
Leonie Valentine	Impacts of burning for weed management on bird and reptile assemblages in grazed open woodlands	JCU	C Johnson (JCU) L Schwarzkopf (JCU) T Grice (CSIRO) J Ludwig (CSIRO)	2003	TS-CRC JCU Birds Australia Norman Wettonhall Award	On track
Adele Acton (nee Vagg)	Integrating on-ground actions that contribute to regional and property goals for sustainable land management	UQ	O Bosch (UQ) H Ross (UQ) D Walker (CSIRO)	2001	TS-CRC UQ	Completed
Annemarie van Doorn	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District	Uni. of Florida	B Brook (CDU) J Woinarski (NT DIPE)	2001	TS-CRC University of Florida VRD Conservation Assocn KCT	On track #

Table 16 Status of Higher Degree by Research Students

Students Recruited during CRC transition	Project Title	Uni	Supervisors	Start	Funding	Status
Michelle Watson	Faunal responses to alteration in plant community structure in tropical savannas	CDU	P Whitehead (CDU) J Woinarski (NT DIPE)	2001	TS-CRC	On track #
Mark Ziembicki	Ecology and conservation of the Australian Bustard <i>Ardeotis australis</i> in northern Australia	Uni. of Adelaide	David Paton (Uni. of Adelaide) J Woinarski (NT DIPE)	2002	TS-CRC University of Adelaide Birds Australia Australian Bird Environment Foundation Wildlife Conservation Fund (SA NPWS) 2001 Herman Slade Foundation AFFA Science Award for Young People	On track #

* MSc Student

Now studying part-time, or on short-term leave of absence, after taking employment opportunities.

Appendix 3

Publications

Refereed papers

Andersen, A.N., Hertog, T., & Woinarski, J.C.Z. 2006, 'Long-term fire exclusion and ant community structure in an Australian tropical savanna: congruence with vegetation succession', *Journal of Biogeography* 33, 823–832.

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Dawes-Gromadzki, T.Z. 2005, 'The termite (Isoptera) fauna of a monsoonal rainforest near Darwin, northern Australia', *Australian Journal of Entomology*, 44, 152–157.

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Fensham R.J. & Fairfax, R.J. 2006, 'Can burning restrict eucalypt invasion on grassy balds?', *Austral Ecology*, 31:317–325.

Fensham R.J. & Fairfax, R.J. 2005, 'Preliminary assessment of gidgee (*Acacia cambagei*) woodland thickening in the Longreach district, Queensland', *The Rangeland Journal*, 27:159–168.

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* Hutley, L.B. Leuning, R. Beringer, J. & Cleugh, H.A. 2005, 'The utility of the eddy covariance techniques as a tool in carbon accounting: tropical savanna as a case study', *Australian Journal of Botany*, 53: pp. 663–675.

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Kutt, A.S., & Kemp, J.E. 2006, 'Distribution, habitat and conservation status of *Leggadina lakedownensis* in Queensland', *Australian Zoologist*, 33, 258–64.

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* Williams, R.J., Carter, J., Duff, G.A., Woinarski, J.C.Z., Cook, G.D. & Farrer, S.L. 2005, 'Carbon accounting, land management, science and policy uncertainty in Australian savanna landscapes: introduction and overview', *Australian Journal of Botany*, 53: 583–588.

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Monographs

Kutt, A.S., E.E. Bolitho, E.E., Retallick, R.W.R. & Kemp, J.E. 2005, 'Pattern and Change in the Terrestrial Vertebrate Fauna of the Pennefather River, Gulf of Carpentaria, Cape York Peninsula', in Gulf of Carpentaria Scientific Study Report', Geography Monograph Series No. 10, Royal Geographical Society of Queensland Inc., Brisbane, pp. 261–300

Conference and workshop papers

National

Jones, P., Aisthorpe, J. and Chilcott, C. 2006, 'Development of long term carrying capacity models for the Desert Uplands,' *Proceedings 14th Biennial Conference*, the Australian Rangeland Society.

Holmes, W.E. 2006, 'Tree clearing and thinning in qld desert uplands: one option in the quest for viability', in *Proceedings of the 2006 Rangelands Conference*.

Smith, C., Russell, I. & King C. 2005, 'Rats and Rice: Belief Network Models of Rodent Control in the Rice Fields of Cambodia', in *Proceedings of the MODSIM05 International Congress on Modelling and Simulation: Advances and Applications for Management and Decision Making*, A. Zerger, & R.M. Argent, eds, Modelling and Simulation Society of Australia and New Zealand, December 2005.

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Johansen, K. & Phinn, S., 2005. Characteristics of Savanna Riparian Zones and their Implications for Mapping Riparian Health Indicators for High Spatial Resolution Satellite Imagery', in *Proceedings of the North Australian Remote Sensing and GIS Conference*, 4–7 July 2005, Darwin.

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Armstrong, R., Yu, P. Morrison, J. 2006, 'Indigenous land and sea management and sustainable business management', paper presented to the International Indigenous Business and Entrepreneurship Conference, Albuquerque, New Mexico, June 19–22.

Rolfe, J. & Shaw, K. 2005, 'GLM+ delivers improved natural resource management and production outcomes to extensive grazing properties in the savannas of semi-arid north Queensland', in *Proceedings of the XXth International Grasslands Congress*, Glasgow, Scotland July 2005. (ed. J. A. Milne), Wageningen Academic Publishers, The Netherlands.

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Woinarski, J.C.Z. 2005, 'A difficult and destructive metamorphosis: conservation and land management in the Northern Territory in the 1950s', in *Modern Frontier: Aspects of the 1950s in Australia's Northern Territory*, J.T. Wells, M. Dewar and S. Parry, eds., Charles Darwin University Press, Darwin, pp. 33–55.

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Petty, A., D. Lindner, J. Freeman, & Bowman, D. 2005, Final Report of the Kakadu National Park Channel Change Project. Charles Darwin University, Darwin, Australia.

J Rolfe, J Kernot, B English, K Shaw, A Wilson(2005) Grazing management to improve regional ecosystems, land condition and optimise beef production in the Upper Herbert Catchment: Final report to Far North Queensland Natural Resource Management Ltd.

McDonald, G., Taylor, B. & Robinson, C. eds, 2005, Desktop review of regional NRM plans: findings and lessons, Project 3.3.5. Healthy Savanna Planning Systems, Tropical Savannas Management CRC, Darwin.

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National

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Chong, C. 2005, 'Riparian seedling resprouting ability and growth traits: functional strategies in a disturbance-prone ecosystem?', BZoNQ – Biological and Zoological Organisation of North Queensland Annual Conference, James Cook University, Townsville, 14–15 November.

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Guenther, J. 2005, 'Identity formation in Vocational education and training', paper presented to the National Centre for Vocational Education Research (NCVER) Conference, Wodonga, 5–8 July.

Guenther, J. 2006, 'Partners in practice: does the national VET rhetoric connect with reality?', paper presented to the Australian Vocational Education and Training Research Association (AVETRA) Conference, Wollongong, 19–21 April.

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Johansen, K. & Phinn, S. 2005, 'Characteristics of Savanna Riparian Zones and their Implications for Mapping Riparian Health Indicators for High Spatial Resolution Satellite Imagery', North Australian Remote Sensing and GIS Conference, Darwin, 4–7 July.

Kutt, A. 2005, 'Vegetation structural change and biodiversity', paper presented to the Vegetation Thickening Forum, Queensland Landcare Conference, Barcaldine, Queensland, 4–7 August.

Kutt, A. & O'Reagain, P. 2005, 'Long term effects of different grazing strategies on wildlife and pastoral production in a semi-arid tropical savanna woodland', paper presented to the Ecological Society of Australia, Annual Symposium, University of Queensland, Brisbane, 28 November–2 December.

Liedloff, A.C., Ludwig, J.A., Bartley R. & Coughenour, M.B. 2005, 'Modelling tropical landscapes for ecological management: what can we learn from preliminary Savanna.au simulations?' paper presented to the International Congress on Modelling and Simulation (MODSIM 05), Melbourne, 13 December.

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Morrison, J. 2006, 'Managing for the future: A culture based economy for northern Australia', paper presented to the Charles Darwin Symposium Series 2006, When People And Environment Collide In The Tropics, Charles Darwin University, Darwin, 11–12 May.

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