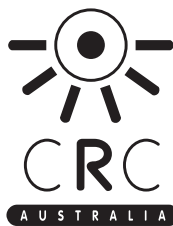




TROPICAL SAVANNAS CRC

Cooperative Research Centre for the Sustainable Development of Tropical Savannas



Established and Supported
under the Australian
Government's Research
Centres Program

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TROPICAL SAVANNAS CRC

Cooperative Research Centre for the Sustainable Development of Tropical Savannas

Annual Report 1999 ~ 2000

Part I

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Overview

This was the year when the benefits of the research theme structure and partner participation became evident. The efforts of the Board and management, stakeholders and research users, researchers, educators and communicators, in implementing our plans and projects, have begun to achieve benefits for Australia's tropical savannas. This year saw major efforts and achievements in coordination of research, education and communication to deliver useful outputs for tropical savanna managers and users.

A series of publications integrating research outputs into technical manuals and management packages, particularly on land management, fire and grazing was produced. Landscape health was defined and the basis of assessing it at a range of scales and uses developed. Landscape system models for both strategic and tactical analysis were developed and are being evaluated. The findings from landscape process and function projects are being incorporated into satellite and ground-based monitoring systems for adaptive management. Education courses and units were developed and delivered to a range of students and stakeholders.

The Centre further developed its role and reputation as a facilitator of collaboration and action in addressing major environmental issues. The North Australia Rural Fire Managers' Forum of senior representatives of the Queensland, Northern Territory and Western Australia rural fire services, continues to develop research, implementation and communication strategies of value across jurisdictions. The Land Administration and Land Management Forum had the major government and stakeholder organisations discussing ways to progress the often contentious and as yet unresolved issues of multiple and shared land management rights and responsibilities. Progress is being made.

Major pastoral companies in northern Australia used the Centre's ability to address complex issues and put together integrated teams of expertise in developing sustainable land management strategies which incorporate productive use and protection of conservation values. The Savannah Guides tourist group utilised the Centre in delivery of their accreditation training. The GIS developed by the Centre, and training in its use, provided the basis for land-management decision making by the Desert Uplands Build-Up and Development Committee.

We developed expertise and gained respect through our participation with Aboriginal groups in development of land-management plans and practices and of ethno-ecology using indigenous and scientific knowledge. These outcomes, together with research related to systems and cultures of Aboriginal management of their land, provide a sound basis for future policies and capacity building activities.

Our education program continues to ensure students and stakeholders learn of the very latest in research findings in the tropical savannas. Qualifications from Masters to Certificate are now available and accepted. With the addition of two further units, which are in preparation, a fully externally delivered Masters in Tropical Environmental Management will be available. Our first postgraduate students have submitted their theses and a number have already found employment.

Our award-winning website, with its Web-based information clearinghouse, *Savanna Information*, is now operational and receiving 20–30,000 visits per month. It is highly commended by users in Australia and overseas. The website is becoming a recognised gateway of information from a number of our stakeholder and partner organisations.

The quality of our work continues to improve. Our external Scientific Program Advisory and Evaluation Group reported to the Board that our project conduct and achievements were of an excellent standard and providing leadership in our field of environmental research. Our project leaders and staff have excelled themselves in the number and quality of publications, supervision of students and development of relevant management information.

The Board and stakeholder Consultative Committee have provided leadership in coordination across our program and between scientists, educators and stakeholders. Their influence, and the efforts of the Management Group, will continue to increase the beneficial outcomes from the Centre's program.



John Kerin
Chair, Board of Management



John Childs
Director Tropical Savannas CRC

MEASURING OUR PROGRESS

The TS–CRC’s research is focused on achieving key results under four themes: North Australia Landscape (NAL), Landscape Processes (LP), Ecosystem Management (EM) and Human Capability Development (HCD). We have identified these themes as most significant to the understanding and sustainability of the tropical savannas (see inside cover).

The Key Result Areas describe in broad terms what the themes should produce.

Key Result Areas

KRA 1: Definitions of healthy landscapes at spatial and temporal scales useful to landholders, managers and users

KRA 2: Methods for assessing landscape health incorporating landscape processes and resource status, at a range of spatial and temporal scales

KRA 3: Management options for ensuring sustainable use and conservation of tropical savannas at scales relevant to decision-makers

KRA 4: Information and learning products and access processes for tropical savanna stakeholders

The Centre’s targets, set out in Table 1, outline how these results will be achieved in Years six to seven of the Centre. Note that targets may flow on from more than one theme or key result area.

Table 1 also illustrates our progress to date in achieving these targets. Overall, the Centre made substantial gains during the year and significant progress toward achieving the majority of targets.

TABLE 1 PROGRESS AGAINST TARGETS

Target	KRA	Theme	Achievement of Target	Comment
1. A definition and description of the nature of, and requirements for, healthy tropical savannas ecosystems	KRA 1	NAL LP	Completed In Progress Waiting on resources or personnel	A document for scientists and stakeholders has been prepared
2. A statement about the general state of health of the tropical savannas	KRA 1	NAL	Completed In Progress Waiting on resources or personnel	To be drafted following acceptance of the method for defining savanna health
3. A framework (issues, processes) to assist decision makers in utilising landscapes/bioregions according to their capability while maintaining values for a range of users	KRA 1 KRA 3	NAL LP EM	Completed In Progress Waiting on resources or personnel	A framework is being developed within the Management Studies. Also subject of a project for the NLWRA
4. Pragmatic methods to assess the health of ecosystems	KRA 2	LP EM	Completed In Progress Waiting on resources or personnel	A NLWRA Audit project is developing and testing novel methodology in the VRD and Burdekin Management Studies
5. Pragmatic management options and their impacts for compatible use and conservation of tropical savanna ecosystems	KRA 3	LP EM	Completed In Progress Waiting on resources or personnel	Modelling and studies of fire, grazing and rubber vine are developing an understanding of impacts. Management guidelines are being formulated
6. Pragmatic fire management strategies	KRA 3	EM LP	Completed In Progress Waiting on resources or personnel	Workshops involving stakeholders are providing the technical basis for a comprehensive publication

TABLE I PROGRESS AGAINST TARGETS

Target	KRA	Theme	Achievement of Target	Comment
7. Frameworks for off-reserve/on-lease conservation and for on-reserve conservation	KRA 3	LP EM NAL	Completed In Progress Waiting on resources or personnel	Biogeographic studies are providing the parameters for conservation plans for granivorous birds
8. An information clearinghouse which is being used by stakeholders	KRA 3 KRA 4	EM HCD	Completed In Progress Waiting on resources or personnel	A Web-based clearinghouse has been released in development version and is undergoing assessment by users
9. The Masters of Tropical Environmental Management and Graduate Diploma in flexible modules and delivery modes	KRA 4	HCD	Completed In Progress Waiting on resources or personnel	Students from Australia and overseas are enrolled. Three units are completed with a fourth under development
10. Publications and other information products integrate knowledge from a range of sources: indigenous, experiential, scientific	KRA 4	HCD	Completed In Progress Waiting on resources or personnel	Manuals and booklets are being/have been completed on fire management and landscape assessment
11. Vocational education and extension modules for topics and management areas which influence sustainable use and conservation	KRA 4	EM HCD	Completed In Progress Waiting on resources or personnel	Modules are being developed on fire and weed management, Aboriginal land management and grazing management
12. Group learning activities have been conducted with stakeholders particularly in relation to the management studies	KRA 4	EM HCD	Completed In Progress Waiting on resources or personnel	The three management studies are conducting participative learning activities with stakeholders
13. A nationally utilised framework and techniques for rangeland monitoring	KRA 4	LP EM	Completed In Progress Waiting on resources or personnel	Two projects for the NLWRA have national relevance; monitoring landscape health and biodiversity status
14. Commercial revenue is being earned from publications and other information products, learning packages and contract research and education	KRA 4	EM HCD	Completed In Progress Waiting on resources or personnel	Contract projects are being conducted. Delivery of learning packages on the internet are being further developed

Highlights 1999 ~2000

The last year saw the new project portfolio and Theme structure—developed two years ago—mature and produce valuable and practical outputs. These included insights from the Aboriginal land management projects, findings of the Savanna computer model, and the development of a framework for savanna health.

The Centre also strengthened its links with user groups. These groups are starting to use the Centre's research outputs—from pastoral companies which adopted Centre research and consultancies with the NLWRA, to the continuing success of the North Australian Rural Fire Managers' Forum which brings together bushfire agencies from across the north.

There was also great progress in the education, extension and communication activities so that people across the tropical savannas have better access to land management research. These included the expansion of online and CD-ROM services in the Centre's Masters course, to the development of a suite of programs in extension and training, and the launching of the Web-based Information Clearinghouse.



Dominic Taylor-Hunt

Two Wagiman Elders explain to a group of young men various aspects of their traditional lands via a 'Men's map', developed as part of the Upper Daly project.

INDIVIDUAL HIGHLIGHTS

Research

- The Savanna computer simulation model developed by Project 4.3.4 produced key predictions for impacts of management on north Australian landscape.
- The suite of Aboriginal land—management projects (4.3.2) broke down barriers and built capacity in Aboriginal communities to deal with land—management issues.
- An innovative framework for savanna health, developed with user groups, was developed and will be used by the Centre's Management Studies.

- The first unified vegetation map of north Australia was developed, and will be released later in 2000.
- A new easy-to-use method of assessing landscape condition using both on-ground and satellite information was developed by Project 3.1.1.
- The Centre's project on fire management was instrumental in establishing two new NHT-funded fire management projects in the north Kimberley and in Cape York Peninsula.

Links with User Groups

- Workshops and meetings involving major pastoral groups such as the Heytesbury Pastoral Co. resulted in their adoption of some of the Centre's research findings on fire and grazing management strategies that incorporate productive use and protection of conservation values.
- The Centre secured two contracts with the National Land and Water Resources Audit involving rangeland condition and biodiversity monitoring. This should enhance the capacity of planners to use the Centre's research outputs.
- Major workshops involving key user groups were held for the Victoria River District and Burdekin Management Studies, helping to ensure research is applied on the ground.
- The North Australia Rural Fire Managers' Forum, chaired by the TS-CRC, saw senior representatives of the Queensland, Northern Territory and Western Australia rural fire services develop common research, communication and management practices across the north.
- The Savannah Guides tourism group continued to use the Centre in delivery of their accreditation training. The NT branch of the Institute of Australian Tour Guides used the Centre's research expertise in the delivery of regular seminars to keep tour guides informed on the ecology and culture of tropical savannas.

Education, Extension and Communication

- Our education program continues to provide qualifications from Masters to Certificate levels. All courses now allow access to remote users, largely through online or CD-ROM delivery.
- Our web-based information clearinghouse, *Savanna Information* is now operational and receiving 20–30,000 visits per month. It provides a gateway to our partner agencies' sites and access for people in Australia and overseas. This year the website received an award for its overall design.
- A range of programs were developed in the vocational education and training area, ranging from a video on weed management on Aboriginal lands, to a series on best practice and the design of a grazing land management module for extension services.
- A forum on land administration and management considered ways to progress the often contentious and as yet unresolved issues of multiple and shared land management rights and responsibilities.
- Innovative publications that integrate research findings across sectors and disciplines on landscape health and land management strategies for the Victoria River District were produced.

Structure and Management

STRUCTURE

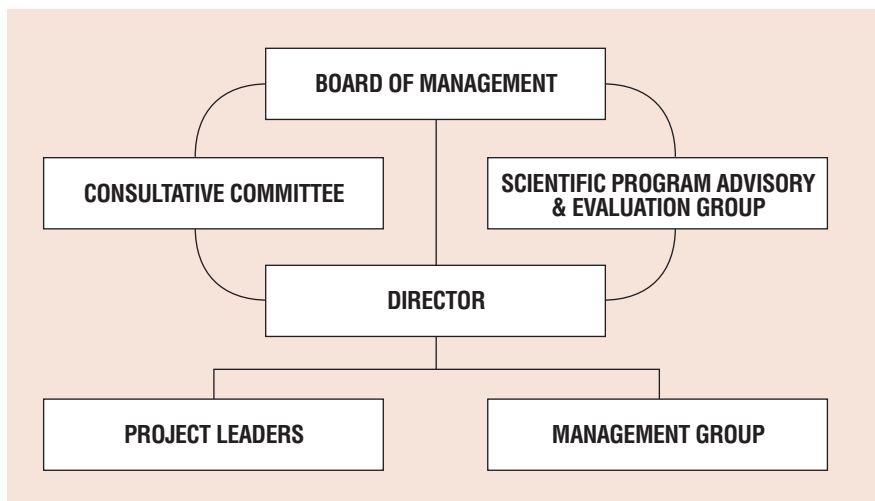
The sustainable use and conservation of northern Australia is the focal point of the TS–CRC. The Centre is an unincorporated joint venture between the Commonwealth and the partner agencies listed below:

- Agriculture Western Australia (AGWEST)
- Australian National University (ANU)
- CSIRO Division of Land and Water (CSIRO L&W)
- CSIRO Division of Tropical Agriculture (CSIRO TAG)
- CSIRO Division of Wildlife and Ecology (CSIRO W&E)
- Department of Conservation and Land Management (CALM WA)
- Environment Australia, Biodiversity Group (EA)
- James Cook University (JCU)
- Northern Territory Department of Lands, Planning and Environment (NTDLPE)
- Northern Territory Department of Primary Industries and Fisheries (NTDPIF)
- Northern Territory Power and Water Authority (NTPAWA)
- Northern Territory University (NTU)
- Parks and Wildlife Commission of the Northern Territory (PWCNT)
- Queensland Department of Natural Resource (QDNR)
- Queensland Department of Primary Industries (QDPI)
- Queensland Parks and Wildlife Service (QPWS)

The Australian National University gave 12 months notice that it would withdraw from the TS–CRC on 30 June 2000, because of the reduction in its research program in north Australia.

As a result of the strategic planning process carried out in 1997–98, the TS–CRC adopted the organisational structure shown in Figure 1. This new structure has proven to be a sound framework for implementing the Centre's strategic directions.

FIGURE I TS–CRC ORGANISATIONAL STRUCTURE



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 Consultative Committee.

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.



Northern Exposure

A number of TS–CRC Board members met in Townsville, May 2000. Seated from left: Neil Burrows, CALM; John Childs (ex-officio); John Kerin (Chair); Dr Steve Morton, CSIRO; Standing from left: Greg Robbins, QDPI; Tom Stockwell, NABRC; Mike Burgess, NTDPLE; Peter Cook, NLC; Rick Murray, Tourism Council Australia, NT.

The Board of Management met three times during the past year in Darwin and Townsville. These included joint field trips with the Consultative Committee to new projects.

Membership (as at 30 June 2000):

Representatives from the TS–CRC partner agencies

A/Prof. Charles Webb	Universities
Mr Peter Wellings	Environment Australia
Dr Neil Burrows	State of Western Australia
Dr Greg Robbins	State of Queensland
Mr Mike Burgess	Northern Territory of Australia
Dr Steve Morton	CSIRO

Stakeholder representation

Mr Peter Cooke	Aboriginal Land Councils (Aboriginal sector)
Mr Darryl Pearce	Chair of the Consultative Committee
Mr Tom Stockwell	North Australia Beef Research Council (pastoral industry)
Dr Tony Milnes	EWL Sciences Pty Ltd (mining industry)
Mr Rick Murray	Tourism Council Australia (tourism industry)
Ms Michelle Bowe	World Wide Fund for Nature (conservation sector)

The independent chair of the board of management is the Hon. John Kerin.

The Centre's director, Mr John Childs, is an ex-officio member.

Replacements

During the past year Dr Steve Morton replaced Mr Allan Kearns as the CSIRO representative. Mr Mike Burgess replaced Mr Roger Smith as the Northern Territory Government representative. Mr Peter Cooke replaced Ms Katy Haire as the Aboriginal sector representative. Mr Peter Wellings replaced Mr John Hicks as the representative for Environment Australia. Ms Michelle Bowe replaced Ms Carol Palmer as the conservation sector representative.

CONSULTATIVE COMMITTEE

The TS–CRC conducts research, communication and education activities for a range of stakeholders involved in land use and management in northern Australia. These stakeholders are Aboriginal, and conservation interests and the pastoral, defence, mining, and tourism industries.

Stakeholders formally contribute to strategy and program development through the consultative Committee. This Committee is established by, and reports to, the Board of Management.

The Consultative Committee strengthened the role of stakeholders this year by inclusion of representatives from the defence sector and the Indigenous Land Corporation. The Consultative Committee met three times during the past year in Townsville and Darwin.



Northern Exposure

Members of the Consultative Committee met in Townsville May 2000. Seated from left: Dr Laurie Corbett EWL Sciences Pty Ltd; Dr Sonia Tidemann, Batchelor Institute; Mr Darryl Pearce, Indigenous Management Group; Mr David Epworth, Balkanu Cape York Development Corp; Standing from left: Mr Paul Styles, Tourism Council Australia; Mr John Childs, TS–CRC.

Membership (as at 30 June 2000)

Mr Darryl Pearce (Chair)	Indigenous Management Group, Perth, WA
Mr Tony Law	Department of Defence, Darwin, NT**
Ms Kirsten Blair	Environment Centre, Darwin, NT*
Mr Tom Mann	North Queensland Beef Research Committee, Charters Towers, Qld
Mr Ross Brunckhorst	Pastoral Enterprises, Yeronga, Qld
Dr Phil Price	Land & Water Resources R&D Corp. Canberra, ACT
Dr Laurie Corbett	EWL Sciences Pty Ltd, Darwin, NT
Ms Rachel Siewart	Conservation Council of WA, Perth, WA*
Mr David Epworth	Balkanu Cape York Development Corp., Cairns, Qld
Mr Paul Styles	Tourism Council Australia, Darwin, NT
Mr Mark Horstman	Kimberley Land Council, Derby, WA
Dr Sonia Tidemann	Batchelor Institute of Tertiary Education, Batchelor, NT
Mr Paul Jenkins	Indigenous Land Corporation, Adelaide, SA**
Ms Imogen Zethoven	Queensland Conservation Council, Brisbane, Qld*

*The conservation sector has a membership rotating between Queensland, Western Australia and the Northern Territory, depending on the location of the meeting.

**Observers on the Consultative Committee

SCIENTIFIC PROGRAM ADVISORY AND EVALUATION GROUP

The Scientific Program Advisory and Evaluation Group (SPAEG) conducted its annual review of the Centre's program from 3–4 April 2000. The review was carried out through a participative, interactive workshop with the management group, theme leaders, project leaders and staff of the TS–CRC.

SPAEG was impressed with the progress made in the evaluation of the research program. SPAEG found that the TS–CRC is rapidly evolving into a cohesive and functional group, with a well-defined framework and clearly identified goals (KRAs).

Membership (as at 30 June 2000)

Prof. Jon Altman	Centre for Aboriginal Economic Policy Research Australian National University, Canberra, ACT
Dr Doug Cocks	CSIRO Division of Wildlife and Ecology, Canberra, ACT
Prof. Rod Gerber	Faculty of Education, Health and Professional Studies University of New England, Armidale, NSW
Prof. Ian Noble	Research School of Biological Sciences Australian National University, Canberra, ACT
Dr Roy Powell	Centre for Agricultural and Resource Economics Armidale, NSW
Dr John Vercoe	Consultant and Centre Visitor, Rockhampton, Qld

MANAGEMENT GROUP

The management group met eight times during the year. The role of the management group is to:

- set strategic and tactical direction;
- implement the strategy statement;
- support the theme leaders and process;
- be a sounding board for strategies;
- monitor performance against the strategy statement; and
- develop strategies for project development.

Membership (as at 30 June 2000):

Dr Alan Andersen	CSIRO W&E, Darwin, NT
Mr Rod Applegate	NT Department of Lands, Planning & Environment, Darwin, NT
Mr John Childs	Director, TS–CRC, Darwin, NT
Prof. Greg Hill	Human Capability Development theme leader, NTU, Darwin, NT
A/Prof. Ross Hynes	Desert Uplands Management Study leader, TS–CRC, Townsville, Qld
Dr Peter Jacklyn	Communication coordinator, TS–CRC, Darwin, NT
Mr Greg Leach	Parks and Wildlife Commission of the NT, Darwin, NT
Dr John Ludwig	Landscape Processes theme leader, CSIRO W&E, Darwin, NT
Ms Susanna Martin	Business manager, TS–CRC, Darwin, NT
Dr Paul Novelty	Ecosystem Management theme leader, AGWEST, Kununurra, WA
Dr Mick Quirk	Burdekin Management Study leader, QDPI, Charters Towers, Qld
Dr Peter Whitehead	North Australia Landscape theme leader, NTU, Darwin, NT

Cooperative Linkages

Cooperative linkages between the different groups of researchers and research users have been an important part of the Centre's success over the past five years. The TS–CRC is unique in that its research efforts are carried out by isolated research groups from different sectors and disciplines scattered over a vast distance spanning close to one-quarter of the Australian continent. The users of the research are also widely spread and diverse. The many links that now exist between these groups were challenging to create but are greatly appreciated. Links with national and international bodies are increasing as the Centre becomes recognised as the coordinating agency for tropical savanna research.

The Centre uses cooperative linkages to achieve three broad goals related to its mission:

- Links between researchers across disciplines (e.g. between ecologists and grazing researchers) help produce sustainable land-management research that can be more easily applied. These links are mainly achieved using our themes.
- Links with educational institutions that improve access to research for students. This is largely achieved through the education project.
- Links with land-management agencies that make research more useful for land managers. This is achieved through the management studies and through individual projects and other initiatives.
- Links between researchers across regions and countries are used to help achieve broader, whole-of-savanna research perspectives and better exchange of ideas. This is largely achieved through individual projects and the themes.

Unless otherwise stated, most of these links were established using face-to-face meetings or workshops and then followed up with continuing contact via phone and email.

Links that produce integrated research that is more easily used

In 1999–2000 the research themes made significant progress in producing distinctive, integrated outputs with a major series of workshops held in late 1999. This resulted in the planning of major publications suitable for a range of users on savanna landscape health and fire management. All publications will involve researchers from a range of disciplines and sectors and from across the savannas working together with user groups.

Other cooperative linkages within themes included:

- Project 4.3.4. *Modelling and Landscape Change* integrates outputs from many of the TS–CRC's projects to produce a computer model that can be useful to land managers. These include using savanna water balance data from Project 1.2.1; tree thickening data from Project 1.1.3; impacts on granivorous birds from Project 2.2.2.
- Project 2.1.1. *Vertebrate Biogeography* used satellite trend summary maps provided by Project 3.1.1–2 to conduct systematic faunal and floristic sampling on loamy soil sites in the VRD. Project 3.1.1 developed breakthrough techniques in land-monitoring assessment during the year, which can be used by land managers.
- The TS–CRC's project *Invertebrate Indicators of Biodiversity and Ecological Change* (3.2.1), based in Darwin, used TS–CRC Theme links to produce research that can be better applied by user groups. These included studies on tree clearing in central Queensland; impacts of pastoralism and military use on plants and animals and rangeland condition and biodiversity studies.

The full list of links among the research projects, driven by the integrated research agenda of the themes, is shown in Table 2.

Links with educational institutions

- NTU students are now able to select units at JCU as electives during their NTU candidature. Several students have chosen to do this. JCU and NTU staff collaborated closely on the development of a new unit, *Land & Sea Managers*, in the Master of Tropical Environmental Management.
- Links were formed with the Batchelor Institute of Indigenous Tertiary Education in the Northern Territory, which wants to use the MTEM CD-ROM as a resource for teaching staff who develop units at undergraduate and diploma level.

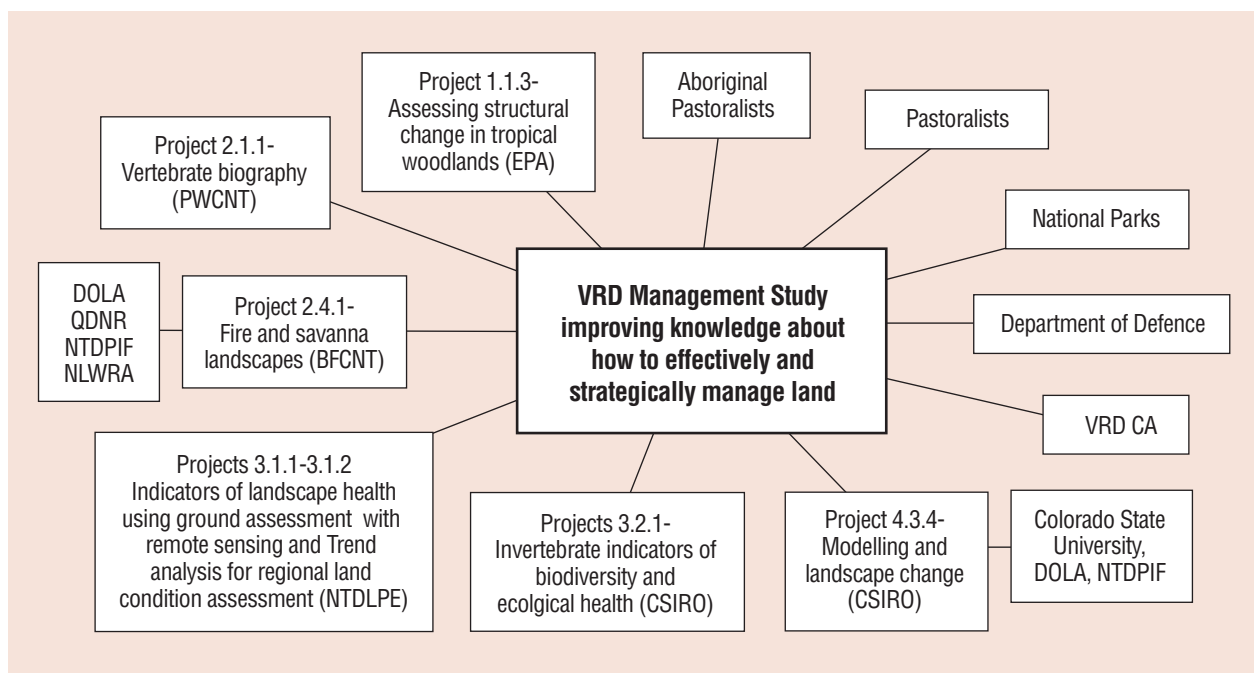
Links with land management agencies that focus on a region

The Centre's three Management Studies continued to develop cooperative linkages in their respective regions—linkages that revolve around practical land-management issues and involving land managers.

The highlights are listed below.

- The VRD Management Study brought together researchers from different agencies and disciplines, land managers, planners and the Australian Defence Force (ADF) to begin production on a major publication, *Managing for Savanna Health in the Victoria River District*, which examines land management in the region. This publication brings together research from the agencies shown in Figure 2.
- The Burdekin Management Study is undertaken collaboratively with QDPI and CSIRO L&W and TAG. This includes staff management and supervision, provision of office space and facilities, including use of vehicles, and administrative support. The study also involves researchers from QDNR, EPA (Qld) and JCU and in November 1999 employed a project officer to keep land managers and other research users informed of developments in the study. At a workshop that brought together these different agency personnel from across the region, it was decided to adopt the landscape health ideas developed by the Centre as a framework for the study.

FIGURE 2 COOPERATIVE LINKAGES WITHIN THE VRD MANAGEMENT STUDY



- Through the Desert Uplands Management Study, the Centre's work with the Desert Uplands Build-Up and Development Strategy Committee (DUBDSC) continued to make strong linkages both with the landowners in the region as well as the relevant Queensland government agencies. A/Prof. Ross Hynes, an invited member of DUBDSC since 1996, is Chair of its Integrated Regional Development Sub-Committee, a member of the DUBDSC Management Group and interim chair of the Desert Uplands Festival Working Group. Strong cooperative linkages were established with EPA (Qld) through an MOU for data exchange from its major land cover/land condition mapping-project. Positive links were also achieved with QDNR when a jointly funded DUBDSC-TS-CRC activity resulted in the development of an MO-DSS for application in regional and property cluster planning and individual PMP processes.

Other links with land-management agencies from individual projects and initiatives

- Project 2.4.1 *Fire and Savanna Landscapes* continued to develop extensive links with fire managers and other land-management agencies (see Table 2). It helped establish NHT-funded projects in Cape York and the Kimberley, western Arnhem Land and the Sturt Plateau/VRD.
- Projects dealing with Aboriginal land management continued to develop important linkages with Aboriginal land-management agencies across north Australia, leading to a loosely formalised land-management structure across the Top End. There are enormous environmental and social benefits to be had from the development of such a structure. There is also a strategic benefit linked to national functions such as defence, quarantine, customs and immigration.
- Many links were made in Project 5.2.2 *Extension, Vocational Education and Training*. For example, weed researchers and Aboriginal Land Councils, educational institutions and a number of NT government agencies were brought together to begin production on a practical video for Aboriginal communities on weed management.
- Support of an integrated approach to fire research and management across the northern savannas continued through its hosting of the North Australia Rural Fire Managers' Forum (NARFMF). Membership of the NARFMF includes all three northern Australian rural fire authorities, as well as the TS-CRC, and meetings were held regularly throughout the year.



NARFM Forum meets in February in Cairns. From left: Peter Jacklyn, TS-CRC; Peter Cann, Fire & Emergency Authority WA; Dave Luxton, Bob Faulkner, Qld Rural Fire Service; Russell Anderson, Bushfires Council NT; John Childs, TS-CRC.

- Collaboration in the Sturt Plateau region began in 1999–2000 with the formation of the Sturt Plateau Technical Group comprised, in part, of staff from a number of TS–CRC projects. Cooperation encompassing enhanced resource assessment, landscape cover change analysis, landscape function, biodiversity and fire ecology were pursued through the year.

Links across regions and jurisdictions to produce a whole-of-savannas view

- Project 3.1.1–2's involvement in the National Land & Water Resources Audit enabled it to identify limitations in data provider organisations that were subsequently addressed by the Audit. Sharing data and expertise across borders was a significant outcome in that for the first time, the lead agencies in range monitoring across northern Australia collaborated under a TS–CRC project.
- Linkages were developed by Project 2.1.1 with institutions in north, central and west Queensland to study the impact of military training and pastoralism on plants and animals; historical changes in the status of birds in central Queensland woodlands and softwood scrub. In South Australia the project strengthened linkages with existing studies on the impact on fauna of tree clearing and the impact upon biodiversity of artificial water sources on pastoral lands.
- Project 5.3.2 *Savanna Information Clearinghouse* continued to allow users and researchers to share knowledge across jurisdictions and geographic boundaries, as well as across disciplines via the Internet. Completion of the first stages of the project involved the cooperation of CSIRO, NTU and different land-management agencies from the Northern Territory, Western Australia and Queensland, and national bodies such as AUSLIG.
- Regular issues of the internal email newsletter *Topical Savannas* kept Centre project teams informed of the Centre's progress as well as linking them to relevant information sources nation-wide.

Links with national bodies

- Links with the National Land and Water Resources Audit were established in Projects 3.1.1–2 on monitoring landscape health in the rangelands and in a consultancy on developing a monitoring framework for biodiversity.
- Links with Ord–Bonaparte Program Management Group were also formed; the Centre will coordinate a major component of the project and director John Childs represents the TS–CRC and CRC Cotton and partner NT government agencies on the project steering committee.
- Links with Council for Sustainable Vegetation Management (CSVM), an advisory group to Senator Robert Hill. Director John Childs is a member of the group and attended meetings in July, September, and November 1999.

Links with overseas researchers and international bodies

Australia's tropical savannas are of global significance, as they represent the most ecologically intact portion of a mega-biodiverse nation. It is also one of the only such areas in the world that has the political and economic stability to maintain an extensive and integrated research program such as the TS–CRC and increasingly the Centre is developing links with overseas researchers and international bodies. These links are shown in Table 2 and some are highlighted below.

- Project 1.1.1 *Savanna Form and Function* and the Landscape Processes theme developed strong links with the International Geosphere–Biosphere Programme (IGBP). Researchers in this project led a workshop in Darwin in July 1999 that brought together savanna transect researchers from around the world.

- Drs Williams, Eamus and Hutley (Projects 1.1.1 and 1.2.1) collaborated with the University of Wageningen (The Netherlands) on the leaf area index project along the NATT.
- Dr Lindsay Hutley, Project 1.2.1 *Water and Carbon Exchange of Savannas* took part in an international field expedition to the savanna ecosystems of the Kalahari region in Botswana. Comparisons with savannas of the Kalahari and the NATT will provide insights into the functioning of both systems. Contact was also made with a range of savanna researchers from Botswana, South Africa, the US and UK.
- Over the past year international linkages were further developed and strengthened through Project 2.4.1 *Fire and Savanna Landscapes*. The project began discussions on collaborative research with the Japanese Space Development Agency (NASDA) concerning its interests in biomass burning in South East Asia. A 30-strong international team was based in Darwin in late August and mid-September 1999 as part of the agency's BIBLE-B program.
- A workshop was held in Darwin in August 1999 to focus on ongoing development of satellite-based fire monitoring systems. Participants included Drs Sindre Langaas, University of Stockholm (previously a TS-CRC visitor) and Kjeld Rasmussen, University of Copenhagen, both with considerable experience in monitoring fire in African savanna environments.
- Development of the collaborative fire management and training program in eastern Indonesia continued, with the result that a five-year program is likely to be implemented beginning in 2001.
- Project 3.2.1 *Invertebrate Indicators of Biodiversity and Ecological Change* also has strong collaborative linkages with invertebrate taxonomic staff at the Australian National Insect Collection, and other Australian, American and European museums.
- Project 4.3.2 (4) *Cape York Collaborative Planning*, linked with several international bodies: WWF's Tropical Wetlands of Oceania project; the People and Plants Initiative (WWF/ UNESCO/Kew Gardens); the Centre for Economic Botany (Kew Gardens, UK); and the University of Washington.
- Collaborative work in Project 4.3.4 *Modelling and Landscape Change* continued with Dr Mike Coughenour, University of Colorado, in parameterising and testing the VRD Savanna computer model (version. 4b). The model was completed in July 1999. Dr Coughenour worked closely with Mr Rodd Dyer, NTDPIE, whose knowledge of fire grazing interactions was invaluable for the VRD Management Study.
- Project 5.1.1 *Higher Education* developed links with the University of Florida through the TS-CRC's educational CD-ROM *Ecology and Management of Tropical Savannas* regarding adapting and using the CD-ROM in the University of Florida's ecology program. Plans for cross-institutional enrolments are being discussed. Links with the University of Georgia were also established during project leader Dr Samantha Setterfield's period with the Department of Instructional Technology, and a collaborative project reviewing the CD-ROM is under way there.

Overseas researchers were also involved in supervising TS-CRC students. For example, Carl Menges' remote sensing PhD project is co-supervised by Dr J. van Zyl from NASA's Jet Propulsion Laboratory, and Grant Whiteman's grass genetics PhD project is co-supervised by Dr Joel Brown of New Mexico State University.

TABLE 2 COOPERATIVE LINKAGES

Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
1.1.1 Savanna Form and Function, CSIRO W&E, late '95	✓	✓			University of Wageningen, The Netherlands NASA IGBP CSIR South Africa		1.2.1 2.1.1 2.4.1 3.2.1	CRC Carbon NTDLPE ANU
1.1.2 A vegetation map for northern Australia, Queensland Herbarium, late '98	✓	✓						CALM AGWA NTDLPE DOLA PWCNT AUSLIG
1.1.3 Assessing Structural Change in Tropical Woodlands, Queensland Herbarium, late '98	✓	✓				Various landowners in VRD region	4.5.1	BFCNT PWCNT NTU
1.2.1 Water and Carbon exchange of savannas, NTU, late '95		✓			Environmentek, South Africa University of Botswana University of Virginia		1.1.1	NTDLPE PWCNT CSIRO L&W CSIRO W&E PAWA CSIR
2.1.1 Vertebrate Biogeography, PWCNT, late '95	✓	✓				Various Stations in Central Queensland	1.1.1 2.2.1-3 2.2.3 2.3.1 2.4.1 3.1.1 3.2.1 4.3.3 4.3.5 4.5.1 4.5.2	Rainforest CRC CSIRO TAG EPA (QLD) SA DEH Key Centre for Tropical Wildlife Management, NTU
2.2.2-3 Grassland patterning and habitat suitability for granivorous birds. Decline of Crimson and star finches in Queensland, EPA (Qld), late '95	✓	✓	✓			Traditional owners in Cape York Peninsula	2.1.1 2.4.1 3.3.2 4.5.3	EA NTU PWCNT QPWS NHT (CY) Birds Australia
2.3.1 Overview of Ord River Riparian Zone, CALM WA, mid '98		✓	✓				2.1.1 3.3.2	UWA NHT LWRDC FRDC CSIRO AGWEST WA WRC

TABLE 2 COOPERATIVE LINKAGES

Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
2.4.1 Fire and Savanna Landscapes, BFCNT, late '95	✓	✓			Indonesian Fire Managers (through ACIAR) University of Stockholm University of Copenhagen Japanese Space Development Agency (NASDA)	BFCNT VRD regional committee Sturt Plateau Best Practice Group	2.1.1 4.5.1	CSIRO TAG CSIRO W&E NTU JCU Murdoch Uni EA DoD NLC PWCNT NTDPIF Balkanu KAPA Jawoyn Assoc. EPA (Qld) QDNR QFRA QPWS AGWA CALM WA WA FESA DOLA WA RIRDC ERIN Melbourne Uni. WWF
3.1.1-2 Indicators of Landscape Health, and Land Condition Assessment, NTDLPE, late '95			✓				2.1.1 2.4.1 3.2.1 4.3.4 4.5.1	AGWEST CSIRO MIS CSIRO W&E CSIRO TAG CSIRO TERC QDPI NTDLPE NTBFC Sturt Plateau Technical Group QDNR NLWRA CWE
3.2.1 Invertebrate indicators, CSIRO W&E, late '95	✓				Various American and European Museums		1.1.1 2.1.1 2.1.2 2.1.3 2.4.1 3.1.1-2 4.5.1	PWCNT DoD CSIRO TAG NTDLPE ANIC
3.3.2 Fire and Rubbervine, CSIRO TAG, QDNR, late '98	✓	✓				Seventy Mile Range Catchment Group	2.3.1 2.2.1-3	EPA (Qld) JCU

TABLE 2 COOPERATIVE LINKAGES

Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
4.2.2 Aboriginal pastoralists in the Kimberley, late '98	✓		✓			Various Landowners in the Kimberley		KAPA NLC KLC ILC
4.3.2 (2) Upper Daly Aboriginal land management, NLC, late '98			✓	✓		Various Pastoral property owners and traditional owners Wagiman, traditional owners		NTDPIF PWCNT ATSIC NTU FATSIS BFCNT OAD NTDLPE
4.3.2 (3) Overview of weeds on NLC Aboriginal land, NLC, late '98			✓	✓		Traditional owners		NTU (CINCRM) NTDPIF PWCNT Parks Australia North
4.3.2 (4) Cape York Collaborative Planning, Balkanu, late '98			✓	✓	Centre for Economic Botany (Kew Gardens), England University of Washington WWF international UNESCO	Traditional owners		Balkanu Corporation CINCRM, KCTWM NTU; Education Queensland Greening Australia QDNR NTBFC RIRDC Aurukun Shire Council, Cook Shire Council, AQIS UQ
4.3.2 (5) North Kimberley Land and Sea Management, KLC, late '98			✓	✓		Balanggarra and Wunambal-Gaambera Aboriginal Corporations		NT Herbarium
4.3.3 Arafura Catchment Management, NLC, late '98			✓	✓		Raminginning Homelands Resource Centre		EA NTU (FATSIS) CFCU NARU PWCNT NTDLPE
4.3.4 Modelling landscape Changes, CSIRO W&E, late '98	✓		✓		Dr M. Coughenour, University of Colorado, USA		1.1.1 1.2.1 1.2.3 2.4.1 4.5.1	AGWEST WA DOLA BFCNT NTDPIF QDNR

TABLE 2 COOPERATIVE LINKAGES

Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
4.3.5 Sustainable Grazing Management in the Burdekin, QDPI, late '98			✓	✓		Various landholders in the catchment through QDPI extension Dalrymple BeefPlan producer group	1.1.3 2.1.1 3.1.1-2 3.2.1 2.4.1 4.3.4 2.1.1 3.1.1	CSIRO L&W CSIRO TAG CSIRO W&E EPA GBRMPA NTDLPE NHT MLA NTDPIF QDNR
4.5.1 Victoria River District Management Study, CSIRO W&E, late '97	✓	✓	✓	✓	Dr M. Coughenour, University of Colorado, USA	BFCNT VRD regional committee Sturt Plateau Best Practice Group		PWCNT BFCNT NTDLPE NTDPIF NTU CSIRO W&E
4.5.2 Desert Uplands Management Study, JCU, 1996	✓	✓	✓	✓	University of Buenos Aires	Various Landowners through the DUBDSC		DUBDSC EPA (Qld) QDNR
4.5.3 Burdekin Management Study, CISRO, QDPI, late '98	✓	✓	✓	✓		Various landholders in the catchment through QDPI extension		ADF EPA (Qld) JCU QPWS TWRC (DNR) Aust. Centre Tropical. Freshwater Research
5.1.1 Higher Education, NTU 1996				✓	Universities of Florida and Georgia			JCU Batchelor Institute KCTWM
5.2.2 Extension and Vocational Education and Training NTU, 1999				✓	WWF	Melaleuca Station Mary River Landcare Group VRD CA Strut Plateau Best Practice Group Katherine Pastoral Industry Advisory Committee NTCA NABRC		AGWEST Batchelor Institute CALM CSIRO MLA EPA (Qld) QDNR QDPI NWS NLC NTBFC NTDPIF NTDLPE PWCNT REC
5.2.3 Learning Processes of Pastoralists, NTU, 1998				✓		Various Landowners		AGWEST QDPI NT Rural ITAB

TABLE 2 COOPERATIVE LINKAGES

Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
5.3.2 Information Clearinghouse NTU, JCU 1998	✓	✓	✓	✓	SIT (Sweden)			CRC Sugar CSIRO Tag CSIRO W&E PWCNT QDPI BFCNT QANTM AUSLIG NTDLPE NTDPIF

Research Themes

The Centre's Strategy Statement, approved by the Board on 13 March 1998, sets the direction and priorities for the period 1998–02. An important element of this statement is the thematic approach taken to our research. The four themes that focus our research and ensure a collaborative approach are North Australia Landscape; Landscape Processes; Ecosystem Management; and Human Capability Development.

The themes provide an overarching structure for all research activities. By adopting this approach, we are able to synthesise the results of individual research projects into a more coherent and meaningful framework. This avoids the fragmentation of effort that can easily hinder research organisations from achieving their goals.

The next section describes the important achievements against each theme during the year using our targets as the measure of success. While individual research projects have clearly defined milestones, their outputs, when viewed as a whole, contribute to the aims of our themes.



The four Theme Leaders (from left) Dr Peter Whitehead (North Australia Landscape); Prof. Greg Hill (Human Capability Development); Dr Paul Novelly (Ecosystem Management); Dr John Ludwig (Landscape Processes).

Theme Leader: Dr John Ludwig, CSIRO Wildlife & Ecology, Darwin



Theme Focus

The North Australia Landscape theme provides a framework for bringing together descriptions and definitions of savanna resources and the data that underpin them. In addition to providing statements of the biophysical status of the savannas, such as vegetation and other forms of mapping, the theme seeks characterisation of the social, economic, cultural and policy landscape.

Summaries of these attributes are important for communicating with TS-CRC stakeholders and participants about the issues of sustainability that concern us. Perhaps more importantly, they provide a context for interpretation of regional or smaller-scale studies. The theme's outputs and the TS-CRC Web-based clearinghouse combine to provide the background against which those narrower studies can be most effectively displayed, and their wider implications assessed.

It is in this area that the theme will make its most important contribution to the Key Result Areas. Defining and measuring health of savanna landscapes is inevitably a comparative process, so the perspective provided by a savanna-wide view is an indispensable element of KRAs 1 and 2.

Achievements

During 1999–2000, effort was divided between the biophysical characterisation of the region and the development of the savanna health definition.

Elements of the biophysical characterisation include:

1. Identification and collation of datasets

Most savanna-wide mapping of biophysical attributes that is available in digital form was aggregated. That process was assisted by involvement in a contract with the National Land and Water Resources Audit (NLWRA) to provide an overview of the status of biodiversity in the rangelands (including the tropical savannas) as a preliminary to the design of a framework for monitoring biodiversity. Coverages are now available for soils, geology, vegetation, topography, climate and its seasonal and inter-annual variability, stock density, land clearing, pasture condition, time of settlement, roads and other measures of land use intensity.

2. Vegetation mapping

As part of a TS-CRC-funded initiative to generate consistent vegetation coverage of the savannas at a 1:1,000,000 scale, the Queensland Environmental Protection Agency has all but completed a savanna-wide map, Project 1.1.2, which will become available later in the 2000 calendar year. The map will be used in a number of biogeographic analyses immediately it becomes available.

3. Links to Savanna Information

Development of the TS-CRC's Web-based clearinghouse, Savanna Information, continues to provide an important focus for the theme. Metadata for the GIS coverages now held was provided to the clearinghouse personnel and new information products will appear during 2000. Moreover, the strong development of the Clearinghouse has illustrated the benefits of integration and demonstrated the congruence of TS-CRC goals with activities such as the NLWRA.

4. Northern Summit

The theme has also served as a focus for provision of environmental information to consultants preparing background information for the Northern Summit. This is a consultative process through which the Federal Government seeks to identify development priorities for the region. This exercise provided some important insights to the difficulties of matching socio-economic to biophysical data for the savannas, which will be further examined by the Centre in the coming year.

5. State of the Savannas

Those PWCNT staff involved in Project 2.1.1 undertook, in conjunction with a contract with the NLWRA, an examination of the status and processes affecting rangeland biodiversity. This analysis will contribute to an assessment of the state of the savannas and link closely to the savanna health work. Other work contributing to an overview of savanna status through examination of historical change in tree-grass ratios, Project 1.1.3, was supported under the theme. Preliminary analysis suggests substantial increase in woody vegetation at a number of sites, and declines of woody species at others, probably related to variation in fire patterns in different parts of the landscape and the interaction of fire with grazing.

6. Savanna Health

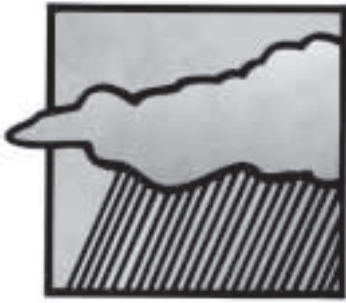
A number of products emerged from work on defining savanna health, and identifying attributes and indicators of health. A comprehensive discussion paper was prepared, together with shorter versions for the Web and a pamphlet for wide distribution. In addition to seeking wider involvement in refining these ideas and their relevance to all stakeholders, validating indicators proposed by contributors to the TS-CRC will provide an important focus for future work. The work was presented to relevant agencies and other stakeholders through addresses to the Board, Consultative Committee, and other formal fora, but wider consultation through active application has yet to be completed.

Future Directions

A number of major challenges remain and these will provide a focus for theme development in the future. Characterising the savannas socially, culturally and economically remains a gap in work completed to date. Some of the data and analysis aggregated as an element of the Northern Summit will make an important contribution here. Integration of socio-economic and biophysical perspectives continues to present difficulties.

Although it is thought that the development of the savanna health definition is fundamentally robust, a good deal of refinement of its use as a communication tool will be required. Some efforts have been made to use the health concept as part of the framework for interaction with stakeholders in management studies, but its application has yet to be comprehensively tested. It will be important that those tests are undertaken and the views of stakeholders explicitly incorporated in further refinement. Such work should be a central component of the theme's efforts during the coming year.

Theme Leader: Dr John Ludwig, CSIRO Wildlife & Ecology, Darwin



Theme Focus

This theme aims to integrate and synthesise knowledge gained from projects that study how healthy savanna landscapes function. Our working definition of healthy savannas is where landscapes maintain processes to (1) retain and use limited resources such as water and nutrients; (2) provide food and shelter for fauna; (3) support viable populations of native plants and animals; and (4) meet the material, aesthetic and spiritual needs of people. If we are to achieve a sustainable use and conservation of savannas (our Centre's mission), we need to understand these basic landscape processes and functions.

Achievements

Progress towards our aim of synthesis and integration was advanced in 1999 by a series of theme workshops held in early November. At these workshops, our definition of savanna health was refined by specifically looking at indicators of landscape function. That is, what surrogates of landscape attributes are useful as measures of how well a savanna landscape is functioning? What are the signals that indicate that a savanna is healthy?

Useful soil surface condition and vegetation indicators were identified, along with potentially useful vertebrate and invertebrate indicators. Workshop participants listed the strengths and weaknesses of proposed indicators and discussed the studies needed to validate these indicators.

Progress was made in a number of research projects during 1999–2000 that significantly contributed to the aim of this theme by increasing our knowledge on important processes found in healthy savanna landscapes. For example, Project 1.2.1 *Water and Carbon Exchange of Savannas* found that both *Eucalyptus* savannas and *Melaleuca* swamp forests in the Howard River catchment of the Northern Territory are unlikely to be vulnerable to damage from groundwater extracted during the wet season. However, they could be negatively impacted by such extractions during the dry season when plants in these savanna systems are most sensitive to water availability. These plant ecophysiology and hydrology studies used new techniques such as the ratios of naturally occurring stable isotopes of oxygen.

Another project that is using ratios of stable isotopes is Project 1.1.1 *Savanna Form and Function*. It was found that savanna fires significantly impact on critical nitrogen cycles. Fires change the pools of nitrogen available for plant growth from forms of nitrogen that are readily available (ammonium) to forms that are less available (nitrate). The result is that trees and grasses in savanna that are frequently burnt have lower concentrations of nitrogen in their leaves. This has significant flow-on effects for fauna dependent on these leaves as food.

Project 1.1.3, *Assessing Structural Change in Tropical Woodlands* used historical pairs of aerial photographs to demonstrate widespread increases in canopy cover of woody vegetation in the VRD, particularly on alluvial flats. This work was complemented by Ben Sharp's PhD study which analysed vegetation change on Bradshaw station in the VRD and Darrell Lewis's series of historical photo pairs, part of Project 2.4.1 *Fire in Savanna Landscapes*. Both studies reinforce the findings of Project 1.1.3, while Ben Sharp's study also shows more complex changes in vegetation at the local scale.

Future Directions

A project that is specifically integrating our knowledge about savanna processes, such as the findings described above, is Project 4.3.4 *Modelling Landscape Change*. This project used the Savanna computer simulation model to quantify the trade-off between fire and grazing. This trade-off is observed when pasture grasses are used for forage by livestock so that the opportunity for using this grass for fuel for fires to control tree and shrub thickening is lost. From these model predictions, forage versus fuel biomass guidelines for pasture management can be established. The development of such guidelines will be a focus for the theme in 2000–2001.

ECOSYSTEM MANAGEMENT

Theme Leader: Dr Paul Novelly, AGWEST, Kununurra



Theme Focus

The TS–CRC defines Ecosystem Management as the integration of biophysical and ecological relationships within a socio-economic and values framework, with the general goal of ensuring long-term ecosystem integrity.

The theme particularly addresses Key Result Areas 1, 2 and 3 of the TS–CRC by adding to the definition of healthy landscapes; by providing knowledge of the consequences and impacts of actions in ecological, economic and social terms; and providing options for both tactical managers and policy makers and the tools to help them make pro-active decisions.

Achievements

All the projects linked to the Ecosystem Management theme progressed well during the year, and consequently the theme progressed as well. With fire a major issue in both north Australia and the Ecosystem Management theme, the substantial progress made in Project 2.4.1 *Fire and Savanna Landscapes* continues to be significant. The theme workshop, held in November 1999, coordinated the production of the major communication output of this project to date: a book on fire management in north Australia aimed at fire managers.

Within Project 2.4.1, the two major NHT-funded projects addressing fire research, monitoring and management issues in the Cape York region and the Northern Territory (western Arnhem Land region and the Sturt Plateau/Victoria River District), were joined by a project in the Kimberley Region of Western Australia. All three projects are integrated, and involve numerous TS–CRC partners, as well as regional communities. These projects were funded mostly through the Natural Heritage Trust with the VRD component also funded through the TS–CRC as part of its VRD Management Study. The linkages provided by a study such as this and the coordinated outputs contribute substantially to the theme meeting its objectives.

The cooperative linkages developed between Agriculture Western Australia, CSIRO Divisions of Mathematics and Information Sciences and Wildlife & Ecology and NT Department of Lands, Planning & Environment played a significant part in extending Projects 3.1.1 and 3.1.2 into the NLWRA Rangeland Implementation project. Under this project the lead agencies in rangeland monitoring across northern Australia collaborated under a TS–CRC project sharing data and expertise across borders. This project has now delivered its final report to the Audit, and its outcomes will have a significant and substantial effect on monitoring savannas.

Mark Horstman in Project 4.3.2 (5) *North Kimberley Traditional Owners' Land and Sea Management* studied a specific human and social role in the savannas—the indigenous peoples—and how there are multiple ways of viewing savannas. This project produced some excellent results. Similarly, Dr Richard Davis (Project 4.2.2 *Aboriginal Pastoralists*) specifically addressed the ramifications of the increase in the number of Aboriginal communities managing pastoral leases, and how their associations with the land and the pastoral industry may differ from other operators. Taken together, these two projects make a significant contribution to the understanding of how indigenous peoples view rangelands.

Highlights

The real highlight of the year was the continued development of linkages between parties to the TS–CRC, the projects and external agencies, and, consequently, contributions to the theme approach. As reported above, Project 2.4.1 had already established strong regional and national linkages, while Projects 3.1.1 and 3.1.2 brought together agencies involved in rangeland monitoring across northern Australia.

The association of the TS–CRC with the NLWRA's Rangeland Implementation Project was again a major highlight. The outcomes of this project and the ongoing increased collaboration among projects and parties confirmed the role of the TS–CRC as a major facilitator of integrated activities across the north of Australia. It highlighted the Centre's abilities to bring together state, territory and federal agencies without concern for state and territory borders, as well as providing the Ecosystem Management theme with a major focus for an important area of its work.

Challenges

The challenges that the theme addresses are:

- What is the ecosystem capacity and how has this been affected by disturbance regimes?
- How do we (or even *can* we) define society's expectations?
- How do we reconcile the expectations from different groups with the sustainable capacity of the ecosystem?

In achieving this, the major barrier is still the wide geographical spread of the TS–CRC and the broad range of issues and stakeholders. In an era of increasing demand for resources and competition among users, the Centre acts as a bridge between stakeholders and a forum for their debates. However, this is not an easy task, and the Ecosystem Management theme (like the TS–CRC as a whole) continually has to balance its support among projects and proposals. Moreover, within the theme the concentration continues to be on the ecological/natural science aspects, with a continuing challenge to increase the role of socio-economic aspects into the theme's considerations.

Future Directions

Activities within the theme will generally continue towards these outputs as planned over the coming year. The outputs from the workshops and the projects (particularly the strong integrating projects) will continue to add to the theme.

With the finalisation of activities for the NLWRA, in particular the *Rangeland Implementation* project, the coming year will see a major move to assist the implementation of many of the techniques defined under these activities and Projects 3.1.1 and 3.1.2. This will involve the state agency parties to the TS–CRC, as it is these agencies which are responsible for land management monitoring across the savannas. The linkage of the parties during the research phase will hopefully be reflected in similar integration in the development and implementation phases.

The Ecosystem Management theme is primarily about developing tools and products to assist with management of the savannas, and this project will be a major contributor in this area.

Planned publications include management recommendations for the control of exotic species (particularly rubber vine *Cryptostegia grandiflora*) in riparian areas, using outputs from Project 3.3.2 *Fire and the Management of Rubber Vine Infested Riparian Communities of Northern Australia*, and a book on the management of fire in savanna lands (in conjunction with the other TS–CRC themes).

Finally, the further development of the Management Studies, which contribute greatly to this theme, will be actively pursued so that the opportunities provided by these activities are fully realised. The Desert Uplands work is being summarised and conclusions drawn, while the Victoria River District and Burdekin Management Studies will continue to contribute towards the development of integrated guidelines for sustainable management of grazing lands, and improved methods for monitoring and managing the impact of grazing, fire and weeds.

HUMAN CAPABILITY DEVELOPMENT

Theme leader, Prof. Greg Hill, NTU, Darwin.



Theme Focus

The Human Capability Development theme focuses on education, training and communication relevant to the stakeholder groups of the tropical savannas as well as the research and management agencies that are partners in the TS–CRC and/or rely on our outputs. More specifically, the role of the theme is to coordinate the operations of the education, training and communication projects described in the following pages. This last year saw great progress for the theme on a number of fronts.

Postgraduate Students

Of the postgraduate research students recruited early in the life of the TS–CRC, a number are now submitting their theses, and have already made a significant contribution to the scientific literature. Those who have completed their courses have already found employment. This demonstrates the quality of the students attracted to the Centre, the relevance of their work to the discipline areas associated with the tropical savannas, and the excellence of the TS–CRC environment that nurtured their development. The professional development activities delivered to these students by the TS–CRC and their experience working in partner agencies outside the universities provided them with unique opportunities. They enjoyed enhanced educational experiences and the relevance of their expertise to industry will stand them in good stead in their future careers.

Coursework Masters (Project 5.1.1)

The coursework Masters program is now fully operational, with core units developed in flexible delivery format, in line with the TS–CRC's mission to deliver to a dispersed client base across northern Australia (and elsewhere). Some of these units were formally evaluated by leading international authorities in distance education and are being used as exemplars of best practice within the university setting.

The Graduate Diploma and Masters courses are now available at both NTU and JCU and are using an increasing range of TS–CRC research findings as they are produced by the projects.

These courses succeeded in filling the educational gap that was clearly identified by the partner agencies at the time the Centre was proposed. At that time there were no units—let alone degree programs—that addressed the ecology and management of tropical savanna environments. In keeping with the vision of this CRC, graduates from the Masters program are staying in the tropical savannas and contributing to the management of these ecosystems through both the public and private sectors.

Extension and Training (Project 5.2.2)

Extension and training activities progressed in association with research into learning needs and models of learning for key stakeholder groups. The major challenge, of providing outputs from the other research themes of the TS–CRC into information and technology transfer packages, comprehensible to specific stakeholder groups, is being met. Again there is innovation and excellence, stimulated through the TS–CRC, that has not been evident for the tropical savannas in the past.

The success of research into general educational provision, stakeholder needs and perceptions, and the specific learning styles of user groups (e.g. pastoralists) is breaking new ground in educational research as well as contributing to the task of efficient delivery to savanna stakeholders.

The TS–CRC is developing learning products that encompass the range of research work that the Centre covers under its four themes. The process of development of these products was participatory in nature, involving the use of learning processes appropriate to the groups taking part, as well as implementation of an action learning process by the Extension Coordinator. Progress was made with products as diverse as the book *Savanna Burning: Understanding and using Fire in Northern Australia*; a video for weeds management on Aboriginal lands; an educational package on grazing land management for the pastoral industry; weed and fire management practical management stories; and a publicity package for the TS–CRC.

Communication

The communication module of the Human Capability Development theme has matured into a sophisticated enterprise that not only delivers relevant information to a diverse client base, but also fills a leadership role in demonstrating best practice via a diverse range of communication strategies. The website, newsletter, clearinghouse and a range of additional educational and publicity materials all attest to the success of the TS–CRC in this facet of its activities. More than 2800 people across the savannas, many of them land managers, now read the newsletter *Savanna Links*, which has been widely praised. The award-winning website and clearinghouse (Project 5.3.2) receive between 20–30,000 hits per month. Both the website and newsletter are integrated and provide TS–CRC stakeholders with better access to savanna research as well as highlighting the Centre's research. The website is also being used as a resource by the Masters and Graduate Diploma students and by the Extension, Vocational Education and Training project.

This year will also see more than half a dozen publications produced that summarise TS–CRC research for various audiences. Other communication initiatives include multi-media CDs, displays at community events, and regular media releases focusing on smaller newspapers and newsletters across the savannas.

Over the last year, the program consolidated its activities as the theme projects commenced early in the life of the Centre have matured. The achievements are gratifying, but there is also the realisation that as the initial research goals of the other TS–CRC themes are reached, the outputs to be packaged and communicated by this theme are growing exponentially. It is also obvious that the potential for further research into optimising human capability development in the tropical savannas is high. We look forward to addressing this need in the future.

Individual Projects

The following section provides more detail on each individual project. Projects are presented in order of project number, a system put in place when the Centre was first established. Numbering gaps arise where projects were finalised and subsequently closed.

PROJECT 1.1.1

SAVANNA FORM AND FUNCTION AT LANDSCAPE SCALES

Project Leader: Dr Dick Williams, CSIRO Wildlife & Ecology, Darwin

Project Overview and Aims

This project is researching the variation in savanna form, composition and function along landscape-scale gradients of moisture, soil texture and fertility, and disturbance. The framework being used is the North Australian Tropical Transect (NATT), one of several 1000 km-scale transects through the world's savannas. The project aims to quantify the variation, along the NATT, in savanna ecosystem structure and diversity, as measured by a suite of vegetation and faunal attributes. The sensitivity of a subset of these attributes to disturbance is also being investigated along the NATT.

Research Progress

Regression models relating savanna characteristics to annual rainfall and soil texture along the NATT were parameterised for tree basal area, tree canopy cover, tree leaf area index (LAI) cover and basal area of perennial grasses, and species richness. These models, which include annual rainfall, soil clay content and soil depth, generally account for 50–80 per cent of the variation in the character.

Leaf area index is an important ecosystem characteristic. The relationship between LAI and rainfall along the NATT is quite predictable. We also have good regressions linking tree size to tree leaf area for a dozen or so key species.

A highlight of 1999 was the IGBP's Terrestrial Transects Workshop held in Darwin in July. This workshop brought together people from around the world that work on continental-scale transects as a means of studying global ecological change. The workshop will provide the basis for continued international collaborations in savanna research.

Other results included the changes over time in three measures of landscape health: perennial grass cover, basal area and the quality of the soil surface as a consequence of defoliation. These were assessed, under the different combinations of rainfall and soil, using generalised linear models.

Work in the Victoria River District using a variety of remotely sensed imagery (SPOT, MMS, radar) showed the potential of high-resolution imagery for predicting savanna attributes such as tree and grass cover and land unit/type. Efficacy depends on image type, and image classification procedures. Under the best combination of procedures, woodlands on red loam soils and grasslands on cracking clays have a highly distinctive combination of spectral signals.

Future Directions

Likely future directions include use of LAI measurements in models of carbon and water fluxes at landscape scales, and determination of tree population size and class distributions at various sites along the NATT.

Project Leader: Dr John Neldner, Queensland Herbarium, Environmental Protection Agency, Brisbane

Project Overview and Aims

This project aims to map the variation in the structure and floristics of vegetation across Australia's tropical savannas. Botanists from the Queensland Herbarium, the Northern Territory and Western Australia are working in collaboration to produce a 1:1,000,000 scale digital coverage with a hard copy product produced at 1:2,000,000 scale.

To do this, individual maps of each state at 1:1 million scale are required. This will be the first time that mapping at this scale will be available for the whole of northern Australia. The major task of this project is developing methods to modify individual datasets that will conform to a uniform scale, vegetation attributes and environmental information.

In addition to the task of interpreting existing maps, a new map is required to fill gaps in vegetation data, notably a substantial area of north-west Queensland (NWQ) not previously mapped at a suitable quality or scale. This area of approximately 300,000 km² is a major focus for the Queensland mapping team.

The final phase will be to develop a consistent set of map unit descriptors for 1:1,000,000 detail that can be applied to savanna vegetation across the continent. These will then be generalised further to produce the final map. The process requires a synthesis of the hundreds of map units that currently describe the vegetation patterns interpreted in the earlier work of many botanists who mapped the area. Compiling those maps into a complete overview will provide a valuable tool for use in the research and management of Australia's tropical savannas.

Research Progress

- Obtained a comprehensive set of digital and hard copy datasets for the northern savannas, including maps for the Northern Territory (NT), Kimberley, Cape York Peninsula (CYP), Central Western Queensland (CWQ), Desert Uplands (DEU), Brigalow Belt North (BBN) and Einasleigh Uplands (EIU).
- Developed and applied methods for generalising existing Queensland 1:100,000 vegetation maps to a scale suitable to the project.
- Generalising process nearing completion for CYP, EIU, DEU and CWQ.
- Generalising BBN commenced.
- Added geology and soil information to the digital maps of NT and the Kimberley.
- Distributed a cleaned version of the Kimberley map to WA researchers for comment.
- Completed five major field trips to NWQ.
- Line work for new vegetation map of NWQ complete.
- Commenced attribute and legend matching across coverages.

Future Directions

A seamless 1:2,000,000 hard-copy map and digital coverages of vegetation across northern Australia compiled at 1:1,000,000 scale or better will be produced by late 2000. This will be an important tool for savanna-wide analysis of biogeographic patterns, land use and management practices, and allowing improved capacity to extrapolate from geographically narrow studies (e.g. NATT) to the wider landscape.

Project Leader: Dr Rod Fensham, Queensland Herbarium, Environmental Protection Agency, Brisbane



Rod Fensham

North Queensland after a drought in the early '90s. The project found that droughts of this intensity, causing significant tree dieback, may have occurred several times since European settlement of Australia.

Project Overview and Aims

This project assesses structural change in tropical woodlands over two widely spaced areas: the Victoria River Downs in the NT/East Kimberley and central Queensland. A large part of the project employs aerial photography to provide a 50-year record of structural change. The project initially seeks to calibrate structural field measurements with quantified measurements of tree and shrub cover as determined from the photography. It then uses a random sampling technique for the two study areas to record the extent of structural change.

In order to gain a fuller understanding of the role of climate in determining fluxes in vegetation structure, the project is also documenting a recent dieback event in north Queensland that coincides with a particularly intense drought.

Research Progress

- All fieldwork completed with 200 sites surveyed for the Queensland dieback survey.
- Calibration exercise completed for Queensland (125 sites) and NT/WA (58 sites).
- Aerial photograph assessment complete for Queensland at four sites with 680 site-time combinations assessed.
- Aerial photograph assessment complete for NT/WA at 294 sites with 584 site-time combinations assessed.
- A landholders' questionnaire was designed to provide information on the management history (including fire, grazing and clearing) of the 200 survey sites was completed and received a 71 per cent positive response.

Calibration modelling of the aerial covers demonstrated that well over 80 per cent of variance associated with predicting field cover from aerial photography can be accounted for. The models also suggest that other structural attributes such as basal area and biomass can be adequately predicted. Thus aerial photography provides an extremely useful means of monitoring vegetation structure and will undoubtedly also prove useful for greenhouse accounting.

In 1998–1999 the project documented that 29 per cent of trees died after a recent drought in over 5 million ha in north Queensland. In 1999–2000, historical records of drought and dieback for other regions were also collated. These records suggest that droughts of sufficient magnitude to initiate substantial dieback were documented during several periods since European settlement of Australia.

Future Directions

The results highlight the need to appreciate the magnitude of climatically driven fluxes in savanna systems in addition to those driven by management. This project has the potential to provide long-term insights not available in the satellite record as well as an important check on reliability of wider-scale (national) assessments of carbon budgets.

PROJECT 1.2.1

WATER AND CARBON EXCHANGE OF SAVANNAS

Project Leader: A/Prof. Derek Eamus, Northern Territory University, Darwin

Project Overview and Aims

This project analyses the hydro-ecology of the savannas with the aim of assessing the water use of the major vegetation types. It also is looking to assess carbon balance and exchange of savanna vegetation.

In an environment where water is such a key resource, for humans and for vegetation, this information is vital in ensuring that development in the tropical savannas is sustainable.

The project tracks complex water flows from rain, to plants, into the soil and finally down to the groundwater in the aquifers. It examines groundwater-dependent ecosystems, water and carbon exchange of savannas along the NATT, savanna carbon balance and spatial and temporal patterns of understorey leaf area index.



Tony O'Grady

TS-CRC researcher Lindsay Hutley measures the water and gas exchange of the grass and shrub understorey during the Top End wet season.

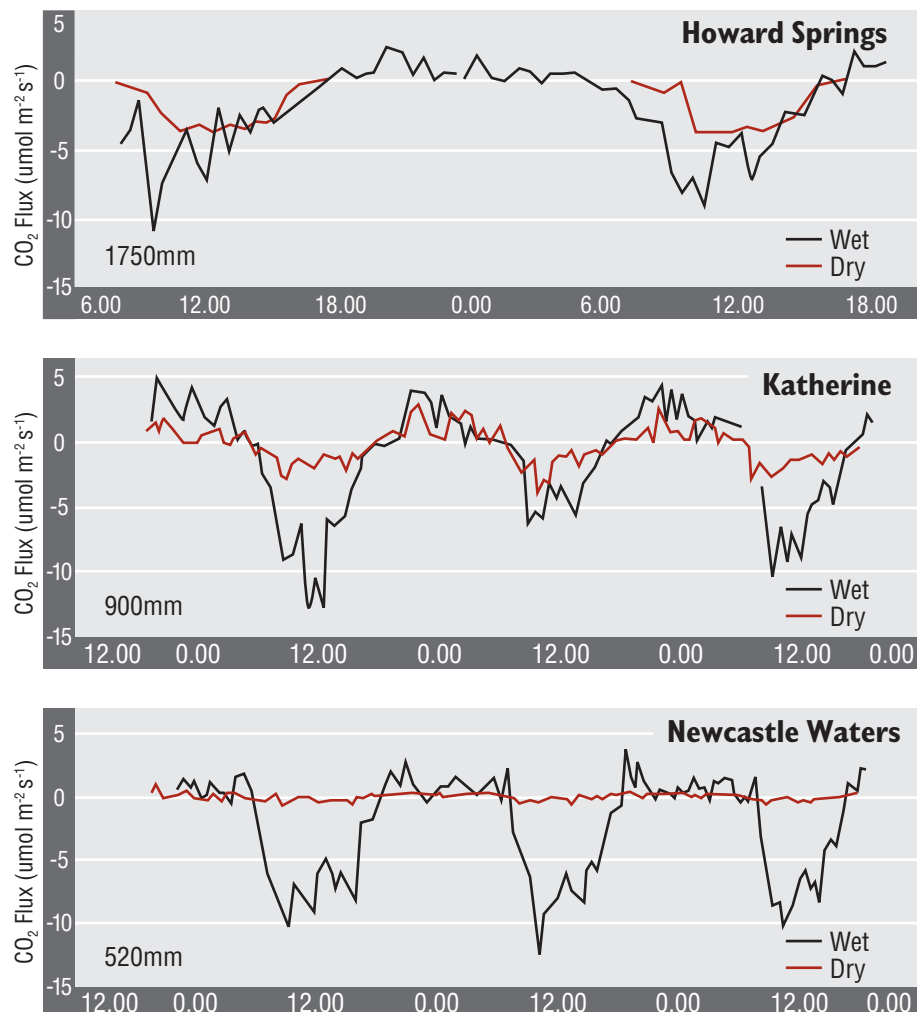
Research Progress

Work examining tree water use was completed with recommendations made in relation to the sensitivity of eucalypt-dominated savanna open forests to groundwater removal. Savanna communities are unlikely to be groundwater-dependent, but low-lying communities such as *Melaleuca* swamp forests and monsoon vine forests are potentially vulnerable. Given the planned use of groundwater in the Darwin rural area, such communities may suffer if utilisation results in large shifts in the water table. Data suggest that trees of these communities use rain-fed surface water during the wet season and stored soil water during the dry season. Despite a large decline in the local perched water table over the dry season, tree use of deeper groundwater resources (>3 m) was limited. This work was studied in detail by TS-CRC PhD student Georgina Kelley in collaboration with Dr Peter Cook, CSIRO L&W.

CO₂ flux data was collected and analysed for three sites along the NATT, in collaboration with Project 1.1.1 *Savanna Form and Function*. Some data describing the seasonality of CO₂ from savanna systems along the NATT are given in Figure 3. This figure suggests that uptake of CO₂ by savanna vegetation during the wet was similar at each location. However, during the dry season the study sites reflected their annual rainfall, with flux rates very low at the semi-arid Newcastle Waters site when compared to the wetter Howard Springs and Katherine sites.

During the wet season, the *Acacia*-dominated site at Newcastle Waters was able to uptake as much CO₂ as the coastal eucalypt open-forests, despite a much lower leaf area index (amount of leaf area per unit ground area).

FIGURE 3 CO₂ FLUXES OVER THREE DAYS FOR THREE NATT SITES, WET AND DRY SEASON MEASUREMENTS



The above data was then used to assess the strength of savannas as a carbon sink and contributed to work on the carbon balance of savannas.

TS-CRC PhD student Chen Xiaoyong completed work in estimating above and below ground biomass and measurements are currently being made on the seasonal patterns of soil respiration, root turnover (in collaboration with Dr David Bowman, NTU) and levels of soil carbon.

This research will provide a critical requirement for national carbon accounting efforts. Such data when incorporated with already completed CO₂ flux measurements, plus leaf litter and tree growth data, will enable the examination of carbon balances of typical open-forest savanna of the Top End.

Future Directions

Effort into estimating carbon stocks and carbon fluxes of tropical savanna vegetation will increase. The study will also work on estimating the sensitivity of riparian and paperbark and rainforest communities to groundwater extraction.

PROJECT 2.1.1

VERTEBRATE BIOGEOGRAPHY

Project Leader: Dr John Woinarski, Parks & Wildlife Commission NT, Darwin



R. Henderson

Martin Armstrong, PWCNT, takes basal measurements of trees to estimate their density in different areas.

Project Overview and Aims

This project collects information on the distribution of biota across the tropical savannas. It then interprets this information, especially in reference to the impacts of land use and threatening processes and incorporates this information into land-use planning and management. The information is then disseminated across a range of outlets.

Research Progress

Fieldwork for a number of studies was completed this year. These included:

- Regional conservation planning work in the Mary River catchment and Daly Basin.
- Studies of the impact of tree-clearing in central Queensland.
- Impacts of grazing and military use around Townsville.

- Historic changes in bird distribution and abundance in central Queensland.
- Biogeography and conservation management of bluebush swamps.
- Impacts of fire regimes on sandstone fauna in the VRD.
- Assessment of changing status of mammals in Kakadu National Park.

Major analysis, reporting and documentation were also completed for a series of studies on biogeographic patterning across the savannas. These include studies on Mitchell Grasslands, on birds in riparian strips, predictive modelling of species distributions, and the assessment of trends in the conservation status of a range of fauna.

Substantial progress in fieldwork was achieved for studies on the biogeography and conservation planning in the Desert Uplands, Arafura Swamp catchment, Tiwi Islands, Sturt Plateau and for cracking-clay ecosystems in the Northern Territory.

Future Directions

Our major field should remain much the same as present: where is the biodiversity? what is it? how is it faring? what environmental factors underpin its variation? what management advice can we give that will enable it to prosper? Over the next year, we aim to complete studies across many of our subject areas and to provide outputs in forms appropriate to the diverse stakeholder groups.

PROJECT 2.2.2

GRASSLAND PATTERNING AND HABITAT SUITABILITY FOR GRANIVOROUS BIRDS

PROJECT 2.2.3

DECLINE OF CRIMSON AND STAR FINCHES IN QUEENSLAND

Project Leader: Dr Stephen Garnett, Queensland Parks and Wildlife Service, Cairns

Project Overview and Aims

The first of these projects aims to determine the relationship between environmental patterns at different scales and the abundance of granivorous birds during the wet season. The data will also be used to determine relationships between abundance and vegetation structure for a variety of non-granivorous birds, some of which are declining in parts of their range.

The second project looks at the biology of crimson and star finches to determine the reasons for their declining status in north Australia.

Research Progress and Future Directions

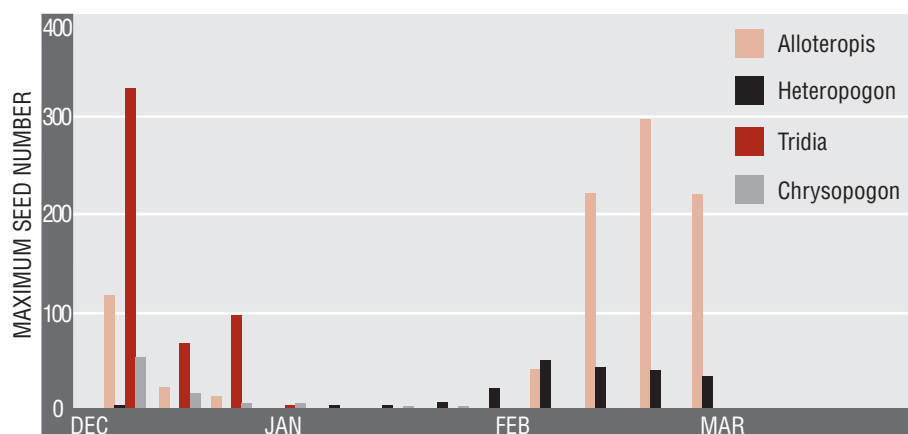
Project 2.2.2

The greatest achievement of the work undertaken over the last year was the production of an unparalleled dataset on perennial grass seed production with enough contextual data to interpret patterns. Seed production is so difficult to assess that it has usually been neglected in pastoral studies of grass production and, in modelling, assumptions about seed production are largely untested. During this last year seed production was measured for five species with widespread distributions across the Australian savannas. Some of these species also occur in African savannas. The implications of this work for management, therefore, go far beyond the intensively studied site from which they were obtained.

The full range of data available will be used to determine how resource patterning at a range of spatial scales can be built into models of habitat suitability for avian granivores. This same dataset and the habitat suitability models can then be used to decide if it is feasible to manipulate resource patterning to favour individual species or assemblages of avian granivores. It will also be used to determine whether such manipulations can reasonably be incorporated into management practice on lands dedicated to conservation and/or pastoral production.

Even before analysis is complete it is apparent that any management that reduces the production of perennial grasses may have negative implications for at least the Gouldian finch and possibly for the long-term sustainability of perennial grasslands. This is because of the effects of grazing on perennial plant size and on seed production.

FIGURE 4 PATTERNS OF SEED PRODUCTION



This year TS-CRC researchers produced an unparalleled dataset on perennial grass seed production. This figure shows the gap in seed target species for granivorous birds during the mid-wet season.

Project 2.2.3

Work on crimson and star finches during 1998–1999 concentrated on Cape York Peninsula where the species have contracted in range. During the wet season of 1999–2000 there was a shift in emphasis to Kununurra where both species of finch are currently thriving. Overall, information was obtained on food, breeding, moult and habitat, all of which have an important role in determining reasons for the decline in bird numbers. Comparisons between Kununurra and Cape York Peninsula suggested that vegetation structure was more important than its constituent species.

Although crimson finches breed in pandanus or the fronds of palm trees, they require rank grass throughout the year. For star finches there is a requirement for rank grass during breeding.

For both species, pastoralism can threaten the rank grasses they need. These grasses are, however, actively promoted by agriculture, in particular sugarcane cultivation. Sugarcane and other crops at Kununurra are one of the reasons finches are abundant in this area. The sugarcane or, in the case of the crimson finch, urban dwellings, provide excellent sites for nesting, while food is available in surrounding shorter grass and from weeds growing beside irrigation channels.

Data from the crimson and star finch study has proved valuable for management of conservation areas on Cape York Peninsula with results incorporated into fire management planning. Required fire regimes are aimed at maintaining a fine-scale fire mosaic, particularly in and adjacent to riparian areas.



Mick Todd

Red-headed male Gouldian finch, at Nitmiluk, Northern Territory. The data being gathered by Project 2.2.2 will be built into models to determine suitable habitat for granivores such as this finch.

PROJECT 2.3.1

INTEGRATED OVERVIEW OF VALUES, USES AND MODIFYING PROCESSES IN THE ORD RIVER'S RIPARIAN ZONE

Project Leader: Dr Tony Start, Department of Conservation & Land Management, Kununurra

Project Overview and Aims

By using the Ord River in Western Australia as a model, this project aims to better understand the resources, values, processes and threats to riparian systems in the tropical savannas and to provide land managers and land-use planners with knowledge of those factors. This will help ensure riparian resources can be managed, used and developed in ways that will sustain or enhance both their conservation and economic values.

The Ord River was chosen for its diversity of values and human modifications. The river is highly valued by both the pastoral and tourist industries and has outstanding conservation, recreation and cultural values. Two dams supply water for irrigated agriculture and hydro-electricity and the consequent flow regulation has created four sections with very different hydrological regimes.

Research progress

Research led by Dr K.H. Wyrwoll, UWA, focuses on the Ord's hydrology and the mobilisation, transport and deposition of sediment which controls many aspects of the development, structure and stability of riparian communities

Dr Start continued documenting the biological resources and studying the influence on them of other disturbances such as weeds, exotic herbivores and fire.

Other activities included:

- Acquisition and collation of existing but widely dispersed datasets, including geology, soils, climate, vegetation and land use/tenure of the catchment. They will be combined with data collected by fieldwork as the basis for an interactive, electronic atlas of the Ord.

- Curation of existing plant collections and the addition of new collections to form the basis of a Regional Herbarium that will be linked electronically to Perth.

Preliminary results indicate there have been quite different but substantial changes in the riparian vegetation of the different sections of the Ord due to differences in hydrology and disturbance regimes.

Future Directions

Activity for the next year will concentrate on collection of field data and progressive communication of results to stakeholders.

PROJECT 2.4.1

FIRE AND SAVANNA LANDSCAPES

Project Leader: Dr Jeremy Russell-Smith, Bushfires Council of the NT, Darwin



Jeremy Russell-Smith

Fires burning in sandstone country late in the dry season appear to be threatening the unique flora and fauna of these areas.

Project Overview and Aims

These projects examine the sustainable use of fire as a management tool in pastoral, indigenous, conservation and military land-use contexts.

Research Progress

Substantial progress was made over the past year, particularly with the consolidation of fire-management projects undertaken in the western Arnhem Land region and the Sturt Plateau/Victoria River District (VRD) of the NT. Both projects involve a number of TS-CRC partners, other agencies and organisations, and regional communities. These projects are funded mostly through the NHT, with the VRD component also funded through the TS-CRC as part of its VRD Management Study.

A further major regional fire-management study, funded mostly through the NHT but with considerable TS-CRC involvement, began in the Kimberley. A similar regional study for Cape York Peninsula has recently been approved.

Progress in other ongoing projects included:

- National assessment of real-time fire monitoring and associated mapping, funded through EA's State of the Environment (SOE) program.

- Associated verification and assessment of satellite-based monitoring and mapping systems, funded through RIRDC.
- Collaborative fire research and training program with TS-CRC partners and a range of organisations and agencies in eastern Indonesia, with funding primarily from ACIAR. The proceedings of an international workshop, *Fire and Sustainable Agricultural and Forestry Development in Eastern Indonesia and Northern Australia*, funded by ACIAR, were published in early 2000.

Substantial effort was made in developing improved systems for monitoring and mapping of fires across the savanna landscapes of northern Australia using satellite and associated GIS and IT technologies, and for dissemination of these data to end-users in close to real-time.

The NHT-funded projects and the VRD Management Study allow a number of studies to examine the sustainable use of fire as a management tool in pastoral, indigenous, conservation and military land uses. The essential aim of all these management-based studies is to develop improved fire-management practices that are both ecologically and economically sustainable, through collaborative partnerships between researchers, managers and regional communities.

Future Directions

- Successful completion of field programs, particularly NT regional projects, and assembling associated datasets for analysis.
- Undertaking and completing resource economic accounting of sustainable fire-management practices and options, particularly for the VRD Management Study.
- Further development of programs already begun on Cape York Peninsula, the Kimberley, and eastern Indonesia.
- Publication of a practical guide for fire management in the tropical savannas.
- Securing funding (through the national component of the NHT) to assist with the communication and extension of program initiatives over the next few years.
- Ongoing development of remotely sensed monitoring of fires, particularly automation of fire mapping and diurnal monitoring of 'hot spots', through a collaborative research program involving Australian, Japanese and European partners.
- Securing funding through the national Greenhouse Gas Abatement Program for assessment, and abatement management, of biomass burning emissions in northern Australian savannas.

PROJECT 3.1.1

INDICATORS OF LANDSCAPE HEALTH USING GROUND ASSESSMENT WITH REMOTE SENSING

PROJECT 3.1.2

TREND ANALYSIS FOR REGIONAL LAND CONDITION ASSESSMENT

Project Leader: Mr Bob Karfs, Department of Lands, Planning & Environment, Darwin

Project Overview and Aims

The aims of both projects are to:

- Interpret changes in the landscape at a range of scales from paddock to region using satellite and ground data over four biogeographic regions in Australia's tropical savannas.

- To develop regional information products for reporting on the functional state of landscapes.
- Establish data management and reporting processes.

Research Progress

The overall approach of the projects is to provide information on how landscapes change over time. They do this using sequences of Landsat satellite data, existing land resource and infrastructure data, and strategically collected ground data on landscape function. This combined data-type approach allows land managers and agency staff to develop a reliable historic picture of landscape change from limited ground data, that takes seasonal changes into account

The project tested these methods in four different regions: the east Kimberley and Victoria River District (VRD) in north-west Australia; the adjacent Sturt Plateau of the NT; and the Burdekin River Region of Queensland near Charters Towers. The focus was the first two regions that span the NT/WA border in north-west Australia, which is more than 300,000 km². It surrounds and includes the Ord Irrigation Area, which is set to expand. This area also has an increasing military presence with significant areas of Aboriginal land and national parks.



Bob Karfs

TS-CRC researchers have developed techniques to assess landscape health at a variety of scales.

The key finding was that this technique has the ability to detect, communicate and report landscape changes at a range of scales from fence line to region. The focus was to detect and report on changes and trends over time over extensive grasslands. Databases were set up which can be easily updated with new image data, and used for other regions of ecological significance. The existing datasets will form a comprehensive baseline for future research.

Detailed project outcomes include:

- Documented methods for data collection and processing for satellite image sequences, historic trend summaries, and ancillary data; ground site selection and ground data collection.
- Databases for the study areas; including historic calibrated imagery, ancillary data and ground site data. The East Kimberley-VRD dataset covers an area of nine Landsat scenes from 1987-1998; it includes virtually all of the Victoria-Bonaparte and Ord-Victoria Plains IBRA regions.

- Information products for each area including summary maps and graphs of condition and change.
- Comments and recommendations on data issues such as data accuracy and availability for sharing between agencies.
- A demonstration video of the project and outputs for the VRD region.

Future Directions

Information products will continue to be refined and provided to land managers. Communication of results through peer-reviewed journals, formal reports and multimedia is a project priority. Permanent research sites will be established in the Sturt Plateau bioregion and monitoring sites in the VRD will be revisited.

PROJECT 3.2.1

INVERTEBRATE INDICATORS OF BIODIVERSITY AND ECOLOGICAL CHANGE

Project Leader: Dr Alan Andersen, CSIRO Wildlife & Ecology, Darwin

Project Overview and Aims

This project aims to define and assess ecosystem health and provide ecological indicators for ecosystem management. Insects and other invertebrates play key roles in ecosystem health, as they contribute most of the faunal biomass and biodiversity in ecosystems and regulate most of the ecological processes that drive ecosystem health. Their high diversity, biomass, functional importance, sensitivity to environmental change and ease of sampling make them effective bio-indicators of ecosystem health.

The project aims:

- To document the distribution of savanna invertebrate assemblages;
- To describe their responses to land use;
- To examine their reliability as bioindicators;
- To develop protocols for their efficient use as bioindicators.

Research progress

- VRD grazing gradient study completed; paper on ant responses accepted for publication.
- Invertebrate contributions to PWCNT Daly Basin and Mary River conservation management studies completed (through Project 2.1.1).
- Invertebrate contributions to study on impacts of pastoral and military land use in the TFTA (in collaboration with CSIRO TAG and PWCNT) completed, and ant indicator species identified.
- Collaborative project with PWCNT and NTDLPE began on the relationship between rangeland condition and faunal biodiversity (VRD Management Study).
- Consultancies at German Creek and Callide Creek mines completed.
- Paper on Kakadu grasshopper fauna completed, which is the first regional analysis of grasshoppers anywhere in Australia. An associated paper was also completed on grasshoppers as indicators of disturbance in the Kakadu region.
- The manuscript of *Ants of Northern Australia* completed.
- Invited keynote paper at biennial Invertebrate Biodiversity and Conservation conference.

Future Directions

- Complete study of relationship between rangeland condition and faunal biodiversity.
- Invertebrate biodiversity of the Sturt Plateau.
- Relationships between grass species, patch types and invertebrate indicators in the VRD.

PROJECT 3.3.2

FIRE IN THE MANAGEMENT OF RUBBER VINE-INFESTED RIPARIAN COMMUNITIES OF NORTHERN AUSTRALIA

Project Leader: Dr Tony Grice, CSIRO Tropical Agriculture, Townsville



TS-CRC research suggests that fire may be valuable in halting the spread of rubber vine. This climbing weed, dominant in riparian areas, is widely found along the banks of rivers in northern and eastern Queensland.

Project Overview and Aims

Rubber vine (*Cryptostegia grandiflora*) is an exotic woody weed that poses a significant threat to the savanna landscapes of northern Australia. It has already invaded a large portion of northern and eastern Queensland and bioclimatic analysis suggests that it is capable of growing across northern sections of the Northern Territory and Western Australia. It is particularly prevalent in riparian zones.

Experimental work since the early 1990s demonstrated that rubber vine is prone to fire. Intense fires kill most seedlings, juvenile plants and a large proportion of adults, as well as causing seed mortality.

Outcomes from the project will include recommendations regarding the use of fire for managing rubber vine in a variety of vegetation types, climatic zones and riparian communities. The project will also identify the value of selected broad taxa, as indicators of the health of northern Australian riparian communities. It will do this by describing their species richness and diversity, in relation to the severity of rubber vine infestations and the occurrence of fire. Agencies and landholders will benefit from the development of Landscape Function Analysis concepts and methods in assessment of land condition.

Research Progress

Experimental sites were established on three tributaries of the Burdekin River. Each site consists of three large plots that span creek lines.

Firebreaks were constructed around all plots in August 1999. Dry-season (September–October 1999) fires were abandoned in 1999 since burning permits could not be obtained because of perceived fire risks. The first wet season burn was imposed in November 1999. In spite of the less than ideal timing of the fire, the treatment appeared to be effective in reducing rubber vine populations though confirmation will await data analysis.

Firebreaks were regraded in May 2000 in preparation for fires planned in August and November 2000.

Vegetation at each site was described in July 1999. Vegetation was sampled by surveying along transects running perpendicular to creeks. Trees and shrub species and size class were documented in permanent quadrats along each transect and herbaceous vegetation sampled using the BOTANAL technique. Both baseline botanical data and first-year data were collected, though analysis of the results is not yet complete.

A JCU Masters student was recruited to study the effects of rubber vine burning on reptile diversity. Preliminary faunal surveys indicate that reptiles may be useful indicator species to address impacts of burning. An additional question to be addressed is what effect rubber vine itself has on biodiversity. Early observations suggest that there was less reptile diversity in dense rubber vine infestations than elsewhere in riparian landscapes.

Future Directions

Research will look at the broader impacts of fire in riparian areas: on plant and fauna diversity, hydrology, soil retention and down stream effects.

Fire has been widely found to reduce woody weed encroachment into rangeland landscapes throughout the world and particularly in northern Australia. Fire therefore has a potentially major role in tropical grazing systems. This will be investigated through links with the Burdekin Management Study.

PROJECT 4.2.2

ABORIGINAL PASTORALISTS

Project Leader: Dr Richard Davis, North Australia Research Unit (Darwin), Australian National University

Project Overview and Aims

This project examines the social impact of the transfer of grazing rights to Aboriginal people in the Kimberley over the last three decades—an ongoing process with significant implications for the tropical savannas.

Taking the theme of savanna as society, this project explores four interconnected social and cultural aspects of Aboriginal pastoralism. Firstly, it inquires into social organisational factors affecting decision making on stations. It seeks to understand men and women's participation in pastoralism, especially focusing on the recruitment of young men to the industry. Thirdly, it explores the associations and uses of land that are unique to Aboriginal pastoralists. Fourthly, it locates Aboriginal pastoralism within a political ecology of state governance and a commodity economy.

From this and other studies on pastoralism elsewhere in the world, a picture is being developed of Aboriginal pastoralism as it intersects with indigenous sociality and culture, state systems of governance and commodity market systems. This project has particular relevance for planning future strategies of Aboriginal cattle and land management.

Research Progress

Following discussions with members of the Kimberley Aboriginal Pastoralists Association, four stations were chosen as research areas: Mt Pierre, Bohemia Downs, Leopold Downs (Fitzroy Valley region) and Lake Gregory (upper margins of the Great Sandy Desert). The four stations have a good mix of management conditions, social settings and environment features.

A number of papers were prepared for publication. These were on the importance of Aboriginal pastoralists to regional cultural life through organising and participating in local rodeos; on the moral implications of 'carrying capacity' as applied to Aboriginal pastoralists; on the relationships between social organisation and decision making with regards to cattle management; on assessing Aboriginal pastoralism through a review of international perspectives on pastoralism, governance and development.

The project also:

- Identified different pastoral systems across Aboriginal stations reflecting different Aboriginal aspirations for cattle and land use.
- Provided input into a number of TS-CRC theme meetings and strategic planning sessions.
- Hosted *Frontier Australia: Contact Geographies in Northern Australia*, a two-day conference held in Darwin, 23–24 September 1999.
- Established good relationships with four Aboriginal station and related communities in the Kimberley.
- Participated in KAPA, KLC, Indigenous Land Corporation and South-east Kimberly station assessments as initial stage in ILC/Land Enterprise Australia's Kimberley Aboriginal Beef Strategy.



Dennis Schulz

The TS-CRC's project on Aboriginal pastoralism is looking at issues such as the associations Aboriginal people have to pastoral land, the uses they put it to and how this might differ from other station operators.

Future Directions

- Develop alternative cattle management strategies to those used at present. In particular, to better integrate cattle management with Aboriginal social objectives.
- Further extend research to Aboriginal organisations.
- Further inform and interact with other TS-CRC research in the tropical savannas
- Conduct additional ethnographic fieldwork.
- Establish international linkages with organisations representing and delivering services to indigenous pastoralists in rangeland regions.
- Publish conference proceedings and two further publications, one describing social organisational features of station families, and the other a literature survey comparing Aboriginal pastoralism with other forms of pastoralism practised elsewhere around the world.

PROJECT 4.3.2 (2)

UPPER DALY ABORIGINAL LAND MANAGEMENT OUTCOMES

Project Leader: Mr Peter Cooke, Northern Land Council, Darwin

Project Overview and Aims

The Upper Daly Land Trust area is an area of about 3500 km² adjoining the Daly River Reserve in the west. For a variety of reasons, the traditional owners have not yet been able to re-establish permanent settlement in the area since it was returned as part of a land claim. Without people living in the area, a number of land-management problems have developed including wildfires in the absence of traditional burning regimes, increasing populations of feral animals, and increasing illegal access and poaching.

The Wagiman people now want to plan management over a much larger area of land than before. The newly regained land in the Trust has many of the same management problems as the rest of the land in the Trust. Emerging and continuing issues include trespass, resource use without permission, a lack of proper fire management and weed issues, especially along the banks of the Daly River.

Research Progress

Difficulty in appointing an appropriate consultant resulted in delays to fieldwork. The principal landowners involved in the project were also focused on a land claim and it was decided that attempting to go ahead with the project would interfere with the claim.

Dominic Taylor-Hunt, an experienced participatory planner at the NLC's Caring for Country Unit, took over responsibility for the project in September 1999. Mr Taylor-Hunt provided training in participatory planning for other NLC staff members including the Caring for Country Women's Land Management Officer and two members of the Darwin/Daly NLC regional office. These three staff are now also involved in the planning team for the Upper Daly project.

A major planning workshop over five days was conducted at Pine Creek in February 2000 by the NLC and Wagiman landowners. A draft planning booklet documenting the workshop and reporting back to participants is well advanced for in-house production at the NLC.

Recent discussions focused on enabling people to get back on their country, generate income and undertake land management. The ideas that were given the most value were (in order of popularity) farming, caring for country, tourism, stock work and 'other work'. All of these topics are only in the initial stages of discussion, and their feasibility has yet to be assessed.

Future Directions

A key issue in this project remains the difficulty that the Wagiman have in re-establishing themselves on traditional lands. Considerable planning also is needed to establish the feasibility of the various land-use options. More negotiation is needed with CDEP and ATSIC. Sub-project meetings will continue, as well as field trips to map and survey country and the education of young people in traditional knowledge.

PROJECT 4.3.2 (3)

OVERVIEW OF WEEDS ON ABORIGINAL LAND IN THE NORTHERN LAND COUNCIL AREA

Project Leader: Mr Michael Storrs, Northern Land Council, Darwin

Project Overview and Aims

Aboriginal people own 170,000 km² of land in the Northern Land Council (NLC) region, yet their capacity to manage rapidly emerging threats, such as weeds, is low. Aboriginal landowners and their community-based agencies are often without the physical, financial and technical resources to control weeds.

In 1998, a meeting of the project's Technical Advisory Committee (TAC) was held to scope the work of the project. The TAC comprised staff from the NLC, NTDPPIF, Parks Australia North and the PWCNT. The Caring for Country Unit (CFCU) of the NLC, in collaboration with the NTU's Centre for Indigenous Natural and Cultural Resource Management (CINCRM), then appointed researcher Nick Smith, to document the weed situation on the Aboriginal lands of the Top End.



Michael Storrs

Delivery of a quad bike for mimosa spraying on the Malak Malak Aboriginal Land Trust in the Northern Territory. Many more resources, technical as well as physical, are needed if Aboriginal communities are to contain the growing threat of weeds on these lands.

The objectives of the project are:

- To prepare an overview of the status of current and potential weed problems through consultation with landowners, experts and practitioners.
- To make an assessment of existing land management capacity.
- To provide recommendations on survey requirements, data collation and storage, training and resourcing and improved collaboration between agencies.

Research Progress

Mr Smith made a number of trips to regional centres to interview landholders, resource agencies and weed-management practitioners and undertook an extensive desk-top review in Darwin. His report was extensively reviewed in consultation with the TAC and will be published by the TS-CRC late in 2000. The TS-CRC is also exploring other mediums for the report, including its Website.

The report, *Not From Here: Plant Invasions on Aboriginal Lands of the Top End*, (provisional title) contains some 30 major recommendations relating to:

- The requirements under upcoming legislation;
- The collection, storage and mapping of weed data;
- Weed management;
- Training;
- Community awareness.

Future Directions

The report will be used as the basis for the CFCU to develop a weed-management strategy for all NLC lands. Case studies have shown that carefully planned ongoing management of weeds is more likely to succeed than short-term, intensive control. Tackling weeds in the sparsely populated Aboriginal lands of the Top End necessitates a strategic approach. The over-arching goal of the CFCU is to help Aboriginal communities develop formal land-management programs, to deal with land-management issues such as weeds. The emphasis for the weed-management program will be strategically based, focusing on the prevention of weed spread and building the capacity of Aboriginal landowners to deal with weed incursions before they become a major problem.

PROJECT 4.3.2 (4)

CAPE YORK COLLABORATIVE PLANNING

Project Leader: Mr David Epworth, Consultant, Balkanu Corporation, Cairns

Project Overview and Aims

This project explores how two different knowledge systems—that of western science and that of traditional Aboriginal landowners—can be integrated.

The project involves two groups of Aboriginal landowners, both of which have witnessed the impact of technological changes on their country. This has led to a realisation that traditional land-management processes may need to be supplemented with ‘white-fella’ scientific solutions. At the same time, scientists have had the opportunity to learn from approaches adopted by Aboriginal land managers.

Research Progress

The initial stages of the project focused on developing collaborative relationships with two land-owning groups on Cape York Peninsula. One of these, with the Wik and Kugu peoples on the central-west coast, progressed well. Discussions with the land-owning groups about the proposed activities on the east coast have not resulted in any significant on-ground activity however, valuable work began with the Kuku Thaypan group of eastern central Cape York Peninsula.

Following an exhaustive consultative process, a number of aspirations were identified with which ‘science’ could assist. These included weed, feral animal and fire management and the development of commercial uses of flora. A basis for sound collaboration was also identified.

This included:

- Access to a skilled facilitator and staff;
- Open and flexible process based on 'normal' activities;
- Absence of 'scientific' agenda;
- Acceptance of Aboriginal people as co-researchers and professional colleagues;
- Working within extant decision-making processes;
- Commitment to capacity building;
- Non-extractive interaction.

All discussions about peoples; country and their interaction with the country took place on the traditional lands of those people. Generally work also linked with ranger training or with the carrying out of more practical aspects of land management. Survey work was carried out from light aircraft, boats and vehicles. Considerable time was spent walking through country. All work was carried out at the invitation of traditional owners.

Key areas where support is required to address changes on Wik and Kugu lands are:

- Inability of traditional owners to get back on to country continues to be the greatest impediment to the re-establishment of proper ecosystem process.
- Inappropriate burning regimes of neighbouring land holders, particularly on pastoral leases and national parks, are also of great concern.
- Inability to re-establish proper burning because of lack of access to country.
- Encroachment of weeds and potentially harmful pasture species, such as *Andropogon guyanus* (gamba grass) and *Calopogonium muconoides* (calopo), was also identified.
- Balancing populations of pigs also requires collaborative attention. While pigs are an important food source, they cause a lot of damage to natural environments and eat bush tucker foods like yams and turtle eggs. Monitoring the impact of pigs has commenced, and a campaign of establishing fires near hatching turtle nests to deter pigs was also instigated.

Work also took place with Kuku Thaypan people. Discussions identified a number of areas in which traditional owners were keen to see collaborative links established. Again weeds were identified as a major problem, especially gamba grass encroachment from pasture areas.

A program of reporting research activities to Wik and Kugu people was carried out. Three progress reports, a weed management implementation strategy and a weed survey were presented to the wider Wik and Kugu peoples. A paper presenting a view of the role of science in Wik and Kugu land management is in preparation.

Future Directions

Proposals to continue the project and broaden its focus are being prepared. The development of ethnobiological records and the extrapolation of these into co-existent management regimes have begun. Work with Kuku Thaypan people will continue once access to country is available.

Project Leader: Mr Mark Horstman, Kimberley Land Council, Land & Sea Management Unit, Derby

Project Overview and Aims

Balanggarra and Wunambal-Gaambera country stretches from Wyndham to Prince Frederick Harbour in the North Kimberley and includes the Mitchell Plateau, a region of about 60,000 km². An Aboriginal population of some 800 people is resident in two main communities, Kalumburu and Oombulgurri. The region is predominantly Aboriginal tenure (as Aboriginal Reserve), and includes Vacant Crown Land, four pastoral leases and the Drysdale River National Park.

This project is an initial component of a strategic management-planning program for the north Kimberley. This research initiative provides information support to assist traditional owners develop a vision and a management strategy for the region on their own terms.



Mark Horstman

Balanggarra traditional owners collecting turtle eggs in Napier Broome Bay, off Kalumbaru, WA.

The objectives of the project are to enable traditional owners to articulate:

- Benchmarks and indicators for sustainable land and water use and management on their country (terrestrial and marine).
- Their understanding of change to country that has occurred or is anticipated to occur, in terms that integrate their traditional knowledge and responsibilities with non-Aboriginal scientific approaches.

The Kimberley Land Council provided all in-situ project management and logistical support, primarily from the Kununurra and Derby offices. The Balanggarra and Wunambal-Gaambera Aboriginal Corporations also provided field support, cultural advice and assistance with traditional knowledge collection and collation.

Research Progress

The final report for the project is complete.

The two corporations of traditional owners, the Balanggarra Aboriginal Corporation and the Wunambal-Gaambera Aboriginal Corporation, comprised the project steering committee. Two traditional owners, one from each group, worked as partner researchers with the project ethnobiologist, Mr Glenn Wightman.

Mr Tom Vigilante, a TS-CRC PhD student with CINCRM, undertook work on the effects of fire regime on plant communities around Kalumburu as part of the project's fieldwork and contributed to the case study on fire.

More than 50 traditional owners participated in this project. About seven weeks of extensive fieldwork were undertaken in six areas from June to October 1999.

Knowledge of Wunambal traditional owners, in the north-west Kimberley, relating to 177 plants and 273 animals was recorded. In the north-east Kimberley, the knowledge of Balanggarra traditional owners relating to 161 plants and 75 animals was recorded. Scientific names, common names, language names and traditional uses of these plants and animals were also included.

The final report includes:

- Four case studies: Mitchell Plateau management; Fire research and traditional knowledge; Balanggarra ethnobiology; Wunambal-Gaambera ethnobiology;
- More than 30 detailed recommendations;
- Review of literature on ecology, conservation and traditional knowledge of north Kimberley (130 items);
- Ninety photographs on CD, 160 annotated colour transparencies; 20 74-minute annotated audio recordings on mini-CD; 200 plant specimens to be lodged with herbaria; Digital video recordings of travel and stories in King George, Berkeley, and Drysdale Rivers.

While the biological knowledge collected is public information, the report is the intellectual property of the traditional owners.



Mark Horstman

This 10m barge was the research platform for the 200 km journey from Berkeley River to Kalumburu. Balanggarra traditional owners recorded traditional knowledge during the journey.

Future Directions

Community meetings will be held in the North Kimberley in July 2000. These will present the outcomes and products of the project to the Aboriginal corporations involved, and will discuss the implementation of the report.

The project provides a foundation to continue ethnobiological research by advancing from the taxonomic level to describing systems and processes at community and ecosystem levels, in the terms and language of traditional owners. Enthusiasm from traditional owners for further research projects such as this, particularly for knowledge conservation, is high.

Other directions include: the completion of the knowledge conservation program; helping the use of traditional knowledge, and the role of traditional owners in land and sea management; regulating and managing visitors and tourists in the area; develop systems for monitoring, regulation, and compensation for use of marine resources; improve access for traditional owners to homelands as the basis of monitoring programs; monitor mining operations in a collaborative program between traditional owners and scientists.

PROJECT 4.3.3

ARAFURA CATCHMENT MANAGEMENT

Project Leader: Mr Michael Storrs, Northern Land Council, Darwin

Project Overview and Aims

Traditional Aboriginal land-management techniques do not address problems arising from weeds, particularly mimosa, or from feral animals. The Caring for Country Unit (CFCU) of the Northern Land Council (NLC) is working with landowners of the Arafura Swamp and surrounds in central Arnhem Land to develop capacity, through training and resources, to deal with these new land-management challenges. As much of the swamp is taken up by the Murwangi Aboriginal Corporation cattle enterprise, the management plan developed by the project must integrate conservation with development objectives.

Research Progress

The project helped develop a loosely formalised Aboriginal land management structure across the Top End using community-based programs. Aboriginal land management programs, some nascent and some relatively advanced, are now dotted across the Top End. However, despite the progress made, major gaps still exist. Priorities for management action were also developed and on-ground work undertaken according to these priorities and the extent of community resources. It is hoped that this will lead to issues-based management and research.

In the north, north-west and north-east of the Swamp, the land-management coordinator, Mr Wayne Barbour, partly funded by the TS-CRC, coordinated local Aboriginal CDEP workers in the Wanga Djakamirr ('looking after the land') Ranger Program. This program is assessing the current health status of country and involves traditional owners and managers. The results are being assembled in a database and stored on the Ranger Program's GIS.

Specific achievements of the Ranger Program include:

- formal certificate training in land management from FATSIS at NTU. The CFCU and Mr Barbour facilitated other informal training.
- A trip to overview new and emerging land-management issues in the region, including mining, and park management issues in Kakadu and Wildman Reserve.

- TS–CRC Honours student, Renee Bartolo, undertook a remote sensing and GIS project to map the geomorphology of the Arafura Swamp. Ms Bartolo worked in close collaboration with the Wanga Djakamirr Rangers during ground-truthing exercises.
- TS–CRC PhD student, Ms Anthea Dee, is undertaking studies focusing on the demographics of the feral pig population of the Swamp, assisted to a large extent by the Wanga Djakamirr Rangers and the CFCU.

The TS–CRC grant partially funded satellite imagery for a PWCNT flora and fauna survey of the Swamp and an ethnobiological study of the northern Arafura Swamp and surrounds by two Aboriginal researchers, Ms Donna Jackson and Ms Lorraine Williams.

Future Directions

CFCU will continue to further a catchment-based approach to management over time. It is hoped that by taking a grass-roots approach, community support for the process of land-management planning will be assured. With the development of the community's capacity to deal with contemporary land management issues, biological diversity and the productive capability of the Arafura Swamp and surrounds should be sustainable in the long term.

The development of an Aboriginal land-management structure across the Top End, using community-based programs will continue.

PROJECT 4.3.4

MODELLING AND LANDSCAPE CHANGE

Project Leader: Dr John Ludwig, CSIRO Wildlife & Ecology, Darwin, NT

Project Overview and Aims

This project aims to integrate knowledge gained from TS–CRC projects, and other sources, into simulation models used to predict how different land-use practices (burning, clearing, grazing) affect the health of tropical savannas. The four models are Savanna, HerdGrasp, AussieGRASS and Flames.

Savanna, developed by Dr Mike Coughenour of Colorado State University, is being applied at local landscape scales to predict ecological change caused by different land uses and climates. The model is based on data and response functions contributed by a number of TS–CRC projects.

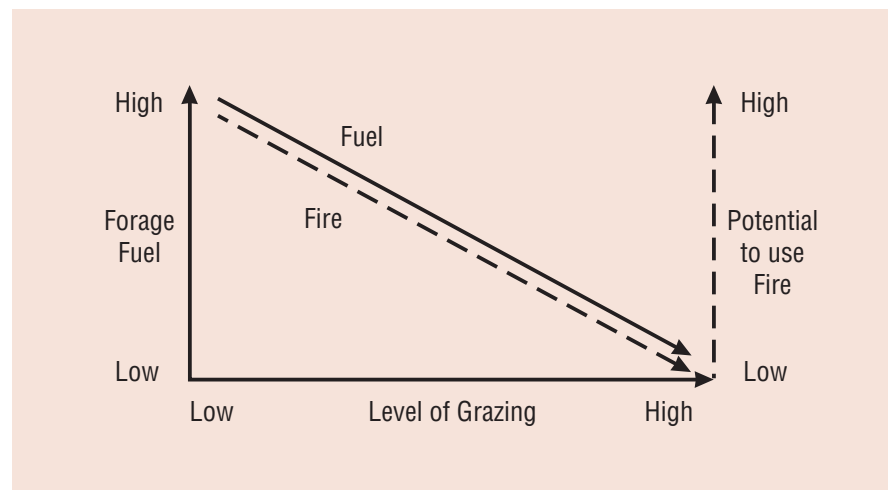
The HerdGrasp model is being applied at regional landscape scales to simulate the impacts of climate variability and land management practices based on data from properties.

The AussieGRASS model is being applied at the national scale to predict pasture growth and will provide pastoralists with timely alerts of potential droughts, particularly during the build-up of El Niño events. Using rates of pasture curing and drying, the AussieGRASS model is also being used to predict potential fuel loads and hence warnings on the risk of fire during the dry season.

The Flames model developed by CSIRO W&E in Darwin, simulates the impact of different fire regimes on the population structure of woody vegetation.

One of the key results from this project will be to improve our understanding of how healthy savanna landscapes function by understanding the relative sensitivity and resilience of different land units to disturbances such as fire and grazing.

FIGURE 5 AT A LOCAL LANDSCAPE SCALE, THE SAVANNA MODEL QUANTIFIES A VERY STRONG TRADE-OFF BETWEEN FIRE AND GRAZING



Research Progress

This project is integrating results from a number of different TS–CRC projects that define how healthy savanna landscapes function over different spatial and temporal scales.

Progress includes:

- Completed parameterising and testing the VRD Savanna model (version 4b) by July 1999. This work was done in collaboration with Dr Mike Coughenour, from Colorado State University, and with Rodd Dyer, NTDPPIF, whose knowledge of fire–grazing interactions in the VRD was invaluable.
- The Savanna model was used to explore trade-offs between different fire and grazing regimes practiced in the VRD. These simulations predict strong interactions between fire and grazing.
- The Savanna model was also used to explore the relative resilience of different savanna landscapes to grazing disturbances. Simulation runs suggested that savanna grasslands on grey clay soils were more resilient to grazing than savanna woodlands on red loam soils.

A second key result from this project is providing options for managing savannas in ways that maintain production goals while conserving the vegetation, soils and biota at scales relevant to these goals.

Progress towards these goals include:

- At the paddock scale, the Savanna model was used to evaluate how clearing groves of trees can impact on the way soil nutrient resources are conserved in savanna landscapes, which leads to a number of general predictions and management principles and options.
- At the property and region scales, the HerdGrasp model was used to simulate the relative viability of different industries in the savannas when facing changes in climate and markets. The Flames model was used to evaluate the relative importance of fire frequency and seasonality on key savanna tree populations. Although both these fire effects are important, results to date suggest that fire frequency had a greater long-term impact on these populations than did season of fire (i.e., early versus late dry). These results have implications for the different options of using and controlling fires in tropical savannas.

- At the national scale, the AussieGRASS modelling component of this project, in close collaboration with DOLA WA, AGWEST, NTDPFI and the BFCNT are producing online maps of active fires. This information, along with predictions of fuel loads and curing states across savanna regions, will help various fire control agencies make better decisions.

Future Directions

Collaboration between this project and Project 2.4.1 using the Savanna, HerdGrasp and Flames models will require some new model developments. For example, a new version of Savanna (version 4k) incorporates improved ways of how savanna simulates nutrient relationships. Savanna model simulations with spatial effects turned ‘on-and-off’ suggest that in the future how the Savanna model deals with the redistribution of resources needs to be improved. The Flames model is being improved to better accommodate tree-grass population dynamics as well as economic outputs.

PROJECT 4.3.5

SUSTAINABLE GRAZING MANAGEMENT OF SAVANNA WOODLANDS IN THE BURDEKIN RIVER CATCHMENT

Project Leader: Dr Mick Quirk, Queensland Beef Industry Institute, QDPI

Project Overview and Aims

This project has two major objectives:

- Identify the principles and practices which underpin sustainable and productive grazing management of the woodlands and savannas of the Burdekin catchment.
- Develop an ecologically-based approach to designing practical grazing plans that are tailored to the characteristics (eg, land types, current condition, infrastructure) of individual paddocks and properties, initially for Dalrymple Shire, and then for Bowen Shire.

Information and data from past and current research and producer experience is being collated and evaluated. Most information and data is specific to only a few of the many land types in the region, so application to all land types requires careful extrapolation. The GRASP grass production model is being used to achieve relevant general relationships to specific land types in terms of pasture production, land condition and carrying capacity. Interaction is occurring with producer groups during the development of these guidelines and decision tools, but the major impact of the project will occur via a grazing land management education program being developed with several other organisations.

Research Progress

In cooperation with CSIRO Land & Water, the application of land-type mapping to paddock-scale planning was ground-truthed and modified to be accurate at paddock scale on eight properties. These were provided with a digital copy of the customised map for their property. Existing geology, soils and vegetation mapping for Bowen Shire was also collated and gaps filled by a combination of remote sensing and limited field work during May this year.

GRASP, a pasture growth computer model, is being used to provide useful estimates of pasture production for the more than 70 land types in the Burdekin. The model was parameterised for north Queensland, however, customisation proved difficult as more data was needed to use the model on a core group of eight land types which cover the range of productivity in the region. All other land types will be associated with one of these core types.

Work continues with CSIRO TAG to develop robust relationships between pasture growth and land condition to be applied across land types. Guidelines are also being set in place for managing grazing pressure in combination with wet season spelling and fire. For long-term perspectives on stocking rates the project is converting pasture productivity of a particular paddock into stocking rate via 'safe' utilisation factors. The factors are derived from grazing trials in the region. The stocking rate is then adjusted for likely evenness of paddock use (location of water points etc.). Testing these procedures with case study properties will take place from July 2000.

Resource material to support extension/education activities was produced which related to monitoring and managing land condition, improved grazing management and recording paddock health via permanent monitoring sites.

These resources are now used to support FutureProfit (property management planning) activities in north Queensland, and were also used to support pasture management days with Landcare groups and the BeefPlan project group in Dalrymple Shire. They were also used in a series of grazing land management days held with beef producers in central Queensland.

Future Directions

This project will provide a technical framework to assist decision-makers in grazing lands according to their capability. It will also develop an education program, together with MLA, CSIRO, NTDPPIF and Project 5.2.2, that assists sustainable management of grazing lands.

PROJECT 4.5.1

VICTORIA RIVER DISTRICT MANAGEMENT STUDY

Leader: Dr John Ludwig, CSIRO Wildlife & Ecology, Darwin

Project Overview and Aims

The Victoria River District (VRD) Management Study was designed to conduct and coordinate a number of related projects so that holistic, systems-based management strategies could be developed. The management study also provides the basis for relevant, participative involvement of landholders and land users in the conduct of the research and in the development of useful outputs. (See Figure 2, p. 13 for the structure of the VRD Management Study).

The VRD is located about 500 km south of Darwin in the north-west of the Northern Territory and covers an area of over 125,000 km². Its environment is a mix of grassy plains, rolling savannas, rocky spinifex country and spectacular mesas and plateaus. Patterns and trends in the district's topography, soils and plant and animal life are closely linked to the underlying geology and a decrease in rainfall from north to south.

While pastoralism is by far the dominant land use in the district, Aboriginal and conservation lands are also present. Weeds, fire, feral animals and erosion are common natural resource management issues to each of these land users. The growth of the live export market, establishment of the Bradshaw Field Training Area by the Australian Department of Defence and in particular, the development of the Ord Stage 2 project, have the potential to change the face of land use in the district.



Rayner collection



Darrell Lewis

One of dozens of pairs of photographs assembled by historian Darrell Lewis that show vegetation change in the VRD. The upper photograph was taken near Coolibah homestead in 1959-1960 and the lower photo is the same scene in 1996.

A great deal of work has been undertaken by the TS-CRC to further our knowledge and understanding of the district's natural environment.

Work focused on:

- Developing a better understanding of the district's landscape and its plant and animal life.
- Investigating the changing tree/grass character of the savanna.
- Investigating the effectiveness of the district's network of reserved areas.
- Understanding the impacts of fire and grazing on different types of country and specific plant and animal communities.
- Developing and recommending local and regional fire and grazing strategies that meet the needs of both production and biodiversity conservation.

While much of this research was done using traditional field-based techniques, some projects are forging new ground in the use of satellite technology and the application of innovative modelling techniques.

Over the past year, the focus was on analysing project data and publishing findings. An outcome of a major workshop of users and researchers was the development of a land-management manual, *Managing for Savanna Health in the Victoria River District*. The workshop also provided the basis for a specific management strategy development for a major pastoral company and the VRD Conservation Association.

Project Leader: A/Prof. Ross Hynes, TS-CRC, James Cook University, Townsville

Project Overview and Aims

The Desert Uplands covers 75,000 km² of north Queensland and supports 58 ecosystem types on 320 grazing properties and several national parks. Cattle production is the main land use. Residents in the area formed the Desert Uplands Build-Up and Development Strategy Committee (DUBDSC) to pursue rural adjustment and regional sustainability in 1995. The TS-CRC, through project leader A/Prof. Ross Hynes, is an invited member of the Committee.

Research aims include:

- Establish and apply a regional GIS with a decision-support system for outputs at property, sub-catchment and regional scales to assist in achieving sustainable practices.
- Enterprise level investigations on sustainable management in conjunction with cost-benefit analyses of options.
- Initiate ecosystem health indicators in case studies within the region.

Project outcomes will contribute to a policy framework for economic, social and environmental development of the region.

Research Progress

During 1999–2000 the Desert Uplands GIS established by the TS-CRC was used to generate an extensive series of maps for application by DUBDSC. These maps included Cadastral-property maps, CD data sets of all available ArcView information, fauna distribution maps, maps of all 115 air-strips.

The five enterprise diversification trials established during 1998–1999 were evaluated during the year. The trials included boer and feral goat production, red claw crayfish production, production and preparation of native vegetation for the florist industry and growing and marketing eucalypt foliage and flowers. An assessment of the viability of an outback furniture-timber production industry was also completed.

The Multi-Objective Decision Support System (MO-DSS) being developed in collaboration with QDNR and linked to the DU GIS, was applied at three scales: whole of region, property cluster and property level.

An MOU was reached with EPA (Qld) to access data outputs of a detailed mapping project that will complete the 1:100,000 land cover/land condition map series for the region over the next three years. This will enable the TS-CRC to maximise its analytical applications of both the GIS and the MO-DSS within the region.

The Desert Uplands Tourism Audit and Marketing Strategy was reviewed, revised and restructured.

Future Directions

Preparation is under way for the publication of *The Desert Uplands Scheme 1998–2004: Achievements and Pathways Forward*, by A/Prof. Ross Hynes.

Between 2000–2001 the study will:

- Assisting in the production of GIS-generated property management plans.
- Providing insight into the potential of a range of enterprise diversification options.
- Identifying effective models of enterprise reconstruction.
- Producing raster-based regional maps of fauna habitats under threat.
- Producing the second edition of the Desert Uplands Atlas in CD format.
- Using GIS to link PMP with indices of carrying capacity for sustainable land use.

Project Leader Dr Mick Quirk, Queensland Beef Industry Institute, QDPI

Project Overview and Aims

The Burdekin Management Study aims to link research, development and education activities in the upper catchment of the Burdekin River (north Queensland) to enhance integration, communication and relevance of science-based information related to grazing land management. Initially, the study is focusing on achieving and communicating a multi-disciplinary overview of landscape and catchment processes in the Burdekin grazing lands and on developing spatially explicit guidelines for sustainable resource management.

The upper part of the Burdekin catchment, across the Dalrymple and Bowen shires, is around 60,000 km². The most intensive land use is cattle grazing, but mining, defence and national parks also play an important part in the area. The major land type is savanna woodland.

The study comprises two stages:

1. Integrate data and information from past and current research to achieve and communicate a multi-disciplinary understanding of the biophysical processes that govern grazing land systems in the study area.
2. Build on the outcomes of Stage 1 to develop integrated landscape-based guidelines that can inform and support policy and management at the enterprise and catchment level. With the involvement of a broad range of stakeholders in workshops and focus groups, this stage will also review existing policies, regulatory and institutional arrangements and assess the state of knowledge of social and economic factors relevant to resource sustainability in the area.

Research Progress

A part-time project officer, Dr Barbara Musso, was employed to assist in coordinating and implementing the study. An initial Burdekin Management Study Workshop—held in February 2000 and involving local R&D users and providers—gained feedback and endorsement on the study's overall directions, process and planned information products. The study will use attributes of savanna health developed by the TS-CRC (November 1999 Research Theme Workshop, *Definition of Healthy Landscapes*) as a basis for integrating information relevant to sustainable management. The workshop's outcomes were incorporated into a work plan.

The study is currently developing:

- A user-friendly, web-based database of published research outcomes, current research and extension activities and personnel, and access details on existing datasets relevant to natural resource management in the Upper Burdekin. This will have links to the TS-CRC Web-based information clearinghouse, *Savanna Information*.
- A 'Green Book', including i) a multi-disciplinary overview of state-of-the-art knowledge of the ecological functions and responses of grazing land systems in the study area and ii) integrated, spatially explicit guidelines for sustainable management.
- Stakeholder workshops planned for late 2000 and ongoing consultation will provide the study with feedback on locally specific information needs that will enhance the relevance of secondary information products ensuing from the 'Green Book'.

A communication plan was also prepared to coordinate information-sharing activities among the participants. An electronic update on the Burdekin Management Study is now regularly sent out by email; preparation for a quarterly newsletter is under way. The newsletter will enhance information sharing in the region and ensure integrated communication of R&D and sustainable management matters among local stakeholders.

Future Directions

The original milestones were revised in light of the work plan. Over 2000 the study will:

- Hold a one-week specialist workshop (by July 2000);
- Develop the database (by December 2000);
- Compile and review the “Green Book” (by January 2001);
- Hold sustainable management guidelines workshop(s) (by December 2000);
- Road-test information products (by April 2001);

Implementation of the communication plan will be ongoing.

PROJECT 5.1.1

HIGHER EDUCATION

Project Leader: Dr Penny Wurm, Northern Territory University, Darwin

This project is described in the Education and Extension section of this report, pp. 67.

PROJECT 5.2.2

EXTENSION AND VOCATIONAL EDUCATION AND TRAINING

Project Leader: Mr Richard Fell, Tropical Savannas CRC, Darwin

This project is described in the Education and Extension section of this report, pp. 71.

PROJECT 5.2.3

LEARNING PROCESSES OF PASTORALIST STAKEHOLDERS IN THE TROPICAL SAVANNAS

Project Leader: Dr Allan Arnott, Northern Territory University, Darwin

Project Overview and Aims

This project explores the learning processes of tropical savanna pastoralists, particularly in relation to changes in management practices. By developing an understanding of these processes, the TS-CRC and other groups will be able to package their learning products in the most appropriate formats.

The research component of the project is now complete and the final draft of the project report, titled *More than can be said: a study of north Australian pastoralists' stories of change and learning* was completed in June 2000.

Research Progress

Several pastoralists were interviewed from three areas in the tropical savannas: north and west Kimberley, Western Australia; Sturt Plateau, Northern Territory; and the Georgetown area, in Queensland, and related experiences associated with the management practices adopted on their properties. By understanding these processes, TS-CRC can better support the ways pastoralists learn and access information. The project will enable the TS-CRC to better present research information and develop education materials for pastoralists.

The study also focused on the desired outcomes of the pastoralists who participated in the project. Thus the pastoralists' case studies can be used as a guide for others who may be considering changing their management practices.

Project outputs include:

- A report on different ways to communicate with pastoralist stakeholders;
- Information on how pastoralists see the uptake of Information Technology;
- Stories of effective change for pastoralists;
- A basis for the development of booklets, workshops and seminars which inform practice;
- Articles for appropriate refereed journals.

The project identified five major issues which relate to the learning processes of pastoralists:

- Individualised nature of informal learning processes;
- Legitimising knowledge through practice;
- Effects of 'hidden' learning processes;
- Where perception does not match what occurs in practice;
- Where perception does not conform to appropriate action;

The report examines the scope of each issue, the implications for learning and for practice, and possible responses to the issues.

Future Directions

There is considerable scope for further research in this area:

- Similar research with other stakeholder groups.
- A joint venture with a developing extension studies project, either evaluating or contributing to an action research team.
- An analysis of the provision of extension services in the tropical savannas. This would be partly a mapping exercise, looking at 'ways of working', layered with perceptions of delivery method. Interviews could be carried out with both extension service officers and pastoralists as to their views on delivery and learning issues.

PROJECT 5.3.2 SAVANNA INFORMATION CLEARINGHOUSE

Project Leader: Dr Peter Jacklyn, Tropical Savannas CRC, Darwin

This project is described in the Communication and Public Outreach section of this report, pp. 83.

Education and Extension

EDUCATION

Dr Samantha Setterfield, Coordinator of the TS–CRC higher education initiatives, left in February 2000 and the position was taken over by Dr Penny Wurm, at Northern Territory University. Dr Setterfield remains a member of the GD/MTEM Steering Committee and a lecturer in the *Tropical Savannas* unit of the GD/MTEM.

The objective of this project is to develop higher education programs that meet the needs of TS–CRC stakeholders. The education project comprises both research and coursework postgraduate programs.

The *Education Needs Analysis*, completed in 1996, identified a need for environmental education available in flexible delivery mode. The Graduate Diploma and Master of Tropical Environmental Management continue to succeed as the means of achieving those goals. These postgraduate coursework programs also provide a structure through which outcomes of TS–CRC research can be communicated to stakeholders.



Lindsay Hutley

Chen Xiaojong exposes surface roots of savanna trees and applies root fractal modelling techniques in an attempt to estimate below ground root biomass.

The work of PhD, Honours and Masters students supported by the TS–CRC also contributes directly to the Centre’s research themes and projects, resulting in a further conduit for the Centre’s research to stakeholders. It also helps link graduate students directly with stakeholders and industry personnel, helping ensure a practical research focus into sustainable land–management research in the savannas.



Ross Hynes

Wendy Hillman with Prof. David Bellamy at the Savannah Guides School in Mareeba, April 1999. Prof. Bellamy was made a Savannah Guide at the School, the group which Wendy is studying for her PhD.

Postgraduate Program: PhD, Honours and Masters Projects

In the last five years the Centre funded a total of 13 Honours, three Masters and 22 PhD projects.

PhD enrolments currently comprise 11 at NTU, seven at JCU, and three at ANU. PhD student Ben Sharp, at the University of Oxford, receives financial operational support. His project is strongly linked to Projects 1.1.1 *Savanna Form and Function*, 1.1.3 *Assessing Structural Change in Tropical Woodlands*, and 4.3.4 *Modelling and Landscape Change*.

A number of the Centre’s PhD students are now in the final stages of writing their theses. Three students submitted their theses during the year:

- Carl Menges, NTU: *The application of radar remote sensing in the Northern Territory of Australia.*
- Catherine Mobbs, ANU: *Regional planing for sustainability: towards adaptive and collaborative models.*
- Myf Runcie, NTU: *The ecology and behaviour of tropical rock-haunting possums.*

PhD student Jodie Pritchard (NTU) withdrew from her project during the year, and Sharon Lovin (JCU) suspended study for one year.

Caesar Rodriguez, at NTU, is the only Master student currently supported by the TS–CRC.

Two Honours students, Josh Forner and Greg Lyons (NTU) completed their projects at the end of 1999. Both students gained employment in their fields of study. Josh Forner is now a candidate for a PhD at NTU. Honours student Gillian Carr (JCU) withdrew from her project midway through 1999.

Graduate Diploma and Master of Tropical Environmental Management

Work within the GD/MTEM is entering a busy phase as TS-CRC research results become available for incorporation into course content. Preparations are also under way to update and review of the CD-ROM, *Ecology and Management of Tropical Savannas*. Because of the transfer interstate of Dr Deborah Hector, a new researcher will be appointed to the MTEM CD-ROM project. They will also continue the development of a unit on rangelands and update several other units.

There were 31 combined enrolments in the GD/MTEM this year, slightly down on last year's 36 enrolments.

Dr Samantha Setterfield supervised a formal evaluation of the unit *Flora & Fauna Survey Techniques*, while based at the University of Georgia, Athens, Department of Instructional Technology (UGA). The evaluation included a student survey, as well as review by three educational technology specialists. Recommendations arising were incorporated into that unit, ready for delivery in Semester 2, 2000. The evaluation report, as well as the skills acquired by Dr Setterfield while based at UGA, will also serve as a platform from which to develop instruments for the ongoing evaluation of other units in the course.

The *Rangelands* unit is being developed for external mode, ready for Semester 2 in 2001. The unit was originally planned to be ready by 2000, but staff changes delayed the development of the unit. This unit will be developed using a problem-based learning approach. TS-CRC project leaders and participants will again be invited to participate in the development of the unit content as unit advisory committee members. Research outcomes of Projects 4.3.4, 3.1.1/2, 1.1.3, 2.1.1, 4.3.5 and 4.2.2 will provide key content for the unit. Guest lectures and field visits will provide the opportunity for researchers and students to interact directly. Video and audio recordings will be used in the learning materials developed for flexible delivery.

Dr Rosemary Hill, based at James Cook University's Cairns Campus, completed writing the TS-CRC funded unit *Land and Sea Managers: Indigenous Peoples and Australian Tropical Environments*, and will offer the unit through James Cook University for the first time in Semester 2, 2000. The online learning materials will be augmented by an intensive residential in Cairns. This unit will be promoted initially as an elective unit in the GD/MTEM program. Lyn Walker will be funded by the TS-CRC through JCU to write a new unit dealing with environmental policy issues. In a survey of graduating JCU students, this topic was identified as a priority area for students, and preliminary expressions of interest in the unit have already been received.

The GD/MTEM website was launched in August 1999. Linked to both the NTU and TS-CRC Websites, it provides access to course information and unit learning materials. Overseas and interstate inquiries indicate that the site is being accessed. (URL: <http://www.ntu.edu.au/faculties/science/sbes/pgrad/tropenvman.htm>)

The education project provides a structure through which TS-CRC research outcomes are communicated directly to the Centre's stakeholders. In return, direct links to research projects ensure high quality and up-to-date content of units. The project also provided resources for regional institutions, and filled a gap in courses available for savanna stakeholders. Finally, outputs of the project are products that will remain after the life of the TS-CRC. The position of Education Project Leader is fully integrated into Northern Territory University's Faculty of Science, Information Technology and Education, further ensuring the continued life of the project.



Sam Settefield

Students in the field have the opportunity to learn first hand from experts such as Rodd Dyer, NTDPIF, who is researching the impact of variable fire regimes on the health of grazing country.

Future Directions

The first priority for the project will be ongoing integration of research outcomes and maintenance of educational products. Research outcomes are becoming available as the TS-CRC is now in its fifth year. Further, educational products require ongoing maintenance. As well as updating content, results of future unit evaluation need to be incorporated into learning materials. Also, online materials need repairs such as solving inevitable technical problems at the site and ongoing checks of web links.

Promotion of the now-completed TS-CRC products is the next priority. These will be promoted amongst the Centre's partners and stakeholders, as well as with overseas institutions. Overseas promotion will be strategic, with a focus on fostering and using the Centre's existing international links.

With its emphasis on online delivery, this course is at the cutting edge of educational technologies and teaching practice. Ongoing evaluation and quality auditing of the learning materials and teaching methodologies will be required to ensure best practices of teaching staff and best experiences for students. This will be ensured through the development of customised evaluation instruments, the ongoing inclusion of upgrade and revision as project milestones, and pro-active course advisory committees.

Project products can be used in other educational programs. For example, Batchelor Institute of Indigenous Tertiary Education has expressed an interest in using the CD-ROM *Savanna Ecology and Management* as a resource for teaching staff involved in the development of teaching materials at undergraduate and diploma level. Discussions were also under way for the adaptation and use of the CD-ROM at the University of Florida, with the possible development and inclusion of examples and materials from the United States.

Summary

Project 5.2.2, led by Mr Richard Fell at Northern Territory University, aims to answer the question of what are appropriate learning materials to enhance the skills and knowledge of tropical savanna land managers in sustainable use and conservation management. This translates into a broader purpose of ensuring end-users are able to access information, knowledge and skills through learning products that satisfies their needs and enables them to apply this in their workplace.

The long-term objectives of the project are:

- To develop and deliver appropriate and relevant learning materials/packages to meet the needs of the six stakeholder sectors: pastoral, Aboriginal, conservation, tourism, mining and defence and all stakeholders of the TS-CRC over the next two to three years.
- To have landholders and users understand the management practices inherent from the research undertaken in the four themes of the TS-CRC: Landscape Processes, Ecosystem Management, North Australia Landscape and Human Capability Development over the next two to five years.
- To have landholders and users adopt appropriate technology under the themes of fire, weeds, grazing sustainability and conserving biodiversity to meet their needs over the next two to five years.
- To extend the research output from the TS-CRC and elsewhere, through delivery of an interactive, integrated series of activities and material to the end-users of the tropical savannas over the next two to three years.
- To design and apply appropriate monitoring and evaluation procedures to enable progress to be measured and evaluated over the next two to three years.

Progress

Weed Management

Three learning packages and materials on weed management were initiated this year.

- Video on weeds management in Aboriginal lands
- Weed Identification Deck for the Top End
- Weed management case studies

The project aims to complete a video on weed management in Aboriginal communities by December 2000. There were four meetings of the video group that established the aim, content and features of the video. Filming is under way by the Batchelor Institute and the Interactive Learning Division at NTU. Galarrwuy Yunipingu, Chairman, Northern Land Council was also contacted and confirmed his willingness to be part of the video.

Support was gained from the NLC and NTDPIF for a proposed pocket guide on weed identification and control for two Aboriginal communities in the Northern Territory. Fifteen weeds of significance in the tropical savannas of the Northern Territory were selected. QDNR is to produce these customised decks. Two Aboriginal communities will be approached for distribution and testing of the guide. The trial will provide useful information for the National Weeds Awareness program, as well as the basis of extension materials for Aboriginal communities across the tropical savannas. One weed-management case study was written.

Fire Management

Learning package and materials on fire management fall under the following headings:

- Fire management book, *Savanna Burning: Understanding and Using Fire in Northern Australia*
- Fire management module for landcare rural landholders manual.
- Case studies of practical fire management.

The book on fire management in northern Australia is to be published late in 2000, and is one of the main activities under this part of the project. A group was set up to write the book, chapters were outlined and people designated to write these chapters.

Ten property case studies were written to illustrate the book with real situations. They form part of a projected new TS–CRC publication series of ‘theory in practice’.

These case studies also formed the basis of the fire presentation to the Mary River Landcare Group, with fire management research and the fire management module from the Landcare book.

Grazing Management

A major project is also under way to develop learning packages and materials in grazing land management/sustainability. The Meat Livestock Association commissioned a learning package in Grazing Land Management (GLM) to be developed by December 2000, and pilot-tested by June 2001.

The market research for grazing land management by the MLA identified pasture species, stocking rates and assessment of pasture as high priorities to ensure sustainability of land use. Fire and fire as a management tool were also identified as areas that pastoralists want more information about, as well as weeds and weed management.

The Development Consortium to write the package and to test it in four regions includes TS–CRC, QDPI, CSIRO and NTDPI. The project gained approval from all key agencies in Queensland, Western Australia and Northern Territory.

The literature that is available on the TS–CRC web-based clearinghouse (around 2300 papers and reports) was audited and assigned to the 25 topics to be included in the GLM. The TS–CRC is also a member of the QFD Reference Group which will enable development of the GLM as a distance education /interactive learning module.

Learning packages and materials are also being developed in sustainable management for the tropical savannas (especially the VRD). This includes the GLM package, data collection on properties in the VRD for case studies, the fire management book and further case studies to support the GLM package.

Case studies on fire management for five properties in the VRD were written.

Data are being collected and analysed on weed control, feral animal control, fire management and soil erosion management from properties in the VRD to form the benchmark for future work with the VRD Conservation Association.

Biodiversity and Conservation

Learning packages and materials on biodiversity and conservation were developed:

- Participatory planning workshop materials for working with Aboriginal communities in September 1999 were tested and offered generally by TAFE and/or REC in 2000;
- Weeds video (as above);
- Associate Degree in Tropical Agriculture (ADTA);
- Collection of research data in theme workshops and defining savanna health.

Associate Degree in Tropical Agriculture

The TS–CRC helped to design and will help deliver a new degree course in Tropical Agriculture based at the NT Rural College. The new course has three themes: Extension and Communication, Grazing Land and Animal Management and Healthy Savannas. The latter will build on the TS–CRC's work and the Grazing Land and Animal Management theme will use the GLM package to define a course that is different and northern in outlook.

A public relations package was also designed based on materials that Centre Director John Childs had assembled for various talks about the TS–CRC. The package included posters and a CD–ROM and was used at Beef 2000 (April 2000) and the CRC Association Conference and the North Queensland Field Days (May 2000). This package provides a public relations vehicle for use by TS–CRC related staff.

Future Directions

- Appropriate evaluation of learning activities will be conducted.

The TS–CRC will continue to demonstrate coordination and integration of people, material and activities in the projects that make up Project 5.2.

Workshops and meetings facilitated by Extension project Leader Mr Richard Fell, December 1999 to February 2000:

- Katherine Pastoral Industry Advisory Group meeting *Focusing the Action*.
- Sturt Plateau Best Practice Group, facilitated its forward action session.
- Biocontrol Group Workshop, *Strategic Planning and Extension*, QDPIF.
- *Land Administration and Land Management Workshop* facilitated the Issues to Solutions sessions, TS–CRC.
- Mary River Landcare Group, *Strategic Actions Day*.
- VRDCA Strategic Actions Workshop.
- NTCA Future Directions, four workshops.
- NABRC Charting Unknowns Workshop, two sessions.
- NABRC Futuring Workshop: Developing Future Scenarios.
- *Weeds Mapping Workshop*, NTDPIF.
- Katherine Landcare Conference, *The Future of Landcare*.
- Needs Assessment Session, Sturt Plateau Best Practice Group.
- Strategic Actions Session, Rangelands Section, Resource Management, NTDPIF.
- Planning Meeting, Northern Territory Irrigators group, organised by NTDPIF.
- NTDPIF Evaluation session, Mt Sanford Field Day.
- NTDPIF, Strategic Planning Meeting, Technical Advisory Group, Resource Management.
- North Australia Program *Live Exports Workshop*.

1999

- *Global Change Transects Workshop*, Novotel Atrium Hotel, 12–16 July, Darwin. This workshop brought around 20 scientists from around the world in a combined workshop on the research of the International Geosphere-Biosphere Program's Terrestrial Transects. The workshop was organised by CSIRO W&E in Darwin and received funding from the TS–CRC and AusAid.
- *North Australia Rural Fire Managers Forum*, 24 Aug., Darwin. Representatives of the rural bushfire services from Queensland, Northern Territory and Western Australia together with scientific and communication support from the Tropical Savannas CRC, discuss issues of mutual interest and coordinate fire management strategies.
- *PhD student get-together*, 10 Sept., Townsville. This meeting invited the Centre's JCU-based PhD and Honours students—with their supervisors—to give a short presentation on their field of study, progress and the challenges so far. Five PhD students and three supervisors attended.
- *Research Project and Theme Workshops*, 20–22 Sept. Darwin.
- *Frontier Australia: Contact Geographies in Northern Australia*, a two-day conference held in Darwin, September 23–24 1999. This symposium was hosted by the TS–CRC Project *Aboriginal pastoralists and land in north Australia*. Fifteen Australian and international speakers, many with high academic and public profile, from a range of social and natural sciences and advocacy organisations gave papers or were present.
- *Futuring Workshops on Research Projects and Themes*, 20–21 Oct., Darwin. This workshop was a first step in the process to work out what the TS–CRC should focus on in its re-submission for another seven-year term. It involved staff, Board and Consultative Committee members and had input from Barney Foran, CSIRO.
- *Four workshops on TS–CRC Research Themes: Ecosystem Management; Landscape Processes; North Australia Landscape; Human Capability Development*, 1–5 Nov., Darwin.
- *Workshop 1: Definition of Healthy Landscapes*

At this workshop a definition of savanna health was broadly agreed upon and a number of products to promulgate the concept were considered.
- *Workshop 2: Defining and Assessing Health: Indicators*

In this workshop it was decided to revise the soil condition of tropical grasslands assessment manual with improved indicators, and combined into a single manual for Australian rangelands.
- *Workshop 3: Management Strategies for Health in the VRD*

This workshop was held to develop a technical publication based on what is known from the Centre's research projects on monitoring and assessment and fire and grazing and impacts on VRD land systems.
- *Workshop 4: Fire Management Options*

The workshop then refined the content of a fire management book primarily aimed at fire managers.

2000

- *Burdekin Management Study Workshop*, 15 Feb., Townsville. This initial workshop involved local R&D users and providers. The workshop provided feedback and endorsement of the Study's overall directions, process and planned information products. The outcomes of the workshop were incorporated in the work plan, and original milestones revised.
- *Land Administration and Management Forum*, NTU, 21–22 Feb., Darwin. This meeting brought together land managers, agency staff and researchers from Qld, NT and WA. It looked at land administration and management policies in the north and ways they might be changed to encourage *sustainable* management.
- *North Australia Rural Fire Manager's Forum*, 2 Mar., Cairns. (See 1999 above)
- *Workshop for pastoral land-managers and owners*, 9–10 Mar., Brisbane. This workshop was run by Alaric Fisher (PWCNT) to develop conservation plans on pastoral properties for Barkly Tableland companies.
- *Heytesbery Beef Pastoral Co. Development Workshop*, 3–5 May, Darwin. Coordinated by the TS–CRC and held to develop management and development plans for their properties in WA, NT and Qld.

TABLE 3 STUDENT RESEARCH DETAILS: PHD STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
G. Calvert	Effects of grazing on plant biodiversity in the Dalrymple Shire	JCU	B. Jackes (JCU) R. Hynes (JCU/CRC) P. O'Reagain (QDPI)	1997	QDPI TS–CRC
A. Dee	Seasonal habitat use, food resources and Aboriginal perceptions of the feral pig <i>Sus scrofa</i> in the Arafura swamp	ANU	D. Rose (ANU) H. Nix (CRES) J. Woinarski (PWCNT) S. Morton (CSIRO) N. White (LaTrobe University)	1997	TS–CRC CSIRO NLC
M. Fegan	Integrating GIS/RS for Environmental Monitoring	NTU	W. Ahmad (NTU) D. Williams (CSIRO) C. Devonport (NTU)	1999	TS–CRC
F. Fraser	The ecology of the partridge pigeon and habitat impacts due to fire and grazing	ANU	T. Norton (RMIT) H. Nix (ANU) P. Whitehead (NTU) S. Garnett (QPWS)	1996	TS–CRC PWCNT
W. Hillman	Ecotourism in northern Australia—interpretive guided tours	JCU	R. Hynes (JCU/CRC) R. Wilkinson (JCU)	1999	TS–CRC Aust. Geogrph.
B. Hoffmann	Responses of ant communities to land use impacts in northern semi-arid Australia	NTU	A. Andersen (CSIRO) G. Hill (NTU) K. McGuiness (NTU)	1997	APA TS–CRC CSIRO
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	NTU	W. Ahmad (NTU) D. Williams (CSIRO)	1997	TS–CRC
J. Jackson	Exotic grass species in tropical savannas of northern Australia	JCU	T. Grice (CSIRO) B. Jackes (JCU)	1998	TS–CRC CSIRO JCU QPWS

TABLE 3 STUDENT RESEARCH DETAILS: PHD STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
G. Kelley	Tree water use and soil physical properties of tropical savannas	NTU	D. Eamus (NTU) L. Hutley (NTU) J. Landsberg (CSIRO)	1997	TS–CRC NTU
A. Kutt	Spatial patterns of distribution, abundance and diversity in the vertebrate fauna assemblages of the Desert Uplands bioregion, northern Queensland	JCU	J. Woinarski (PWCNT) C. Johnson (JCU) R. Pearsen (JCU)	1996	TS–CRC PWCNT EPA (QLD) JCU
S. Lovin (suspended study)	Cultural tourism; consuming or sustaining the bush	JCU	R. Hynes (JCU/CRC) J. Elder(JCU)	1998	TS–CRC
C. Macgregor	Achieving sustainable urban communities in the Australian Savanna by ecological planning and community participation	JCU	R. Hynes (JCU/CRC) D. King (TESAG) M. Fenton (TESAG)	1996	TS–CRC
C. Menges	The application of radar remote sensing in the Northern Territory of Australia	NTU	W. Ahmad (NTU) J. van Zyl (NASA)		APA TS–CRC
C. Mobbs	Regional planing for sustainability: Towards adaptive and collaborative models	ANU	H. Ross S. Dovers H. Nix	1997	LWRRDC TS–CRC
K. Pfitzner	The use of remotely sensed data, ancillary data and GIS technologies for the evaluation of the rehabilitation of two mine sites	NTU	W. Ahmad (NTU) R. Clifton (NTDME)	1997	TS–CRC
J. Pritchard (withdrawn from project)	Modelling the water balance of a tropical savanna for the sustainable development of groundwater resources, Howard River Catchment, NT	NTU	D. Eamus (NTU) J. Cox (CSIRO)	1999	NTDLPE TS–CRC NTU
M. Runcie	The ecology and behaviour of tropical rock-dwelling possums	NTU	G. Hill (NTU)	1998	TS–CRC APA
B. Sharp*	The roles of fire and grazing in producing long-term landscape-scale vegetation change in an Australian tropical savanna	Visiting student from Uni Oxford, UK	R. Whittaker (UO) D. Bowman (CINCRM)	2000	TS–CRC ARC
T. Vigilante	An ecological study of the North Kimberly landscape	NTU	D. Bowman (CINCRM) N. Williams (CINCRM)	1998	TS–CRC APA
G. Whiteman	The effect of pastoral practice on the genetic diversity of the grass <i>Heteropogon contortus</i> in a Queensland tropical savanna	JCU	J. Brown (NMSU) R. Hynes (JCU/CRC) M. Waycott (JCU)	1996	TS–CRC JCU
C. Xiaoyong	Production structure and carbon balance of an <i>Eucalyptus</i> open forest in tropical savanna, Northern Australia	NTU	D. Eamus (NTU) L. Hutley (NTU)	1997	TS–CRC APA
Z. Yue	Spatial patterning of resources for graminivores—developing a model for habitat management	NTU	P. Whitehead (NTU) W. Ahmad (NTU)	1999	TS–CRC APA

TABLE 3 STUDENT RESEARCH DETAILS: MSC STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
C. Rodriguez	Monitoring past and present fire regimes and development of fire management strategies for conservation of biodiversity in Cape York	NTU	J. Russell-Smith (BFC) W. Ahmad (NTU)	1997	TS-CRC

TABLE 3 STUDENT RESEARCH DETAILS: HONOURS STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
G. Carr (withdrawn from project)	'Rainforests of the Desert': an interpretive study into the dry rainforests of the Riversleigh World Heritage Area	JCU	J. Luly B. Jackes R. Hynes	1999	TS-CRC
J. Forner	The integration of GIS and remote sensing for sustainable management of didjeridu timber species on Jawoyn lands	NTU	P. Whitehead C. Devonport W. Ahmad (informal)	1999	TS-CRC PWCNT** KCTWM**
G. Lyons	Spectral, spatial and temporal analysis of the noxious weed <i>mimosa pigra</i> on the coastal floodplains of the Northern Territory	NTU	W. Ahmad G. Cook	1999	TS-CRC

*Operational funding only. **Logistics support NB: Honours students' grants were made in the 1998–1999 financial year.

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
G. Calvert JCU	This research, at the simplest level, will provide a valuable collection of botanical data points for the semi-arid savannas. These botanical surveys are of particular interest to mine sites for revegetation and to national parks to assist with conservation. At its most complex, it is hoped that trends in plant species change will be recognised which will help identify appropriate cattle stocking rates. This research will confirm currently recognised biological indicator species of pasture decline, and add many species to this 'toolbox' of indicators. This research may also identify the differences in which cattle and macropods influence their environment. This research should significantly advance our understanding of the intricate nature of herbivore-plant relationships and general ecosystem function in the semi-arid savannas. It appears that more than 900 plant species will be involved in the data analysis, a number of which are likely to be new, undescribed species.	LP EM
A. Dee ANU	This project aims to detail the social and environmental impacts of feral pigs in the Arafura wetlands, north central Arnhem Land. In addition, the project aims to develop an understanding of Aboriginal perceptions of feral pigs and their effect upon contemporary Aboriginal culture and land management. Field surveys were conducted from June–August 1999 (dry season), October–December 1999 (late-dry/early wet season) and February 2000 (wet season). These surveys measured pig activity within a range of vegetation communities. The importance of local food resources to contemporary Aboriginal diet is also being studied simultaneously and aims to establish whether seasonal bush foods may be being diminished by the presence of feral pigs.	EM HCD 4.3.3

PHD STUDENTS

Student	Research Highlights	Theme/Project
M. Fegan NTU	This project aims to integrate remote sensing and GIS for environmental monitoring, and is approached from a data fusion perspective. Data from several sources (image and non-image) are used in combination (fused) with the goal of producing output information of higher quality than obtainable from a single source. As a start, an attempt to use GIS data to assist the automation of image classification, incorporating the spatial context of image pixels was made. Initially any spatial correspondence between reference GIS data and an unsupervised image classification is estimated by GIS overlay and cross-tabulation. Secondly, the similarity between a pixel's immediate spatial neighbourhood and cover type reference template is estimated.	EM
F. Fraser ANU	In this research, the partridge pigeon is used as a case study to explore the possible effects of grazing and altered fire regimes on some of the bird's basic ecological needs. These needs include availability of seed and particular habitats for nesting or roosting. Data indicate that there are food shortages in the early wet season with large increases in home range size coinciding with a rapid and severe decline in seed abundance following wet season rains. Data suggest these birds need a structurally patchy understorey within the confines of the home range. This sort of patchiness may best be achieved through fire management, which ensures small scale patchy fires. Land management which results in a structurally uniform understorey (e.g. characteristic of late dry season fires unbroken by prior early wet season burning; large areas unburnt for years) may not be suitable in meeting habitat requirements for these pigeons.	NAL LP EM 2.2.2
W. Hillman JCU	This project examines interrelationships between the Savannah Guides, the tour group under study, and the environment. This will investigate a balance between the communities and people who depend on the savannas and the savanna environment. The aim is to understand a blending of people's needs with those of the environment, and looks at the move away from site-specific or individual land-use management, to the interactions of the Savannah Guides with the ecosystem of the savannas. The second element of the research covers the Savannah Guides as a stakeholder group within the tropical savannas. It will also contribute to an added awareness about information on the savannas, as well as sustainable development of natural and cultural resources.	EM HCD
B. Hoffmann NTU	This year the project is summarising all of the published research using ants as bio-indicators in Australia, identifying recurrent trends and exploring avenues for future research. Given the poor taxonomy of Australian ants, the greatest challenge has been sorting collected specimens to species level. The lack of collections in these research areas exacerbated the challenge, but the collecting of previously unrecorded species is most rewarding. This PhD project is almost complete.	LP 3.2.1
H. Khwaja NTU	This research project aims to develop image-processing techniques which could predict and map the variation in savanna vegetation as it varies along a broad latitude and moisture gradient in north Australia. Sub-issues include finding the most appropriate of data resolution; identifying the influence of parameters such as land cover, land use, rainfall and temperature on the classification technique; and the development of procedures based on remote sensing and GIS technologies to map savanna vegetation.	NAL LP 1.1.1

PHD STUDENTS

Student	Research Highlights	Theme/Project
J. Jackson JCU	The first part of this project aims to investigate the impacts of buffel grass, a widespread, exotic pasture grass, on ecosystems in north Queensland. While it is commonly stated that exotic plants impact negatively upon ecosystem components and processes there are few studies that actually quantify such impacts. Identifying cause and effect was particularly challenging where the possible impacts of buffel grass are confounded with the impacts of other factors such as grazing, other disturbances and environmental variability. The first part of the project investigates the effects of buffel grass and a native perennial grass on herbaceous species richness. The second part of the project aims to investigate the impacts of fire on buffel grass communities. This work involves collaboration with QPWS which is interested in the containment or removal of buffel grass from national parks. Two sites were established in buffel-dominated vegetation in 1999. A soil seed bank study was completed.	LP EM
G. Kelley NTU	This project concentrates on the ways in which soil properties and plant physiological characteristics affect fluxes of water in the soil-plant-atmosphere continuum. Study sites are contained within the Howard River East catchment, in conjunction with other activities of Project 2.1.1. Fieldwork is now complete, and this year tree water use and other physiological parameters were monitored in three systems: open eucalypt forest, Melaleuca swamp forest and wet monsoon forest. A highlight was the collaboration with the CSIRO Centre for Groundwater Studies, where Ms Kelley learned to use stable isotopes techniques to investigate sources of water used by Melaleuca trees, in particular to see how reliant such vegetation is on the near-surface groundwater.	NAL LP 1.2.1
A. Kutt JCU	Field surveys on the patterns of distribution, abundance and diversity in the vertebrate fauna assemblages of the Desert Uplands bioregion are almost complete. Cat gut analysis and grazing/fire study are now complete, and in process of being written up. Challenges included record rains and flooding while highlights included new species distribution records, including rare and threatened species, and identification of two new species of reptile.	NAL LP 2.1.1
C. Macgregor JCU	This project is developing and using an analytical index model to measure the sustainability of a representative sample of small town communities within the savanna region of Australia. The aim is to provide advice to local government about achieving community sustainability. This PhD project is now almost complete. Local community profiles of the major towns in the region were obtained to include demographics, service provision, economic base, and, natural and cultural features. A set of suitably representative towns from the region were identified in which to conduct more detailed studies. Community values and attitudes with respect to sustainability issues were assessed, as well as possible development opportunities, environmental protection and community participation in the development and planning process. Representative towns were compared and contrasted to identify areas of strengths and weaknesses with respect to sustainability. From these data an analytical model was developed, enabling recommendations to be made to develop sustainability of towns in northern Australia.	NAL HCD
C. Menges NTU	Tropical savannas are of great importance to tropical regions and are of global significance because of their impact on the global carbon balance. The use of Synthetic Aperture Radar (SAR) can add to the benefit of established remote sensing techniques by allowing wet season monitoring and by providing additional information related to the vegetation structure. This research project has provided a methodology for the utilisation of SAR data for land cover mapping. The project has also established an appropriate filter to use for the suppression of speckle; developed a new method to correct for the effect of incidence angle variation; and reduced the effect of variation in incidence angle. Land cover classification of AirSAR data was successfully implemented using standard image processing techniques.	LP EM

PHD STUDENTS

Student	Research Highlights	Theme/Project
C. Mobbs ANU	This thesis concerns processes of regional planning for ecologically sustainable development in Australia. It explores and clarifies the nature of two key perspectives on regional planning: adaptive and collaborative. The research conducted by Ms Mobbs challenges the assumption that these two perspectives are broadly compatible and argues that while both are necessary in regional planning, they exist in tension. The thesis establishes the distinctive characteristics of these perspectives and proposes an analytical framework for examining regional planning in practice. The framework is applied to two case studies of regional planning: the regional forest agreement process in NSW and the Cape York Peninsula Land Use Strategy in Qld.	HCD
K. Pfitzner NTU	This project evaluates mine site rehabilitation using GIS and remote sensing data. This year Ms Pfitzner examined the abandoned Captains Flat Mine in the NT. Environmental degradation has occurred, resulting in heavy metal contamination of the Molonglo River which eventually flows into the ACT's Lake Burley Griffin. Field observations showed that the mine site is a pollution source, with springs and flows evident from abandoned adits as well as seeps from the bedrock itself. This pollution produces flocs of iron-rich water, sulfates and precipitates at the surface. The old mill site and ore concentration storage area is also a pollution source. Fieldwork included spectral measurements to spectrally characterise mine pollutants. The collection of these signatures in the field confirmed the presence of weathering minerals such as jarosite, goethite and ferrihydrite. The main advantage of identifying pollutants using hyperspectral analysis is that these techniques may be applied routinely and temporally to assess changes in the environment and result in an aerial extent map (for incorporation into a GIS), rather than just point measurements, like those often obtained with field studies alone.	NAL LP
M. Runcie, NTU	Ms Runcie has studied two species of possum: the rock-haunting (<i>Petropseudes dahlia</i>) and scaly-tailed possum (<i>Wyulda sqaumicaudata</i>) both of whom had received relatively little study. Both are vulnerable to population decline because of their restricted distributions (from the Kimberley across the Top End to the Gulf of Carpentaria and western Queensland). Radio-tracking and behavioural observations of a population in Kakadu National Park revealed the rock-haunting possum to be highly social. Characteristics include bi-parental care with the male providing 50 per cent of total parental care—a degree of male care rare among mammals and unreported in marsupials. They have an extensive communication system involving scent marking and sentinel behaviour. Suggestions for management of these two possum species' habitat involves reducing habitat modification, (particularly ensuring the regeneration of trees up to 50 m from rocks) and reducing feral predators. The protection of rainforest patches for survival of frugivore dispersers will also help to maintain the vegetation diversity in rock possum habitats.	LP
B. Sharp UO	This research seeks to examine and quantify landscape-scale vegetation change systematically across a range of habitats on Bradshaw Station in the VRD, and to reveal the causes of observed changes with reference to the management history of the area, with a specific emphasis on fire and grazing effects. To that end a study area was chosen to encompass the full range of variation in management histories (i.e. long-grazed versus only recently-grazed, frequently burnt versus unburnt). Preliminary assessments of vegetation changes took place through analysis of recent (1992–97) and historical (1948) aerial photographs. The air-photo analysis was combined with extensive vegetation surveys of the same locations, and the survey data was examined to reveal demographic shifts in tree populations that may correspond to specific environmental events (e.g. fires, exceptionally wet seasons, or the establishment of fenced pastoral operations).	LP EM VRDMS

PHD STUDENTS

Student	Research Highlights	Theme/Project
T.Vigilante NTU	This project examines some of the ecological effects of Aboriginal landscape burning in the north Kimberley. The project has both ecological and ethnographic research components. A vegetation map was developed using satellite imagery and GIS and some aspects of Aboriginal interpretation of the landscape will be overlaid on this map. A landscape-scale experiment was set up at Kalumburu Aboriginal Community (April to October 1999) comparing the structure and floristics of woody vegetation across three vegetation types and different fire histories (remote versus inhabited). The effect of timing of fire on fruit production in several understorey trees was investigated. Roadside burning was assessed every fortnight throughout the dry season to get an insight into burning patterns. Mr Vigilante conducted a number of interviews with Aborigines on traditional use of fire, with permission of Elders. He was also shown how Aboriginal people use fire in the landscape. An important topic of the research is the role of fire in the hunting of kangaroos, cattle, emu and bustards.	LP 4.3.2 (5)
G.Whiteman JCU	This study examines the effect of pastoral activities on the genetic diversity of the grass <i>Heteropogon contortus</i> (black speargrass) in tropical savannas. During his research, Mr Whiteman discovered that the species, thought to reproduce only by asexual seed production can, in fact, reproduce sexually. He found that this type of reproduction may be associated with a highly unusual climatic event—a prolonged wet spell extending through a winter and following summer—leading to early flowering and seed set. He found that demographics, such as seed set and seed transport, rather than the direct impacts of pastoral activity dominated the processes of genetic population. Management practices that are conducive to sustainable pastoral production will also conserve the genetic variability of <i>H. contortus</i> populations. The species is likely to recover from occasional over-use and local extinction provided seed sources are maintained, as genetic diversity is not partitioned among specialised ecotypes. Sexual reproduction helps explain the level of genetic diversity and suggests a linkage between ecological and evolutionary processes which will be used to support a hypothesis concerning the worldwide distribution of races of <i>H. contortus</i> with different chromosome numbers.	LP EM
C. Xiaoyong NTU	Research focuses mainly on biomass accumulation and mass distribution, root growth and turnover, carbon stock in soil, soil respiration process and carbon input-output budget in the eucalypt open forest in north Australia. All the above parameters are fundamental to establishing the carbon cycling model in Australia's tropical savannas, which will contribute to the national and global scale carbon balance and global climate change. Fieldwork this year investigated carbon storage in the soil; root fractal measurement; root growth and turnover measurement through root growth bags method; monitoring seasonal changes of fine root growth through root <i>rhizotrons</i> methodology; monitoring seasonal changes of soil respiration; and measuring litter fall pattern of the Eucalyptus open forest.	NAL LP 1.2.1
Z.Yue NTU	This project is developing a model to manage the habitat of graminivorous birds. It is using satellite imagery to establish patterns of burning at Yinberrie Hills in the savannas. Woodland or open woodland communities dominated by <i>E. tintinnans</i> and <i>E. tectifica</i> are likely to be burnt, and these vegetation classes are among those considered particularly important graminivore habitat. An analysis of the impact of different fire frequencies in these habitats was carried out. The proportion of the site classified as recovered increased significantly with an interval between fires. An analysis of burning frequency in different localities and in different vegetation communities in the past 10 years was also carried out. These studies should clarify the influence of fire on the development of graminivore habitat and shed light on the fire ecology of tropical savannas in a region that supports one of the largest known breeding colonies of the endangered Gouldian finch.	NAL EM LP 2.2.2

MSC STUDENTS

Student	Research Highlights	Theme/Project
C.Rodriguez NTU	This project undertakes remote sensing and associated GIS studies to document: the extent of patterns of burning in the Laura Basin area of Eastern Cape York Peninsula; the development of a 10-year fire history for the region based on the interpretation of LANDSAT imagery; the assessment of the change in status of grasslands in the Laura Basin area using a combination of satellite imagery and aerial photographic records; and a detailed analysis using GIS to explore relationships between burning patterns and vegetation change.	EM 2.4.1

HONOURS STUDENTS

Student	Research Highlights	Theme/Project
J. Forner NTU	This research demonstrated that commercial didjeridu harvesting practices strained the health of north Australian savannas and require active management planning to achieve sustainability. This includes the need for more detailed harvest permits and returns forms, the need for an indigenous approved tagging system and the potential utility of a GIS-based harvest management system. Traditional and commercial harvesting methods were compared, including yield, and a survey conducted to sample harvesting density, on an area of Jawoyn land near Katherine, NT. Harvesters in the Katherine region, both traditional and commercial, favoured one species (<i>Eucalyptus phoenicea</i>) over others. Traditional harvesting was a time-consuming and selective process, whereas commercial harvesting was more indiscriminate, resulting in a much higher yield of stems. A broad-scale vegetation map for the area was produced and a digital geological map (1:250000) were incorporated into a GIS and then combined to produce a refined distribution map (in relation to <i>E. phoenicea</i>). Field survey based on this and other existing mapping resulted in crude estimates of resource size and potential harvest extent. Hons. Completed.	EM
G. Lyons NTU	This project involved analysis of the spectral and spatial properties of the noxious weed <i>mimosa pigra</i> on the coastal floodplains of the Northern Territory. This noxious woody weed invades coastal floodplains and is a prolific producer of floating seeds. It forms dense strands that render large areas of floodplain inaccessible to people, cattle and native fauna. Project investigated the spectral reflectance properties at various sites in the Northern Territory using a radiometer and field spectrometer. Classification methodologies suitable to identify and map <i>mimosa</i> infestations were also analysed. Hons. Completed.	EM

Communication and Public Outreach

This year sees the Centre's communication strategy build upon the achievements of previous years in pursuing the three goals established in 1997–1998: improving information provision to stakeholders; creating a more cohesive and distinctive identity for the centre; and improving information and skills needs of Centre staff. The progress made towards each of these goals is outlined below.

The year saw a maturing of the integrated research of the Centre and the consequent preparation of publications that present this research. A major achievement was the completion of the first stage of the Web-based clearinghouse of land management information, greatly assisted by a grant from AUSLIG.

Important workshops and fora were held that brought researchers and stakeholders together from across the savannas to discuss issues of mutual interest.

Providing information to the Education and Extension programs of the Centre was emphasised this year and will increase over the next two years. The result was the establishment of a unique communication infrastructure that will serve the Centre well over its final two years when many of the research results will be produced.

GOAL ONE: IMPROVING INFORMATION PROVISION TO STAKEHOLDERS

Publications that integrate research for stakeholders

Several publications were prepared during 1999–2000 that used the work of TS–CRC themes or projects to bring together research findings on tropical savanna management for non-scientific audiences. The first four are now in press and will be distributed later in 2000.

- *Healthy Country in Australia's Tropical Savannas* (Theme 1). This booklet describes a new way of measuring landscape health developed by the TS–CRC. It is aimed at land management agency staff. A brochure aimed at a general audience accompanies it.
- *Managing for Savanna Health in the Victoria River District* (Themes 2 and 3). This report summarises the landscape, ecology and socio-economic setting of the Victoria River District in the NT, outlines current research and suggests strategies for sustainable land management in the region. It is aimed primarily at agency staff and land manager peak bodies (pastoral, Aboriginal, and ADF).
- *Not from here: Plant invasions on aboriginal lands of the Top End* (Project 4.3.2). A report that gives an overview of weed management issues faced by Aboriginal communities in the Top End of the NT. Aimed at Aboriginal and other land management organisations in the area. Sections of the report will be available online in 2000–01.
- *Land Administration and Management Forum*. This forum brought together views on land administration and management in the tropical savannas and is aimed primarily at agency staff and land manager peak bodies.
- *Savanna Burning: Understanding and Using Fire in Northern Australia* (Theme 3). This major publication will bring together a range of knowledge on fire management in north Australia. It is aimed at fire managers and should be released late in 2000.

Workshops and Forums

The Centre's position as a linking body and a 'neutral' broker was used to great effect to bring together researchers and land managers during 1999–00. (See Education and Extension section, pp. 74 for list of TS–CRC Workshops, Symposia and Meetings.)

- *Land Administration and Management Forum* (21, 22 Feb.). This meeting brought together land managers, agency staff and researchers from Qld, NT and WA. It looked at land administration and management policies in the north and ways they might be changed to encourage sustainable management.
- The Centre facilitated meetings between researchers and key stakeholder groups including Heytesbury, and NABRC during the year. These meetings used the findings and expertise of TS–CRC to develop management plans and strategies relevant to the pastoral businesses. They also developed research proposals to be participatively implemented on grazing management, conservation strategies and landscape monitoring.
- *Northern Grassy Landscapes Conference*. Planning and preparation is now well advanced for this major conference on northern grasslands, an ecosystem of interest to both conservation and pastoralism. It is being organised with support from Environment Australia's Bushcare and will be held in Katherine, NT in August 2000.

Savanna Information and TS–CRC Website

The *Savanna Information* section of the TS–CRC Website is designed to exploit the Centre's links across the different land-management regions, sectors, and disciplines to provide a 'clearinghouse' of land-management information drawing on both production and conservation perspectives.



Andreas Wagner, director of WWd, won the North Queensland Media Awards Website Design Category for the TS–CRC's website.

Three initial sections are now completed:

- *Savanna Explorer*. This area provides summaries of land-management topics for eight broad regions of the savannas. It now has 152 pages of information covering all regions and most topics. Knowledgeable researchers supplied the information. The site uses an innovative navigation system that won a Website design award.
- *Savanna Search* now has references and summaries for 2200 papers, reports and articles on research in weeds, fire and grazing. The references can be searched for using regions or keywords. An AUSLIG grant assisted in compiling this section. Another few thousand summaries on flora, fauna and conservation research will be uploaded in 2000–2001.
- *Savanna Map Maker* is a GIS-based mapping tool on the Web that focuses on the Victoria River District. It was tailored for students in the MTEM and other courses. It shows how different components of the VRD landscape, such as soils, vegetation and fire, are related.

Future plans involve more detailed summaries of TS–CRC research, using the synthesis of the publications listed above and better integration of different data types such as GIS maps.

In other parts of the website there is a new section on research findings and news. The site is now quite large and future plans include integrating it with an Oracle database and dynamic web server so that it can be managed more efficiently.

The site now has around 20–30,000 pages downloaded a month and is being publicised in displays, *Savanna Links*—the TS–CRC’s external newsletter—postcards and brochures. It is now acknowledged as a significant source of information for land management across north Australia and links are being made with the prototype website of the NLWRA. (*url: <http://savanna.ntu.edu.au>*)

Savanna Links

The Centre’s quarterly newsletter is primarily aimed at the TS–CRC’s external stakeholders, including a wide variety of staff in government agencies, significant numbers of pastoralists, Aboriginal groups, and tour operators. It is now up to its 14th issue. Reader feedback has been very positive after a survey conducted early in 2000. Circulation is now at about 2800. Over the past year, the largest increase in readership was from the government agency sector.

‘Excellent publication. I work in the area of environmental interpretation and find the articles of great value in helping me prepare activities. I especially appreciate email contacts so I can approach professionals for more info.’ (*Ranger, PWCNT*)

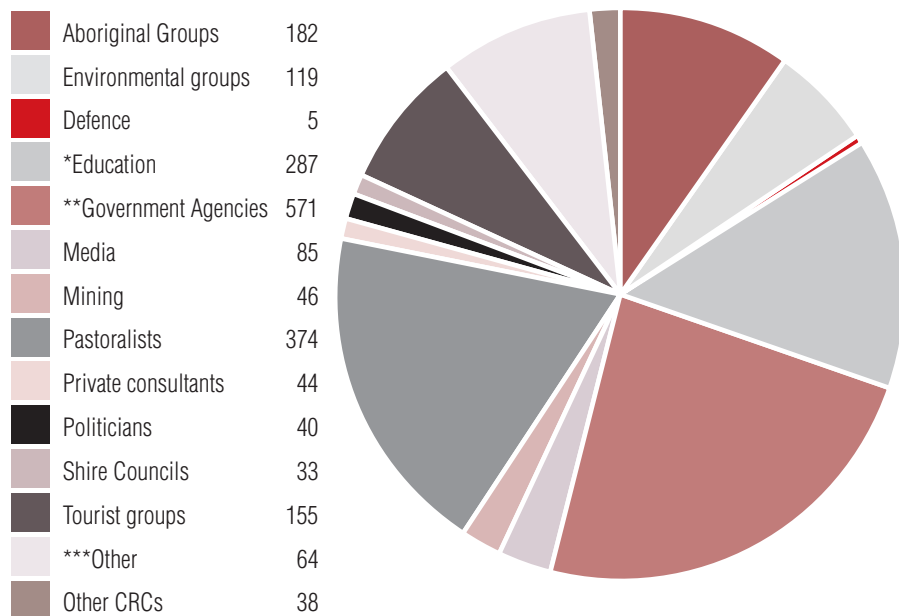
‘Each copy circulates to 15 staff at the DPI Office. I find articles relevant and interesting. Well done and congratulations.’ (*QDPI*)

‘The most useful source of current rangelands landcare information. Good level of detailed information in articles. Balances concern for both people and land well.’ (*a Qld Landcare committee member*)

‘Good reading, with good information’ (*CALMWA*)

Trends in content over the last year saw increasing focus on TS–CRC activities and research. Particularly encouraging is the rising number of contributions from readers.

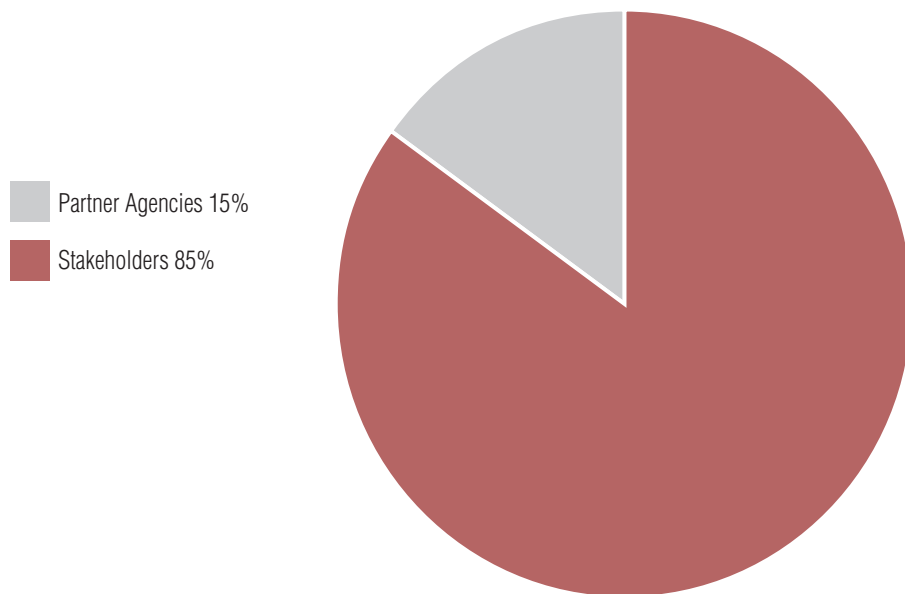
FIGURE 6 SAVANNA LINKS STAKEHOLDER DISTRIBUTION AND READERSHIP



* Education stakeholders include NTU, JCU and ANU partner agency representatives, other education institutions, libraries, partner agency libraries and students.

** Government Agencies include all TS-CRC major partners except NTU, JCU and ANU.

*** Other includes all other government agencies and organisations, media outlets, CRCs, miscellaneous recipients.



Planning for the Future

The next stage in providing information for stakeholders will involve circulating publications, summaries of research, case studies and website resources to various land manager groups using the extension networks of the Centre's vocational education and training program coordinated by Mr Richard Fell.

Different networks will be used to get information about conservation research to stakeholders. A new communication officer, specialising in conservation research will start work in July 2000. This person will write articles, summaries etc. of the Centre's research relevant to conservation land management and will use networks of our partner agencies and stakeholder groups and the media to reach audiences interested in conservation research.

GOAL TWO: CREATING A MORE COHESIVE AND DISTINCTIVE IDENTITY FOR THE CENTRE

As many of the TS–CRC publications and research findings will be completed in 2000–2001, this year the profile of the Centre relied on letting key stakeholders know about research in progress and our capacity to provide information on existing research. Workshops that integrate research and encourage cohesion among staff were important.

Workshops and meetings

- Various workshops on the themes and projects brought researchers together from different sectors, disciplines and regions of the savannas. These helped build cohesion among researchers and provided a distinctive benefit by the Centre. (See *Education and Extension* section, pp. 74 for TS–CRC Workshops, Symposia and Meetings.)
- Other fora and meetings such as the Land Administration and Management Forum provided a rare opportunity for a cross-section of researchers and land managers to get together and discuss issues of mutual interest. Again, a distinctive benefit provided by the Centre.

Media

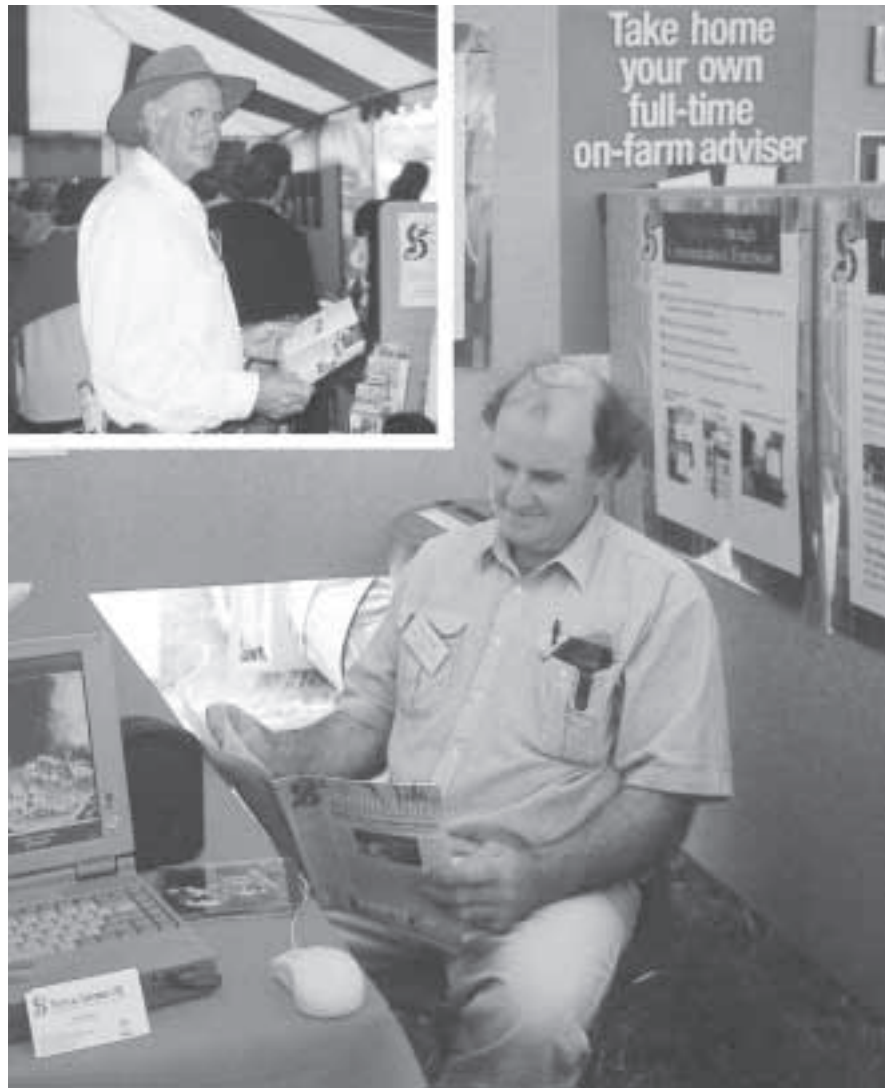
This year Centre staff concentrated on organising specific workshops and meetings among key stakeholder groups to raise awareness of the Centre's research and information resources. There was a refined focus for the Centre's media profile, using *Savanna Links*, which is now a substantial outlet in its own right, and local or regional media outlets such as newsletters, regional radio, information sheets, etc. to let key stakeholder groups know of the Centre's research and information resources.

There was less focus on reaching urban audiences, as this can be time-consuming for little reward. This explains the reduced media coverage this year (see media list at end of this section). However, there is an ongoing need to raise awareness about the Centre and the tropical savannas in urban areas and this will be one focus for a new conservation research communication officer.



Kathryn Thorburn

The TS–CRC website was given a test drive by primary school students at Science Week in Darwin, May 2000; and by visitors to the North Queensland Field Days in Townsville in May.



Kate O'Donnell

Around 45,000 people attended the Field Days in Townsville, many of whom were pastoralists from across remote and regional Queensland.

Other TS-CRC promotion

Another area that saw more emphasis this year than in previous years was in trade shows and displays (see full list, under Displays, this section). Together with the Centre's vocational education and training program displays targeting pastoralists were held at Beef 2000 and the North Queensland Field days held in Townsville.

As shown in the public outreach section below, various Centre staff are continuing to promote the Centre at a face-to-face level.

GOAL THREE: IMPROVING INFORMATION AND SKILLS NEEDS OF CENTRE STAFF

Links with the Education and Extension programs

Providing information resources for the Education and Extension programs will be a major priority over the next two years. Display and promotional materials were provided for both programs this year. Next year will see further promotion as well as contributions to teaching resources for both programs. The savanna Map Maker for the VRD will be prepared for MTEM students and components of the extension program will be prepared and printed.

Topical Savannas

Eighteen issues of the staff email newsletter *Topical Savannas* were issued during 1999–00 up from 14 last year. This newsletter is being increasingly linked to web-based information resources. All newsletters are stored on the Centre's internal website.

Internal Website

The internal website now has various useful documents that can be downloaded by staff, including several brochures, information sheets and reports. The site also has a staff calendar, and a publishing style guide to help with report writing.

Skill development

Two TS–CRC students were funded to take a two-day BHERT (Business and Higher Education Round Table) Leadership course in Townsville 23–27 November 1999.

PUBLIC OUTREACH

- Arnott, A. 1999, 'A perspective on how pastoralists learn', *In-house seminar, CTLDEC*, July.
- Calvert, G. 1999, 'An overview of the role of fire in the development of Tropical Queensland Ecosystems', *Northern Australian Fire Workshop*, Cooktown, July.
- Childs, J. 1999, 'Progress on TS–CRC's research projects', NABRC, Darwin, Sept.
- Childs, J. 2000, 'NABRC's involvement in the new TSM–CRC submission proposal', NABRC, Brisbane, Mar.
- Cook, G.D. 1999, 'Savanna landscapes', *CSIRO TERC Seminar*, Darwin, Apr.
- Cook, G.D. 1999, 'Transects as a research tool', *IGBP Transects Workshop*, Darwin, July.
- Cook, G.D. 1999, 'Landscape variation along the NATT', *IGBP Transects Workshop*, Darwin, July.
- Cooke, P. 2000, 'The Wagiman people and the Northern Land Council discuss how to care for Country', *Workshop*, Pine Creek, Feb.
- Davis, R. 1999, 'Black spurs: Aboriginal pastoralists in the Kimberley', *NARU Seminar*, Dec.
- Davis, R. 1999, 'Cattle country—more than a land use', *Lecture, Diploma of Resource Management*, (Regional Planning Case Studies: Rangelands Management), NTU, Dec.
- Fell, R. 1999, 'Extension and the TS–CRC, and the Grazing Land Management package', Rangelands section workshop, Kidman Springs Research Station, Nov.
- Fell, R. 1999, 'Extension and the TS–CRC in the Northern Territory', *ALIAS Northern Territory Chapter AGM*, Darwin, Mar.

PUBLIC OUTREACH

- Fell, R. 1999, 'Future Directions for the NTCA', *NTCA Top End Branch meeting*, Darwin, Aug.
- Fell, R. 1999, 'Starting from scratch: Planning for extension programs in TS-CRC', *Rural Extension Centre Training workshop*, Darwin, Oct.
- Fell, R. 1999, 'Learning styles and their application to Aboriginal communities', *Participatory Planning for Aboriginal Groups workshop*, Darwin, Sept.
- Fell, R. 1999, 'Extension and the TS-CRC, and the Grazing Land Management package', *Sturt Plateau Best Practice Group*, Dec.
- Fisher, A. 2000, 'Research on biodiversity and options for conservation management for the Mitchell Grasslands', *Workshop for pastoral land-managers and owners*, TS-CRC, Brisbane, Mar.
- Fisher, A. 2000, 'Research on biodiversity and options for conservation management for the Mitchell Grasslands', *Northern Territory Cattlemen's Association AGM*, Tennant Creek, Mar.
- Fisher, R. 2000, 'Dynamic multimedia presentation: Turning information into understanding', *NTDLPE Lunchtime Talk Seminar Series*, Darwin, Apr.
- Fisher, A. 1999, 'Links between biodiversity and land condition in the Victoria River District', *CSIRO Seminar Series*, Darwin, Sept.
- Fisher, A. 1999, 'Biodiversity conservation on pastoral land', *lecture at the Faculty of Aboriginal and Torres Strait Islander Studies*, NTU, Dec.
- Fox, I. 2000, 'Progress on a vegetation map for northern Australia', *National Vegetation Information System (NVIS) Technical Workshop*, Brisbane, Feb.
- Grice, A. 1999, 'Fire and the management of rubber vine', *Seventy Mile Range Landcare Group*, June.
- Grice, T. 1999, 'Woody weed management', *Charters Towers Meat Profit Day*, Sept.
- Grice, A. 1999, 'Fire and the management of rubber vine', *Seventy Mile Range Landcare Group*, Nov.
- Hoffmann, B.D. 1999, 'Responses of ant communities to dry sulphur deposition from mining emissions', *Poster paper, Ecological Society of Australia*, Fremantle, Sept.
- *Hynes, R.A. 1999, 'Managing ecosystems for conservation', *QPWS Workshop People on Track for Parks*, Bardon, Aug.
- Hynes, R.A. 1999, 'Action learning and action research for ecotourism: The Savannah Guides program', *7th National Conference Ecotourism Association of Australia*, Kingfisher Bay, Fraser Island, Qld, Oct.
- *Hynes, R.A. 1999, 'Adult learning approaches: Skills and information for sustainably managing an ecotourism enterprise', *Katherine Savannah Guides School*, Tropical Savannas CRC, Oct.
- *Hynes, R.A. 1999, 'Effectively managing your ecotourism business', *Katherine Savannah Guides School*, Tropical Savannas CRC, Oct.
- *Hynes, R.A. 1999, 'Futuring exercise: Skills and information for sustainably managing an ecotourism enterprise', *Katherine Savannah Guides School*, Tropical Savannas CRC, Oct.
- *Hynes, R.A. 1999, 'The Savannah Guides program for sustainable outback tourism', *Longreach Savannah Guides Workshop*, Dec.

- *Hynes, R.A. 1999, 'Identifying specifications for a Savannah Guides heritage site register', *Cairns SGL Workshop* convenor and presenter, Dec.
- *Hynes, R.A. 2000, 'The Savannah Guides—tourism with natural resource management', *Mareeba Wetlands Savannah Guides School*, Apr.
- *Hynes, R.A. 2000, 'Introduction to Geographic Information Systems and the Global Positioning System for developing a Savannah Guides register', *Mareeba Wetlands Savannah Guides School*, Apr.
- *Hynes, R.A. 2000, 'Developing interpretation and site management plans for Savannah Guides stations or tours', *Mt Boradaile Savannah Guides School*, Apr.
- *Hynes, R.A. 2000, 'Using the "Facilitator" Decision Support System at property, sub-catchment and regional levels', *DU Scheme MODSS Workshop*, Barcaldine, May.
- Hynes, R.A. 2000, 'Townsville, 'Science Education Tropical Queensland for 2000'', *Catholic Education Office—Science Coordinators North Queensland*, June.
- Karfs, R. 1999, 'Implementation of a regional monitoring program', *NTDPIF Weeds Workshop*, Darwin, Aug.
- McCallum, B. 1999, 'Burdekin grazing management project', *DNR/DPI grazing lands liaison meeting*, Brisbane, Dec.
- McCallum, B. 1999, 'Update of TS—CRC project: Guidelines, decision tools, and education programs for sustainable grazing management of savanna woodlands in the Burdekin River catchment', *Dalrymple Landcare Committee*, 'Ewan', Aug.
- Quirk, M. 1999, 'Managing land condition for beef production', *Grazing Land Management Days*, Chinchilla, Wandoan and Condamine, Aug.
- Quirk, M. 1999, 'Grazing land management', *Meat Profit Day*, Charters Towers, Sept.
- Quirk, M. 1999, 'Education and training in grazing land management', *MLA review of NAP projects*, Marburg, Oct.
- Quirk, M. 1999, 'Indicators of healthy grazing lands', *BeefPlan meeting*, Charters Towers, Nov.
- Quirk, M. 1999, 'Education and training in grazing land management', *DNR/DPI grazing lands liaison meeting*, Brisbane, Dec.
- Quirk, M. 2000, 'Education and training in grazing land management', *North Qld Beef Research Committee*, Townsville, Mar.
- Runcie, M.J. 1999, 'Behaviour and ecology of the tropical rock-haunting possum', NT, Field Naturalist Club, Aug.
- Setterfield, S.A. 1999, 'Distance education and environmental education in northern Australia: A perfect match', *Seminar to Department of Instructional Technology*, University of Georgia, Athens, Sept.
- Storrs, M.J. 1999, 'The land needs its people: Assisting contemporary Aboriginal land management', *US university students*, NTU, Darwin, June.
- Storrs, M.J. 1999, 'Towards strategic weed management for the Aboriginal lands of Australia's Top End', *TS—CRC Master of Tropical Environmental Management seminar*, Jabiru, July.
- Storrs, M.J. 1999, 'Community wetland management: The Northern Land Council's Top End Indigenous People's Wetlands Program', *TS—CRC Master of Tropical Environmental Management seminar*, Jabiru, July.
- Storrs, M.J. 1999, 'Aboriginal community involvement in the management of *Mimosa pigra* on the wetlands of the Top End', *CSIRO Seminar Series*, Darwin, Oct.

PUBLIC OUTREACH

Storrs, M.J. 1999, 'The land needs its people: Assisting contemporary Aboriginal land management', *CINCRM Seminar Series*, NTU, Darwin, Oct.

Storrs, M.J. 1999, 'The land needs its people: Assisting contemporary Aboriginal land management', *Regional Planning Course students*, FATSIS, NTU, Darwin, Dec.

Storrs, M.J. 2000, 'Towards strategic weed management for the Aboriginal lands of Australia's Top End', *Asia-Pacific Wetland Managers Training Program*, NTU Centre for Tropical Wetland Management, Darwin, Mar.

Vigilante, T. 1999, 'Aboriginal burning practices in the north Kimberley: Past and present', *CINCRM Seminar Series*, NTU, Darwin, Oct.

Whitehead, P.J. 1999, 'Managing harvests of the Magpie Goose', *Guest lecture, Wetlands Management Unit of TS-CRC Masters of Tropical Environmental Management Northern Territory University*, Jabiru, July.

Whitehead, P.J. 1999, 'Developing an analytical framework for monitoring biodiversity in Australia's rangelands', *Inception Report to National Rangelands Monitoring Coordinating Committee*, Adelaide, Oct.

Whitehead, P.J. 1999, 'Nesting ecology of the Magpie Goose: Bet hedging in an erratic climate', *Northern Territory Field Naturalists*, Darwin, Dec.

Whitehead, P.J. 2000, 'Habitat dynamics in the Magpie Goose: A perspective on the Mary River Land Use Objectives' *CSIRO Tropical Ecosystems Research Centre Seminar*, Darwin, Feb.

*Whitehead, P.J. 2000, 'Wildlife conservation in northern Australia: The role of defence lands', *Caring for Country: Neighbours in Town and Country Seminar*, Northern Territory University and Australian Defence Forces, Darwin, 27 June.

Whitehead, P.J. 2000, 'Land use planning in the Mary River catchment: The Magpie Goose perspective', *Guest lecturer, for Wetlands Unit of Masters of TS-CRC Tropical Environmental Management, Northern Territory University*, Jabiru, 21 July.

Williams, R.J. 1999, 'The North Australian Tropical Transect', *IGBP Transect workshop*, Darwin, July.

Williams, R.J. 1999, 'Climate and Vegetation of the VRD', *TS-CRC VRD Theme Workshop*, Nov.

Williams, R.J. 1999, 'Fire in savanna landscapes', *TS-CRC Fire Workshop*, Nov.

Williams, R.J. 1999, 'Vegetation of the Top End', *In-service for NT secondary teachers*, Darwin, Mar.

DISPLAYS

1999

- *Townsville Show*, 5–7 July. Displayed posters, brochures, newsletters and booklets.
- *Global Change Transects Workshop*, Novotel Atrium Hotel, Darwin, 12–16 July. Panels and brochures on display at workshop. This workshop brought around 20 scientists from around the world in a combined workshop on the research of the International Geosphere–Biosphere Program's Terrestrial Transects.
- *VI International Rangelands Congress*, Townsville, 19–23 July. Displayed Website clearinghouse (by demonstration), brochures, booklets, information sheets and newsletters. TS-CRC was a major sponsor at this Congress which had 1000 delegates 70 per cent of whom were from overseas.

* Invited Paper

- Extended display of TS–CRC panels and brochures at NT Wildlife Park, August (three weeks).
- Mareeba Wetlands Foundation Opening, Mareeba, 20 Aug. Displayed brochures, information sheets, newsletters.
- *Meat Profit Day*, Charters Towers, 16 Sept. TS–CRC displayed newsletters, posters and information sheets in exhibition spaces of partner agencies QDPI, QDNR and CSIRO. Attended by pastoralists from across northern districts.

2000

- *National Science Week display*, Darwin, 6–7 May. Centre’s Website, brochures, info sheets and panels on display. Attended by high school students.
- *Beef 2000*, Rockhampton, 9–16 April. Approximately 40,000 people attended Beef 2000, both from Australia and overseas with delegations from Asia, North and South America, Europe and Zimbabwe. The TS–CRC had a stand at the trade show, displaying its Website, CD–ROMs, posters, newsletters and information sheets.
- *JCU Courses and Careers Day*, 7 May. TS–CRC shared display space with CRC Sugar and CSIRO Davies Laboratory. The Centre’s Website, CD–ROM, posters, newsletters and information sheets were displayed. Attended by prospective students from across northern Queensland.
- Cathedral School Science Week, 10 May. TS–CRC exhibited its Website and CD–ROMs at local high school for National Science Week.
- *North Queensland Field Days*, Townsville, 17–18 May. Biannual show of agricultural equipment and services. TS–CRC had CD–ROM, brochures, newsletters, posters and information sheet displays in exhibition tents of partner agencies QDPI and QDNR. About 55,000 people attended the field days from rural northern Australia.
- *CRC Association Conference*, Brisbane, 17–19 May. TS–CRC displayed its Website, posters, CD–ROMs, newsletters and information sheets. Attended by CRC staff and researchers from across Australia.
- CSIRO Davies Lab, May. Installed a shared brochure display with CRC Sugar.

NEWSLETTERS, BROCHURES AND INFORMATION SHEETS, CD–ROMS

Savanna Links

- Issue 14, April–June 2000 (16 pp.)
- Issue 13, January–March 2000 (12 pp.)
- Issue 12, November–December 1999 (12 pp.)
- Issue 11, September–October 1999 (12 pp.)
- Issue 10, July–August 1999 (12 pp.)

Brochures and Information Sheets

- What is Healthy Country?
- Breakthrough in land condition monitoring
- Rubber vine and fire
- Aboriginal Projects
- Conservation Projects
- Pastoral Projects
- Postcard on TS–CRC Website

CD-ROMs

- Tropical Savannas CRC Presentation
- Tropical Savannas CRC Website

MEDIA

July 1999

Radio

'Fire in northern Australia', *ABC Radio Darwin*, featuring Dr Garry Cook.

'Global Change Workshops', *ABC Radio Darwin*, featuring Dr Garry Cook.

'Gamba grass', *ABC Radio National*, featuring Dr Garry Cook.

Print

'On the trail of a legend', *The Advocate*, Coffs Harbour, NSW, featuring A/Prof. Ross Hynes.

'Joint effort in research', *The Northern Miner*, featuring Ms Brigid McCallum, p. 6.

'A piece of history', *The Border Mail*, featuring A/Prof. Ross Hynes, p. 73.

August 1999

Print

'Practical advice for NQ graziers', *DPI Research & Extension*, Issue 45, p. 8.

'Savannas on the Net', *North Queensland Register*, featuring TS-CRC Website, p. 9.

'New era for Aboriginal pastoralism', *Savanna Links*, Issue 10, July-Aug., featuring Dr Richard Davis, pp. 1-2.

'Remote sensing: The view from above', *Savanna Links*, Issue 10, July-Aug., featuring Centre visitor, Dr Sindre Langaas, p. 8.

'More maps, better maps for the north', *Savanna Links*, Issue 10, July-Aug., featuring AUSLIG grant to TS-CRC, p. 2.

'Website explores research on our tropical savannas', *Savanna Links*, Issue 10, July-Aug., featuring Centre's Website, p. 3.

'Developing sustainable grazing systems for the NT', *NAP News*, Issue 12, Winter 1999, featuring Mr Rodd Dyer, p. 7.

September 1999

Radio

'Biodiversity research in the Victoria River District', *ABC CountryWide*, featuring Dr John Woinarski.

'Spiders as bioindicators', *ABC Radio Perth*, featuring Dr Tracey Churchill.

'Vertebrates in the Victoria River District', *ABC NT Country Hour*, featuring Dr Alaric Fisher.

'Wildfires and fire forum', *8 TOP FM*, featuring Mr Russell Anderson.

'Wildfires and fire forum', *ABC Radio 8DDD*, featuring Mr Russell Anderson.

'Wildfires and fire forum', *CAMMA Radio*, featuring Mr Russell Anderson.

'Frontier Australia Conference', *ABC Radio 8DDD*, news item, featuring Dr Richard Davis.

'Frontier Australia Conference', *ABC Radio Kununurra*, news item, featuring Dr Richard Davis.

Print

'Camp marks ill-fated expedition', *The Bayside Star, Victoria*, featuring A/Prof. Ross Hynes, p. 18.

'Grass curing project', *Katherine Rural Review*, featuring Andrea Johnstone.

'Preserving our pioneering history', *The Australian Senior*, featuring A/Prof. Ross Hynes, p. 70.

'Production hinges on islands of fertility', *Australian Landcare*, featuring Dr Garry Cook, pp. 33–45.

'North Australia Fire Managers Forum', *Rural Fires Bulletin*, featuring north Australian fire forum, p. 7

October 1999

Radio

'Fire in savannas', *ABC Country Hour*, featuring Dr Dick Williams.

'Fire in northern Australia', *ABC Radio National*, featuring Dr Dick Williams.

'Fire issues in west Arnhem Land', *ABC NT Country Hour*, featuring Dr Jeremy Russell-Smith.

'Future directions of NTCA', *ABC Rural Hour*, featuring Mr Richard Fell.

Print

'More maps, better maps for the north', *Top Paddock*, Oct., p. 6.

'ADF moves to strengthen land care', *Savanna Links*, Issue 11, Sept.–Oct., featuring TS–CRC projects on defence land, pp. 1–2.

Article featuring the research of Drs John Woinarski and Carla Catterall, *Savanna Links*, Issue 11, Sept.–Oct., pp. 4–5.

'Sustainability needs a viable economy', *Savanna Links*, Issue 11, Sept.–Oct., featuring Mr Colin Macgregor, p. 7.

'Is it time to fill the north's empty landscapes?', *Savanna Links*, Issue 11, Sept.–Oct., featuring Dr Peter Whitehead, pp. 6–7.

'Traces of Tracy in tropical trees', *Savanna Links*, Issue 11, Sept.–Oct., featuring Dr Lindsay Hutley, p. 9.

'Northern exposure', *Uniview*, University of WA graduate magazine, featuring Mr Gordon Graham and Centre's fire ecology project, pp. 14–15.

November 1999

Radio

'Sustainable townships in northern rural Australia', *ABC Radio National*, featuring Colin Macgregor.

'Victoria River District', *ABC NT Country Hour*, featuring Dr Paul Novelty.

'Victoria River District', *ABC NT Country Hour*, featuring Mr Daryl Hill.

Print

'Study looks at growth of Aboriginal pastoralism', *ANU Reporter* vol. 30, no. 17, featuring Dr Richard Davis.

'Watch where you walk!', *Katherine Rural Review*, featuring Dr Tracey Churchill, p. 1.

December 1999**Print**

'Savanna landscapes: Defining health', *Savanna Links*, Issue 12, Nov.–Dec., featuring TS–CRC defined attributes for healthy country, pp. 1–2.

'Book on north's fire management', *Savanna Links*, Issue 12, Nov.–Dec., featuring coming TS–CRC publication on fire management, p. 3.

'VRD Map Maker now online', *Savanna Links*, Issue 12, Nov.–Dec., featuring the TS–CRC's Map Maker on the Centre's Website, p. 2.

'Search for fire information on the Web', *Savanna Links*, Issue 12, Nov.–Dec., featuring TS–CRC's searchable fire database on the Centre's Website, p. 2.

'Graduate courses overcome the distance', *Savanna Links*, Issue 12, Nov.–Dec., featuring GD/MTEM courses available online and on CD–ROM, p. 5.

'Study taps into future of water resources', *Savanna Links*, Issue 12, Nov.–Dec., featuring the work of Drs Lindsay Hutley and Derek Eamus, and Mr Tony O'Grady, pp. 6–7.

'Fire, grazing and partridge pigeons', *Savanna Links*, Issue 12, Nov.–Dec., featuring Ms Fiona Fraser, pp. 4–5.

'Scaly tales', *Australian Geographic*, Oct.–Dec., featuring Ms Myf Runcie.

January 2000**Radio**

'Remote sensing and land condition', *ABC Radio, NT Country Hour*, featuring Mr Robert Karfs.

'Savanna health', *ABC Radio, NT Country Hour*, featuring Dr Peter Whitehead.

February 2000**Print**

'Northern Grassy Landscapes Conference', *Bush Magazine*, information section.

March 2000**Radio**

'Case studies in practical management', *ABC Rural Hour*, featuring Mr Richard Fell.

Print

'Monitoring biodiversity in the rangelands', *The Web, Newsletter of the Threatened Species Network*, featuring Don Franklin, p. 1–2.

'Northern Grassy Landscapes Conference', *Katherine Rural Review*, no. 214, featuring TS–CRC conference, p. 6.

'First workshop for Burdekin study', *Savanna Links*, Issue 13, Jan.–Mar., featuring TS–CRC Burdekin Management Study, pp. 1–2.

'Northern Grassy Landscapes Conference', *Savanna Links*, Issue 13, Jan.–Mar., featuring major TS–CRC conference on grasslands, p. 3.

'Project frames up to rangeland biodiversity', *Savanna Links*, Issue 13, Jan.–Mar., featuring NLWRA biodiversity project undertaken by TS–CRC, p. 3.

'Land management and administration in the savannas', *Savanna Links*, Issue 13, Jan.–Mar., featuring three presentations from the TS–CRC Land and Administration Forum, pp. 4–8.

'North Australian Fire Managers Forum', *Fire Life Magazine*, featuring northern fire managers forum in Cairns.

'Monitoring biodiversity in the rangelands', *Life Lines*, vol. 6, no. 1, featuring Mr Don Franklin, p. 21.

April 2000

Radio

'Fire research work', *ABC Regional Radio*, 'Phone Home' segment, featuring PhD student Tom Vigilante.

'Fire and introduced grasses', *ABC Radio 8DDD*, featuring Dr David Bowman.

Television

'Savannah tourism', *Network 10, Cairns*, featuring A/Prof. Ross Hynes.

Print

'Gateway to the Savannah', *Cairns Post Weekend Extra*, featuring A/Prof. Ross Hynes, David Bellamy and Savannah Guides, pp. 4–5.

'Northern Grassy Landscapes Conference', *Top Paddock*, no. 25, featuring TS–CRC conference, p. 12.

'Northern Grassy Landscapes Conference', *Insufferbulletin*, vol. 20, no. 1, featuring TS–CRC conference, p. 17.

'Northern Grassy Landscapes Conference', *Caring for Catchments*, vol. 20, no. 1, featuring TS–CRC conference, p. 7.

May 2000

Radio

'TS–CRC research across northern Australia', *ABC Radio National*, featuring Ms Kate O'Donnell at North Queensland Field Days.

Print

'Adventures at possum rock', *Nature Australia*, Autumn (April–May), featuring Ms Myf Runcie.

June 2000

Print

'TS–CRC to publish reports: landscape health, fire, weeds and land forums', *Savanna Links*, Issue 14, Apr.–June, featuring upcoming publications of TS–CRC, p. 3.

'Savanna carbon: Going down the sink?', *Savanna Links*, Issue 14, Apr.–June, featuring the work of Dr Lindsay Hutley et al., p. 6.

'Breakthrough in land condition monitoring', *Savanna Links*, Issue 14, Apr.–June, featuring the work of Mr Bob Karfs, p. 7.

'Tropical savannas: Not what they used to be', *Savanna Links*, Issue 14, Apr.–June, featuring the work of Darrell Lewis, John Neldner, Jeremy Russell-Smith and Ben Sharp, pp. 8–9.

'Nature's bulldozer: Tree dieback in the savannas', *Savanna Links*, Issue 14, Apr.–June, featuring Mr Rod Fensham, pp. 10–11.

'Indigenous unit for Tropical Environmental Management course', *Savanna Links*, Issue 14, Apr.–June, featuring new unit in GD/MTEM, p. 11.

Utilisation and Application of Research

The fifth year of operations saw the Centre's research findings adopted by key groups of land managers and the start of major strategies for increasing public awareness of savanna research.

Users of the Centre's research include land managers such as pastoralists, Aboriginal groups, park rangers, the Australian Defence Force (ADF) and the mining industry, as well as conservation groups, the tourist industry and the general public where research findings can raise awareness and understanding of these landscapes.

This section describes how adoption and awareness raising is being pursued using two basic strategies that arise from specific targets set by the Centre:

- Consulting with and involving user groups in research and development.
- Making sure research is as accessible and as easy to use as possible for user groups.

CONSULTATION WITH, AND INVOLVEMENT OF USER GROUPS IN RESEARCH

Core Partners, the Board and the Consultative Committee

Many of the prime users of the Centre's research are core partners, for example the land-management agencies who use the land management research and the universities who use the educational programs. The partners are involved in both shaping and carrying out Centre research. They are represented on the Board together with other user group representatives from the Aboriginal, mining and conservation sectors.

The Consultative Committee is the other main avenue by which user groups can influence the overall strategy of the Centre. It comprises representatives of the pastoral industry, Aboriginal groups, conservation groups, the tourist and mining industries and the ADF.

Management Studies

The Management studies are designed to develop workable land-management solutions on the ground and feature close involvement of user groups. Workshops and meetings on VRD research were held in 1999–2000 involving user groups such as Heytesbury Pastoral Co. and the VRD Conservation Association. Similarly the Burdekin Management Study held a workshop involving researchers from partner land management agencies and JCU to decide on the direction of the study. A 'Green Book' is under way of information resources for sustainable grazing in the region. The Desert Uplands Management Study operates as part of the Desert Uplands Build-Up and Development Strategy Committee, which is run by the land managers of the region.

Savanna health

User groups were also consulted in developing a major framework for the Centre's research: the concept of Savanna Health. Two workshops involving representatives of land-management agencies as well as pastoral and Aboriginal groups developed the concept in late 1999. The resulting concept is unusual in that it incorporates land-user values into the definitions of healthy landscapes.

Project involvement

As seen in the Cooperative Linkages section, the other research projects also involve users in their research.

- The strategy of Project 2.4.1 *Fire and Savanna Landscapes* has been to help set up NHT-funded, user-driven projects across the savannas. Each of these projects is guided by a steering committee of fire managers and researchers.
- Groups within the relevant Land Councils in each region run the suite of projects on Aboriginal land management (4.3.2). These projects focus on building capacity in Aboriginal communities and encouraging collaboration between outside agencies and communities so Aboriginal people can supplement their own skills
- Project 2.3.1 *Integrated Overview of Values, Uses And Modifying Processes in the Ord River's Riparian Zone*, is advising the Western Australian Water and Rivers Commission on the ecological water requirements of the lower Ord so that it can construct a water allocation plan (including 'environmental water') for the Ord River dams.
- Many of the other projects are alliances of research agencies, such as CSIRO or the universities with research users such as government land management and planning agencies, thus these user groups are involved in planning research from the start of the project.

The Education, Extension and Communication projects also involve user groups in developing their strategies. The Centre now offers a Graduate Diploma level course in tropical environmental management, the establishment of which was in response to a user survey. Again, the *Savanna Information Clearinghouse* project was set up in response to a survey of stakeholders and continually consults with user groups (see *Communication and Public Outreach* section, pp. 83). The *Extension, Vocational Education and Training* project also continually consults with user groups in developing its initiatives, for example it brought together representatives of planning agencies, primary industries agencies, Aboriginal communities and conservation groups in developing a video for weed management to be used in Aboriginal communities.

EXAMPLES OF RESEARCH USE THROUGH IMPROVED ACCESSIBILITY FOR EACH USER GROUP

General Public, All Stakeholders

Project 5.3.2 *Savanna Information Clearinghouse* was initiated in response to demand from our stakeholders for better access to land-management research in the tropical savannas. They saw the TS-CRC as an organisation with access to a broad range of research in the savannas through its many links across jurisdictions, disciplines and sectors.

During the year, three modules of this online service were developed that greatly increased the accessibility and ease of access to land management research in the tropical savannas. The Savanna Explorer section now has dozens of summaries of land management issues; the Savanna Map Maker is used by students and the Savanna Search online database has more than 2000 references to research on fire, weeds and grazing.

The TS-CRC Newsletter *Savanna Links* summarises the latest land management research in plain language for a broad audience across the savannas. For more details and figures on usage for the website and the newsletter, see *Communication and Public Outreach* section, pp. 83.

Planners

Vegetation map

The development of the first seamless vegetation map of northern Australia by Project 1.1.2 will provide a broad overview of the floristic, structural and landscape diversity of the savannas, and permit localised projects, management practices or planning problems to be seen in context by planners and researchers. It also complements other integrated datasets on natural resources, e.g. soils, geology, and extends the range and quality of geographic analysis for planners. The project will also provide better vegetation information to assist in national carbon budget calculations.

Projects with the NLWRA

The Centre projects conducted for the National Land and Water Resources Audit on rangeland condition assessment (3.1.2) and on monitoring biodiversity (2.1.1) will allow planners to have access to better picture of rangeland health.

Northern Summit

The Centre provided environmental information to consultants preparing background information for the Northern Summit. This is a consultative process through which the Federal Government seeks to identify development priorities for the region.

Students

The Centre's Higher Education and Extension projects use the links with other agencies to provide students with the latest land-management research as well as insights into how it can be applied.

Higher Education

Research findings from various TS-CRC projects were made available to students through the Master of Tropical Environmental Management, including Projects 1.1.1, *Savanna Form and Function*, Project 4.3.4 *Modelling and Landscape Change*, Project 2.1.1 *Vertebrate Biogeography*, Project 2.2.1-3 *Declining Granivorous Birds* and Project 2.4.1 *Fire and Savanna Landscapes*.

A CD-ROM version of the MTEM course was developed and successfully used during 1998-99. This improved access to the course for remote-based students in the savannas. For more details on the services to students provided by this project see Education section, pp. 67.

Undergraduate Education

The Centre is helping to develop Agricultural undergraduate courses at the NT Rural College through its *Extension Vocational Education and Training* project.

Pastoral Land Managers

Many of the pastoral industry's applications of the Centre's research are mediated through the three regional Management Studies, which bring together different partners, combining the latest research with on-ground extension networks and focusing on the land management issues in a particular region.

VRD Management Study

In 1999-2000 the Study worked on a publication that outlines the land management research, strategies and tools developed for the VRD. The publication arose out of a workshop attended by user groups (see Management Studies, this section). It brings together research into fire management, pasture management, grazing impacts, vertebrate and invertebrate biodiversity, land condition monitoring, groundwater use, social and economic research as well as discussions on future land management strategies.

The workshop and other meetings also led to the Centre's research into land monitoring and fire management being used by Heytesbury Pastoral Co.'s stations in the region.

The Savanna simulation model (Project 4.3.4) was parameterised and verified for paddocks at Kidman Springs in the VRD (a NTDPFI site). Results from simulation runs that explore trade-offs between fire and grazing and that examine the resilience of different land units can be utilised to develop management guidelines for the VRD. Pastoral groups expressed an interest in using the model.

Burdekin Management Study

This year saw a project officer for the Management Study, Dr Barbara Musso, appointed. Dr Musso helped organise a workshop for the study involving user groups (see Management Studies, this section). Products planned are a 'Green Book' that will bring together as much existing information as possible on the ecology and management of the Upper Burdekin Catchment. A database of information is also planned.

The target audience for these products will initially be partner agency personnel, with products and information more suitable for landholders flowing from the initial gathering and synthesis of information. In this way the Management Study will allow the Centre's research relevant to the Burdekin to be more effectively used. The workshop agreed to adopt the Centre's Landscape Health framework, and research in the 'Green Book' will include that from a number of projects such as *Rubber vine and Fire*, *Declining Granivorous Birds*, *Land Condition Monitoring*, the impacts of grazing and land clearing on biodiversity, and fire management.

Much of the research used in the 'Green Book' will come from Project 4.3.5, *Sustainable Grazing Management of Savanna Woodlands in the Burdekin River Catchment*. In 1999–2000 this project rewrote a module on resource management for the 'Future in Beef' FutureProfit workshop series which was presented to six groups of producers across north Queensland. A module was also developed for 'Assessing and recording paddock health' and presented to BeefPlan and other groups that are integrating land condition assessment into their property management. This material was also provided to extension staff in other centres.

Desert Uplands Management Study

This year saw this management study produce a number of outputs that improve the accessibility of research for pastoralists. They include the *Desert Uplands Atlas* and a wide range of maps of various scales and purposes generated from GIS. A MO-DSS (Multi-Objective Decision Support System) will also provide a powerful tool for community involvement in regional planning for the Desert Uplands and establish a model that could be applied in other regions throughout the tropical savannas.

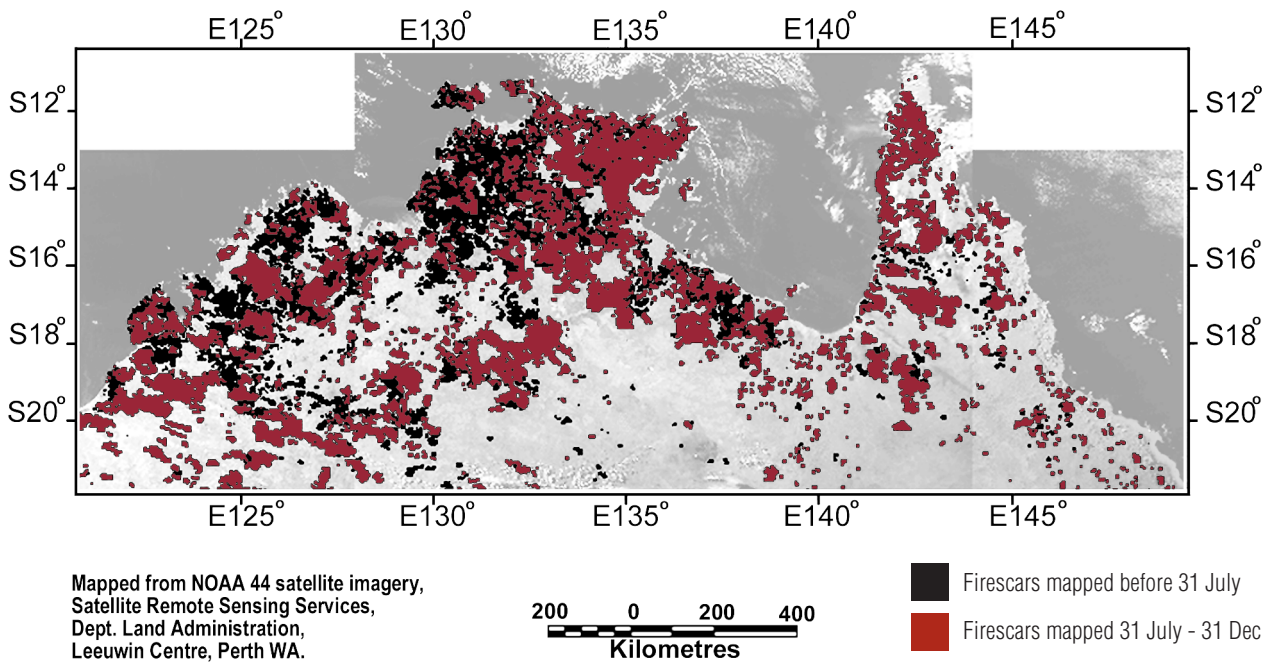
Using biodiversity research to plan sustainable grazing

The vertebrate biodiversity research of Project 2.1.1 is being increasingly used by agencies and other interested groups in land-use planning and land management, most notably through filling a major gap in northern Australia: good information on biodiversity and its likely responses to a variety of land use and management changes. Links through the TS-CRC made this research more accessible to pastoralists, evident in contributions towards planning for sustainable pastoralism in the Mitchell Grasslands.

Soil assessment for graziers

Centre researchers D. Tongway (CSIRO) and R. Karfs (NTDLPE) trialled a 'grazier-friendly' version of the soil assessment manual for tropical savannas. This manual is now nearly complete, with the expectation that it will become available later in 2000.

WESTERN AUSTRALIA, NORTHERN TERRITORY AND QUEENSLAND FIRE HISTORY 1999



Fire monitoring technology

Together with the WA Department of Land Administration, the TS-CRC is helping to disseminate satellite-based fire monitoring information to pastoralists and fire managers. Already, such information is widely used by land managers and agencies in the Northern Territory and is starting to be used in northern WA.

Aboriginal Land Managers

Although the Centre's suite of Aboriginal land-management projects (4.3.2) started only recently, they are designed to provide results that can be used quickly by Aboriginal people, as described below.

Report on weed management

Project 4.3.2 (3), is producing a publication *Not from here: Plant invasions on aboriginal lands of the Top End* which provides a useful guide to Aboriginal communities and land management agencies on how to tackle weed management on Aboriginal lands in Northern Land Council Lands in the NT. It features detailed descriptions of the weed issues in each catchment and parts of the publication will be released later in 2000. Plans are under way for it to be produced on the Centre's Website.

Collaborative planning in Cape York

Project 4.3.2 (4) set out to investigate and describe how Aboriginal people can employ science in addressing change in their lands, initially focused on developing collaborative relationships with land-owning groups on Cape York Peninsula. As a result of many hundreds of hours of interaction a number of aspirations were identified with which 'science' could assist. These include weed, feral animal and fire management and the development of commercial uses of flora. Further, a number of characteristics of interaction that bode well for sound collaboration were identified.

Kimberley land and sea management

The report produced by project 4.3.2 (2) is seen as an invaluable resource by the Balangarra and Wunambal-Gambera traditional landowners of the north Kimberley. It is a record of the encyclopaedic landscape knowledge held by many people in the area, knowledge related to plants and animals, and to broader land management issues such as fire.

This project also gathered broader information relating to land and sea management and the major priorities of the Balanggarra and Wunambal-Gaamberapeople. Their major concerns were then incorporated into a broad framework for resource management across the north Kimberley. Depending on permission from the traditional owners, sections of the report will be published in various forms for other land managers and users.



Mark Horstman

Eric Johnstone (left) and ethnobiologist Glenn Wightman record Balanggarra knowledge of plants at the Berkeley River crossing. This knowledge will be integrated into the broader strategy being developed for the management of Balanggarra lands.

Tourist Industry

Collaborative work with the Savannah Guides

A/Prof. R. Hynes has now conducted workshops and action research activities at 10 Savannah Guide Schools since 1995. In 1999–2000, schools were convened at Katherine, NT, Mareeba Wetlands, Qld and Mt Borradaile, NT. Topics included managing ecotourism businesses, natural resource management, CIS and GPS techniques. A/Prof. R. Hynes is an honorary Savannah Guide, an invited member of various guide working parties and continues to be a member of the Strategic Plan Steering Group. The Savannah Guides Website has extensive links to the TS–CRC site which it uses as an information resource.

Collaborative work with the Institute of Australian Tour Guides

A Seminar series, developed by the TS–CRC and the Institute of Australian Tour Guides (NT) which imparts the latest tropical savanna research findings to north Australian tour guides, continued in 1999–2000. This year seminars were given on bird ecology, lizards and snakes, fire ecology, history, Aboriginal rock art and crocodile ecology. It is estimated that more than half the total number of tour guides operating in the NT attended one or more sessions.

Conservation Managers

Use by conservation agencies

The land conservation and national parks agencies of the tropical savannas are all partners of the Centre and benefit from their involvement as it improves their access to both research and land managers outside conservation reserves.

- The TS–CRC allows the conservation agencies to collaborate more easily with CSIRO and the Universities. For example the CSIRO researchers from Project 3.2.1 are now working with PWCNT in assessing the potential impacts on biodiversity of development in the Daly River region and on the Mary River.
- The Centre also facilitates links across regions between conservation agencies. In Projects 2.2.1–3 researchers on granivorous birds in Queensland (EPA) and the NT (PWCNT) collaborated. Applications of this (Project 2.2.2) research so far were in the management of conservation areas in Queensland where the data on seed production are being incorporated into management plans. The results from Project 2.2.3 *Decline of Crimson and Star Finches in Queensland* have already been incorporated into park planning (particularly fire plans) in Queensland.
- By working within the Centre, conservation agencies can more easily extend their research to off-reserve areas—strengthening overall conservation goals. For example, researchers from PWCNT are able to work in the VRD and Queensland to examine impacts on biodiversity from pastoralism and defence force activity.

Spreading the word on conservation research

At the end of 1999–2000, the TS–CRC took an innovative step in promoting the uptake of conservation research across north Australia by employing an experienced writer and journalist to help communicate the Centre’s conservation research to various audiences. A major audience will be park rangers and conservation agencies across the savannas.

Mining Industry

The Centre has helped the mining industry gain better access to the research expertise of different agencies. CSIRO researchers were contracted via the TS–CRC to work with MIM on assessing the impact of a sulphur dioxide plume at Mount Isa. Other examples from 1999–2000 are described below.

Measuring landscape condition and managing fire

The landscape function analysis developed by the Project 1.1.1 was used in mine site rehabilitation programs by ERA Pty Ltd at Ranger Mine, NT. Wet season burning techniques, encouraged by Project 2.4.1 were used to control fuel loads on the mine lease at Ranger Mine, NT.

Consultancies using invertebrate indicators

Researchers from Project 3.2.1 assessed mine-site restoration with the German Creek and Callide Creek mines in Qld.

Australian Defence Force

Links developed through the TS–CRC have also allowed the ADF to tap into research expertise.

Helping Manage Bradshaw Field Training Area

Biodiversity research by Project 2.1.1 on the ADF’s Bradshaw Field Training Area in the VRD is being incorporated into the Environmental Management Plan for that area. Similarly the ADF received fire management advice for Bradshaw from Project 2.4.1.

Gauging the impact of military activities

Researchers from Projects 3.2.1 and 2.1.1 measured the impact of military and pastoral activities at the Townsville Field Training Area use by the ADF in Queensland.

TABLE 4 CONSULTANCIES

Sector	Consultant	Project	Consultancy	Funding Source	Amount	Period	
2	Mining	J. Neldner, EPA (Qld)	1.1.2	Pre-mining and monitoring survey of vegetation	Consolidated Rutile Ltd	\$60,000	2000
2	Mining	R. Fensham, EPA (Qld)	1.1.3	Clermont Coal Project <i>Trioncinia retroflexa</i> survey	Clermont P/Ltd	\$12,000	1999–2001
1	Education	L. Hutley, TS–CRC, NTU	1.2.1	Second-year teaching in plant physiology	NTU	\$1800	1999–2000
1	Government	J. Childs, TS–CRC	2.1.1	Development of an analytical framework for monitoring biodiversity	NLWRA	\$125,000	1999–2000
1	Government	J. Russell-Smith, BFCNT	2.4.1	Assessing fire patterns and their environmental impacts for national State of the Environment reporting	EA	\$64,500	2000–2001
1	Government	J. Russell-Smith, BFCNT	2.4.1	VRD and Sturt Plateau project coordinator	NHT	\$71,000	2000–2001
1	Government	R. Karfs, NTLPE	3.1.1	Interpreting landscape change using Landsat satellite data over four biogeographic regions in northern Australia's tropical savannas	NLWRA	\$55,000	2000
2	Mining	A. Andersen, CSIRO W&E	3.2.1	Ant monitoring at German Creek Mine	Capricorn Coal	Commercial in confidence	2000
2	Mining	A. Andersen, CSIRO W&E	3.2.1	Ant monitoring at Callide Mine	Reclamation Services	Commercial in confidence	2000
1	Government	J. Childs (CRC), P. Whitehead (NTU), P. Cooke (NLC), R. Hynes (JCU), T. Nevard (JCU), D. Kuchler (JCU), G. Kirby (NTDPIF)	4.4.2	Northern Australia: summit on growth into the new century	CW Dept. Transport & Regional Development	\$55,000	2000
1	Agriculture	R. Fell	5.2.2	Consultant: develop cooperative activities between TS–CRC, REC and local organisations.	REC	\$2000	2000

1. Consultancies administered by TS–CRC 2. Consultancies administered by TS–CRC Partner

TABLE 5 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 and Livestock Australia				✓				
North Australian Beef Research Council	✓			✓		✓		
Agforce Qld.				✓				
Katherine Pastoral Industry Advisory Committee				✓				
Kimberley Beef Research Committee				✓				
NT Cattlemen's Association			✓	✓		✓		
Northern Territory Pastoral Land Board			✓	✓				
Conservation Interest Groups								
World Wide Fund for Nature	✓		✓	✓		✓		
The Wilderness Society				✓				
Environment Centre of the NT	✓			✓				
Arid Lands Environment Centre				✓				
Kimberley Conservation Group				✓				
Victoria River District Conservation Association			✓	✓		✓		
Queensland Conservation Council	✓			✓				
Queensland Wildlife Preservation Society				✓				
WA Conservation Council	✓			✓				
Mining Industry Sector								
MIM Group of Companies/ McArthur River Mining Pty Ltd				✓				
Energy Resources of Australia			✓					
EWL Sciences Pty Ltd	✓			✓				

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

TABLE 5 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
Aboriginal Community Groups								
Balkanu Cape York Dev. Corp.			✓	✓				
Bawinaga Association, Arnhem Land			✓	✓				
Cape York Land Council	✓		✓	✓		✓		
Kimberley Land Council	✓		✓	✓		✓		
Indigenous Land Corporation				✓				
Northern Land Council	✓		✓	✓		✓		
Jawoyn Association				✓				
Tourism Industry Sector								
Alliance for Sustainable Tourism				✓				
Northern Gateway Pty Ltd				✓				
National Centre for Studies in Travel and Tourism Pty Ltd			✓	✓				
Tourism Council Australia (NT)	✓		✓	✓		✓		
Institute of Australian Tour Guides				✓		✓		
Savannah Guides Ltd			✓	✓		✓		
GLADA				✓		✓		
Queensland Tourist Commission			✓	✓				
Undara Experience				✓		✓		
Sanctuary Park Endangered Wildlife Foundation			✓	✓				

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

TABLE 5 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
Funding Agencies								
ACIAR			✓	✓			✓	
LWRRDC	✓			✓			✓	
Environment Australia (Biodiversity Group)	✓	✓						
Department of Environment Sport and Territories				✓			✓	
Meat and Livestock Australia, NAP				✓				
Rural Industries Research Development Corporation							✓	
Bureau Resource Sciences				✓				
Government Agencies								
AUSLIG				✓			✓	
Australian Defence Force	✓		✓	✓				
Bureau of Meteorology			✓					
Great Barrier Reef Marine Park Authority				✓				
Agriculture Western Australia		✓						
WA Department of Land Administration			✓			✓		
Fire and Emergency Services Authority			✓	✓		✓		
WA CALM	✓	✓						
Caring for Country Unit, NLC			✓	✓				
Kakadu, Nitmiluk Litchfield, National Parks			✓	✓				
NT Power and Water Authority		✓						
NT Bushfires Council			✓	✓		✓		
NT Department Primary Industry and Fisheries		✓						
NT Parks & Wildlife Commission		✓						
CYPLUS			✓	✓				

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

TABLE 5 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
Government Agencies cont.								
ERIN			✓					
NRIC				✓				
CSIRO Wildlife & Ecology	✓	✓						
CSIRO Tropical Agriculture		✓						
CSIRO Land & Water		✓						
CSIRO Mathematical & Information Sciences			✓	✓				
Queensland Department of Primary Industries	✓	✓						
Queensland Department of Natural Resources		✓						
Queensland Parks and Wildlife Service		✓						
Queensland EPA		✓						
Queensland Forest Research Institute				✓				
Townsville City Council				✓				
Cooperative Research Centres								
CRC for the Conservation and Management of Marsupials				✓				
CRC for Tropical Rainforest Ecology and Management			✓	✓				
CRC for Tropical Aboriginal Health				✓		✓		
CRC for Sustainable Sugar Production				✓				
CRC for Freshwater Ecology			✓					
CRC for Cotton				✓				
CRC for Sustainable Tourism				✓				

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

TABLE 5 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
Community Groups and Professional Bodies								
Desert Uplands Build-Up & Development Strategy Committee			✓	✓		✓		
Mary River Landcare Group			✓					
Mary River Technical Working Group			✓					
Savanna Landcare Groups				✓				
Balfes Creek Catchment Landcare Group			✓	✓				
Fletcher Creek Catchment Landcare Group				✓				
Sturt Plateau Best Practice Group				✓				
Daly River Landcare Trust			✓	✓				
Sustainable Beef Group, Torrens Creek Qld			✓	✓				
Landcare North West Initiative Group (NW Qld)				✓				
Regional Bushfire Council Committees (NT)			✓					
WA Land Conservation District Councils				✓				
Educational Institutions								
Centre for Indigenous Natural & Cultural Resource Management (NTU)				✓		✓		
University of Western Sydney			✓	✓				
James Cook University		✓						
University of Queensland, REC			✓	✓		✓		✓
University of Sydney			✓	✓				
University of South Australia				✓				
Curtin University				✓				
University of New South Wales				✓				
Northern Territory University	✓	✓						
University of WA			✓	✓				
Australian National University		✓						
Central Queensland University				✓				

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

TABLE 5 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
International Collaboration								
Oregon State University			✓					
Colorado State University			✓					
University of Virginia			✓					
University of Miami			✓					
Indonesian Government Agricultural Agencies			✓					
University of Wisconsin			✓					
Museum of Natural History, New York			✓					
University of Botswana			✓					
NASA			✓					

Partner agencies by their nature are involved in cooperative and collaborative arrangements and hence are not included in these columns.

Staffing and Administration

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

The Darwin Office has six staff: the Director; Communication Coordinator; Business Manager; Assistant to the Director; Communication Assistant and Assistant to the Business Manager. The Townsville Office has three staff members: Leader of the Desert Uplands Management Study; the Publications & Web Manager and Administration Officer.

TABLE 6 SPECIFIED PERSONNEL

Name	Organisation	% of time in Centre	Role
Mr John Childs	TS-CRC	100	Director
Ms Susanna Martin	TS-CRC	100	Business Manager
Dr Peter Jacklyn	TS-CRC	100	Communication Coordinator
Mr Richard Fell	TS-CRC	100	Coordinator, Vocational Education & Extension
Dr Peter Whitehead	Northern Territory University	20	Leader Theme 1
Dr John Ludwig	CSIRO, Wildlife & Ecology	100	Leader Theme 2
Dr Paul Novelty	Agriculture Western Australia	50	Leader Theme 3
Prof. Greg Hill	Northern Territory University	30	Leader Theme 4

Publications

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Ludwig, J.A. 1999, 'How landscape patches and processes conserve resources and habitats in savannas: Implications for land-use practices', *International Association for Landscape Ecology, 5th World Congress*, Aspen, Colorado, US, July.

Ludwig, J.A. 1999, 'Disturbance impacts on landscape function and biodiversity in Australian woodlands: Is proof in the patches?', *84th Annual Meeting of the Ecological Society of America*, Spokane, Washington, US, Aug.

Setterfield, S.A., Douglas, M. & Benson, R. 1999, 'Environmental education in northern Australia: Meeting the needs of a diverse and remote population', *84th Annual Meeting of the Ecological Society of America*, Spokane, Washington, US, Aug.

Williams, R.J. 1999, 'Phenology of Australian savannas', *XVI International Botanical Congress*, St Louis, US, Aug.

Where there is more than one author for a reference, underlining of a name indicates that this author is from the TS-CRC.

An * denotes an invited paper

Grants and Awards

TABLE 7 GRANTS

	Researcher	Research Project	Title of Grant	Funding Source	Amount	Period of Award
2	G Cook, CSIRO	1.1.1	Determinants of Land Degradation in Tropical Savannas	LWRDC	\$25,000	1999–00
2	J. Neldner, EPA (Qld)	1.1.2	National Vegetation Information System	NLWRA	\$160,000	1999–00
2	R. Fensham, EPA (Qld)	1.1.3	Endangered Flora Species, Vegetation and Landholder Survey of Artesian Springs in Queensland	EA	\$54,000	1999–01
2	J. Woinarski; K Brennan, PWCNT	2.1.1	Conservation Planning for the Arafura Swamp	NHT	\$37,000	1999–00
2	J. Woinarski, A Fisher, PWCNT	2.1.1	Conservation Planning for the Sturt Plateau	NHT	\$72,000	1999–00
2	J. Woinarski, M Armstrong, PWCNT	2.1.1	Conservation Planning for the Mary River Catchment	NHT	\$42,000	1999–00
1	J. Childs, CRC	Various Projects	Northern Grassy Landscapes Conference	EA–Bushcare	\$50,000	1999–00
1	Kimberley Fire Management Committee	2.4.1	Sustainable Fire Management for the Kimberley Region of Australia	NHT	\$210,000	1999–00
2	R. Karfs, NTDLPE	3.1.2	Development of a strategic management plan for the Sturt Plateau bioregion	NHT	\$300,000	1999–02
2	M. Quirk, QDPI	4.3.5	Practical Grazing Management Guidelines for Dalrymple Shire	NHT	\$18,800	2000–01
2	M. Quirk & C. Paton QDPI, R. Fell TS–CRC, J. McIvor CSIRO, N. MacDonald NTDFIF, K. Day QDNR	4.3.5	Development of a grazing land management education program for northern Australia	NHT	\$300,000	2000–01
2	M. Quirk, QDPI	4.5.3	Development of a natural resource management strategy for the grazing lands of the Burdekin region	NHT	\$18,500	1999–00
1	R. Hynes, JCU/CRC P. Lawrence, JCU	4.5.2	MO–DSS Development and Application of GIS for the Desert Uplands Region	DUBDSC	\$22,100	1999–00

1. Grants administered by TS–CRC

2. Grants administered by TS–CRC Partner

Awards

North Queensland Media Award for the Design of the TS–CRC website, to Andreas Wagner, WWd.

Ben Hoffmann

Runner-up, Best Student Poster Presentation, Ecological Society of Australia, July 26, 1999.

Grant Whiteman

Doctoral Merit Research Scheme Grant, James Cook University

Renee Bartolo and Carl Menges

Best of Plenary Session award for their paper ‘Wetland mapping in northern Australia using SAR’, at the Sixth International Conference Remote Sensing for Marine and Coastal Environments, Charleston, South Carolina, USA, 1–3 May.

Performance Indicators

COOPERATIVE ARRANGEMENTS

Indicator

Level of participation of the partner agencies and stakeholders in major decisions concerning the activities of the Centre

Assessment

- The Consultative Committee, the Board, the Management Group and the project leaders actively participated in implementation of the Strategy Statement.
 - Stakeholders are well represented on the board and the Consultative Committee, both of which provide strategic focus and relevance for the research and education program of the Centre.
 - Stakeholders were involved in identifying education and training needs, and communication needs and strategic direction through formal and informal consultation.
-

Extent and frequency of the interaction of the personnel from the partner agencies in the conduct of the activities of the Centre

- The Board met three times during the year in Darwin and Townsville. These included joint field trips with the Consultative Committee to new projects.
 - The Consultative Committee met three times during the year, both in Townsville and Darwin.
 - The Management Group met eight times throughout 1998–99.
 - The Burdekin Management Study involved four partner agencies in a major workshop to decide the direction of the Study. The new project officer for the Study is a QDPI position, funded by the TS–CRC, and housed by CSIRO.
 - Workshops and meetings on VRD research were held in 1999–2000 involving user groups such as Heytesbury Pastoral Co. and the VRD Conservation Association.
 - Several workshops involving partner agency staff were held to determine future directions pursued in various projects, and the research themes.
-

Extent of interaction with other research funding bodies

- Meetings held with LWRRDC, MLA, NLWRA, RIRDC, Environment Australia, ACIAR and AUSLIG.
- Working with MLA on a series of biodiversity and grazing workshops.
- Participation in the State Advisory Panel, NT in the project selection process for the NHT.

COOPERATIVE ARRANGEMENTS

Indicator

Extent and form of interaction with other researchers, research groups and institutions in Australia and overseas

Assessment

- All projects involve the participation of more than one partner agency.
- The North Australia Rural Fire Managers Forum continues to establish a strategic alliance between TS–CRC and the Bushfire Agencies in WA, QLD and the NT.
- Projects 1.1.1, 1.2.1 collaborated with the University of Wageningen (The Netherlands) on the leaf area index project along NATT.
- Through an international field expedition to the savanna ecosystems of the Kalahari region in Botswana, Project 1.2.1 made contact with savanna researches from Botswana, South Africa, the US and UK.
- Researchers in Project 1.1.1 and the Landscape Processes theme developed strong links with the International Geosphere–Biosphere Programme (IGBP) and led a workshop that brought savanna transect researchers together from around the world.
- Project 2.4.1, Fire and Savanna Landscapes, involves personnel from nine partner agencies working with people from 11 other research institutions and agencies.
- A workshop was held in Darwin in August 1999 to focus on ongoing development of satellite-based fire monitoring systems. Participants included Drs Sindre Langaas, University of Stockholm (previously a TS–CRC visitor) and Dr Kjeld Rasmussen, University of Copenhagen.
- Development of the collaborative fire management and training program in eastern Indonesia continued. A five-year program is likely to be implemented beginning in 2001.
- Important overseas links were strengthened with the Indonesian Government, Colorado State University, IGBP, Miami University. Links were made with the Japanese Space Agency, NASDA.
- Project 4.3.2 (4) *Cape York Collaborative Planning*, linked with several international bodies: WWF's Tropical Wetlands of Oceania project; the People and Plants Initiative (WWF/UNESCO/Kew Gardens).
- Collaborative work in Project 4.3.4 *Modelling Landscape Change*, continued with Dr Mike Coughenour, University of Colorado, in parameterising and testing the VRD Savanna model (version 4b).
- Project 5.1.1 *Higher Education* developed links with the University of Florida through the TS–CRC's educational CD *Ecology and Management of Tropical Savannas* regarding adapting and using the CD in the University of Florida's ecology program. Plans for cross-institutional enrolments are being discussed. Links with the University of Georgia were also established during project leader Dr Setterfield's period with the Department of Instructional Technology, and a collaborative project reviewing the CD is under way there.

COOPERATIVE ARRANGEMENTS

Indicator

Extent and form of commissioned, collaborative and contract research undertaken with the users and owners of tropical savanna land

Assessment

- See figures and tables in sections Utilisation and Application of Research (pp. 98) and Grants and Awards (pp. 126) for more details.
- User groups were consulted in developing the concept of Savanna Health, a major framework for the Centre's research. Two workshops were held with representatives of land management agencies as well as pastoral and Aboriginal groups. The resulting concept incorporates land user values into the definitions of healthy landscapes.
- Collaborative research undertaken with Cattlemen's Association of the NT, NT Pastoral Land Board, VRD Conservation Association, DUBDSC, Mary River Land Care Group, Mary River Technical Working Group, Balfes Creek Catchment Landcare Group, Daly River Landcare Trust, Sustainable Beef Group, Energy Resources of Australia, Jawoyn Association, National Centre for Studies in Travel and Tourism, Australian Tourism Council, Queensland Tourist Commission, Sanctuary Park Endangered Wildlife Foundation, ACIAR, Australian Defence Force, Bureau of Meteorology, WA DOLA, Bushfires Board of Western Australia, NT Bushfires Council, CYPLUS; landowners in central Qld, VRD, Traditional owners in Cape York, Wagiman traditional owners, Seventy Mile Range Catchment Group, Dalrymple Beef Plan Producer Group, Sturt Plateau Best Practice Group, NABRC, Katherine Pastoral Industry Advisory Committee.

RESEARCH AND RESEARCHERS

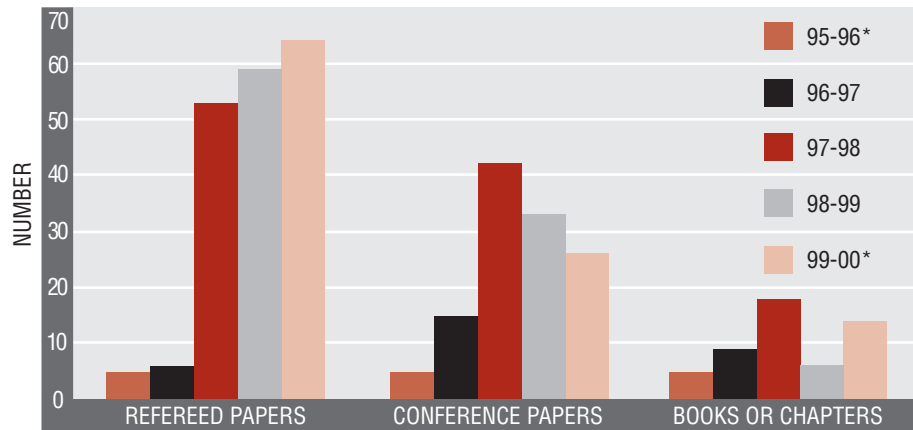
Indicator

Extent to which program objectives and milestones have been achieved

Assessment

- This year has seen the maturing of research in all projects to the point where many are producing outputs. These outputs are being coordinated and integrated by the research Themes and the outputs are being used by the Education, training and communication programs of the Centre.
- The research program has strengthened its links with research users in 1999/2000 – particularly through the Management studies and associated workshops and industry meetings. There were more contracts with user groups this year. See Utilisation and Application section.
- The research program continues to strengthen links with national and international researchers. The Global transects workshop saw a rise in the number of international visitors; the Centre is now working with several national bodies such as the NLWRA.
- The profile of the Centre's research program continues to be strong with good media coverage and publication outputs.

FIGURE 7 NUMBER OF PUBLICATIONS THAT ACKNOWLEDGE THE CRC



*These figures are estimates only and include attendance at TS-CRC workshops

FIGURE 8 NUMBER AND VALUE OF GRANTS AND CONSULTANCIES NOT ADMINISTERED BY THE CRC

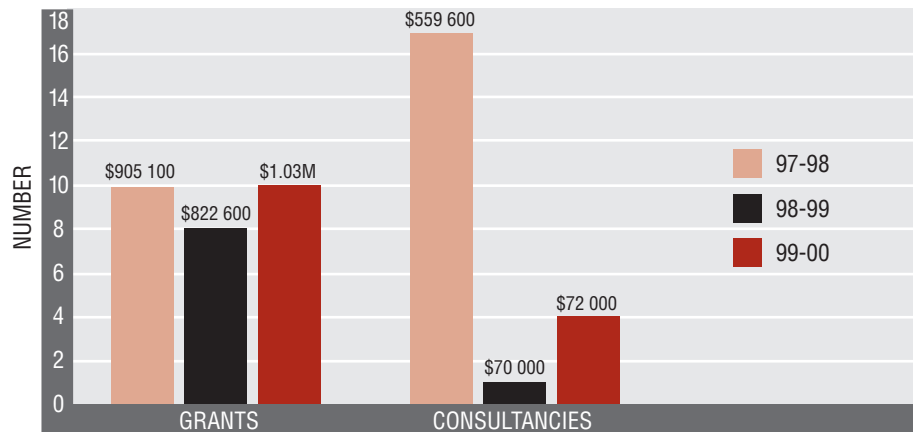


FIGURE 9 NUMBER AND VALUE OF GRANTS AND CONSULTANCIES ADMINISTERED BY THE CRC

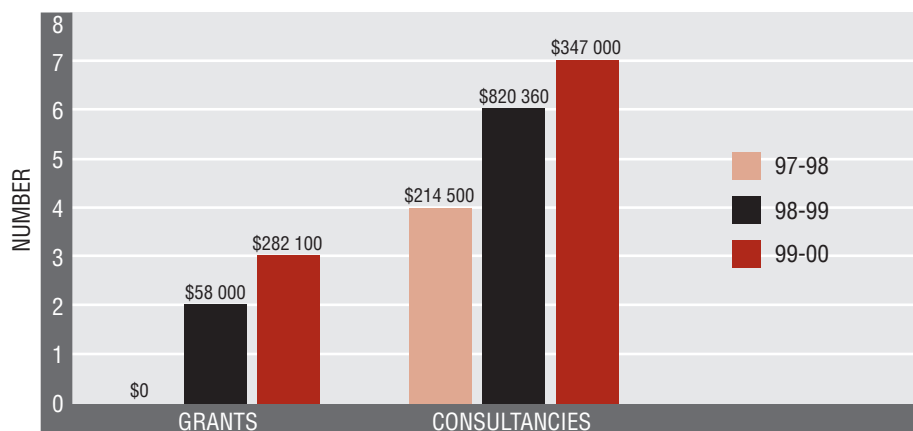
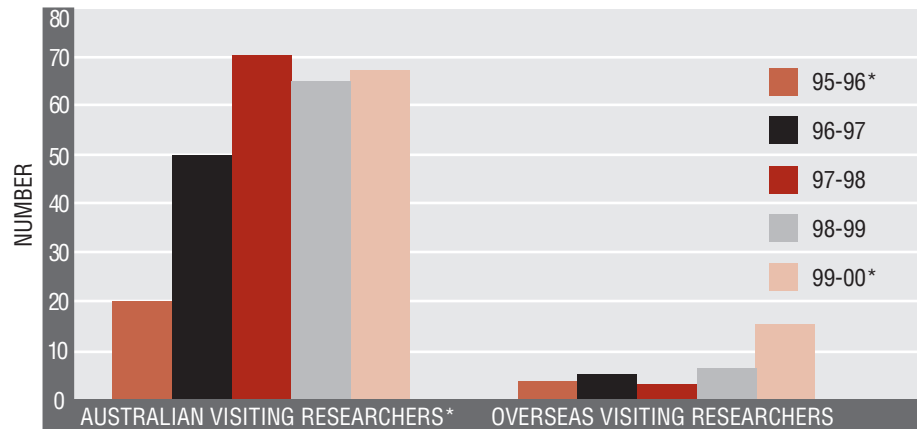


FIGURE 10 EXTENT TO WHICH RESEARCHERS ARE ATTRACTED TO VISIT THE CENTRE



*These figures are estimates only and include attendance at TS-CRC workshops

FIGURE 11A EXTENT OF NATIONAL AND INTERNATIONAL RECOGNITION OF THE CENTRE

Awards and Invited Papers

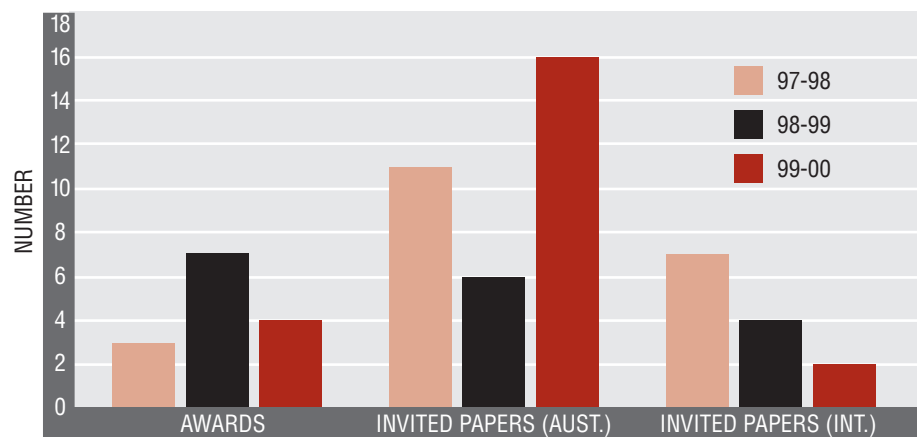
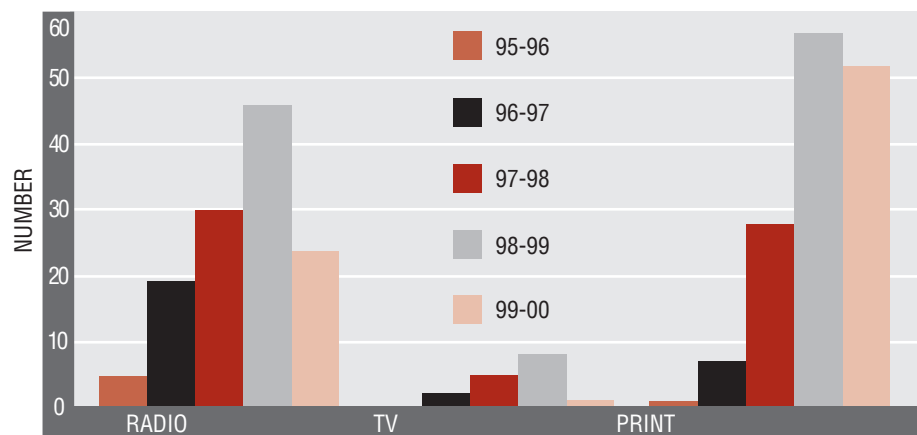


FIGURE 11B EXTENT OF NATIONAL AND INTERNATIONAL RECOGNITION OF THE CENTRE

Media Recognition



EDUCATION AND TRAINING

Indicator	Assessment
Extent and nature of graduate training programs developed by the Centre	<ul style="list-style-type: none"> ● Graduate Diploma in Tropical Environmental Management is being conducted, students can articulate into the coursework Masters program. ● Masters and Grad Dip of Tropical Environmental Management now have 31 students. ● All modules in the Masters and Grad Dip are available for remote users, most via online or CD-ROM technologies. The University of Georgia, USA, has carried out formal evaluation of one unit. ● New module is now complete: Land and Sea Managers Indigenous People and Australian Tropical Environments. ● Position has been funded to write a further module on Environmental Policy areas. ● Research outcomes of several TS–CRC projects are contributing to the new Rangelands Unit. ● Two TS–CRC students were funded to take a two-day BHERT Leadership course in Townsville 23–27 Nov. 1999.
Number of postgraduate students in the Centre and their ability to find employment after graduation	<ul style="list-style-type: none"> ● 22 PhD*, 1 Masters, three Honours. ● Of the three 1998–1999 Honours students, two completed their Honours, and both were employed in their field of study. One has begun a PhD. Three PhD students submitted their theses, and a number of others are close to completion. ● 10 MTEM/GDTEM graduated with Masters or Grad. Dip; five were confirmed as gaining employment in environmental management and one went on to further study.
Extent to which non-university staff involved in the supervision of postgraduate students and the distribution of students amongst partner agencies	<ul style="list-style-type: none"> ● 13 non-university and collaborative staff were involved in supervising students. ● Students at NTU, JCU, ANU, CSIRO W&E, CSIRO TAG, PWCNT, BFCNT, QDPI, UO.
Extent to which the extension and vocational education services of the Centre are successful in modifying management practices within tropical savannas	<ul style="list-style-type: none"> ● Fire-management strategies are being developed with stakeholders as part of Project 2.4.1. ● Extension work with Heytesbury Pastoral Co. and 12 other pastoral holdings saw a “healthy landscapes” approach influence land management. ● Modules on weed management are being used in landholder training. ● Range of sustainable land planning and skills-based training modules implemented. Selected competencies are being incorporated in Savannah Guide management practices. ● Tour guides who have attended IATG/CRC seminars are providing tourists with better insights into the tropical savannas landscape. ● Strategic planning advice provided by the TS–CRC selectively incorporated into the Desert Uplands Build-Up and Development Strategy.

*In last year's report there was an error reporting the number of PhD students: there were 21 last year, not 20.

EDUCATION AND TRAINING

Indicator

Extent and nature of the involvement of stakeholders in the development and conduct of training programs

Assessment

- MLA, NLC, land management agencies and other user groups are closely involved in the design and delivery of the modules developed by the vocational education, training and extension project.
- Land management agencies and other user groups are involved in the design of weeds modules in project 5.1.1.
- Grad. Dip. in Tropical Environmental Management was developed in response to education and training needs analysis involving stakeholders.
- Savannah Guides workshops and training seminars driven by Savannah Guides Inc.
- Tourism Council Australia involved in initiating and developing tour guide seminars.

FIGURE 12 NUMBER OF POSTGRADUATES

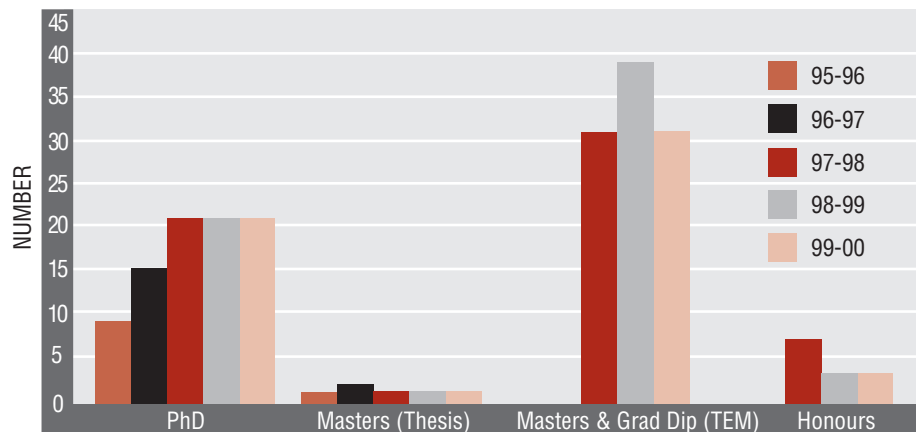
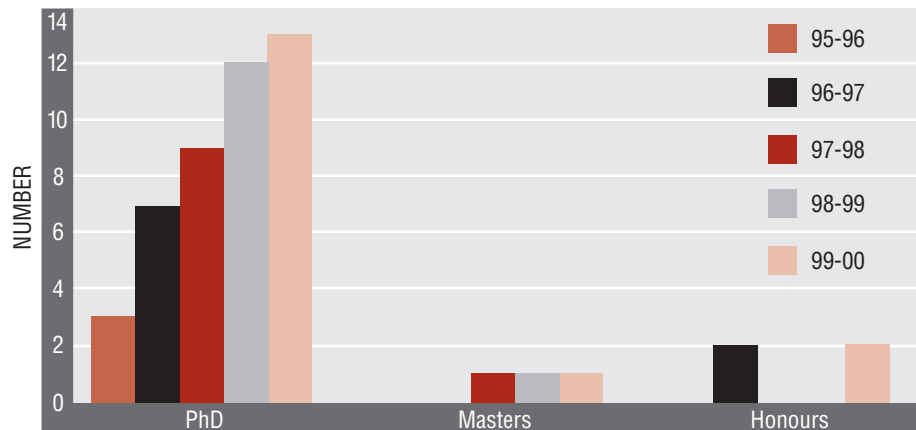


FIGURE 13 NUMBER OF NON-UNIVERSITY OR COLLABORATIVE STAFF INVOLVED AS SUPERVISORS



APPLICATION OF RESEARCH

Indicator

Extent to which Australia and overseas industry and stakeholders adopt knowledge and information developed by the Centre

Assessment

- TS-CRC Fire management research now being used by land managers involved in three NHT-funded projects in Western Arnhem Land,VRD-Sturt Plateau and the Kimberley
 - Satellite based fire mapping technology developed with WA DOLA now used by fire managers in NT,WA and Qld.
 - The Centre's web-based Clearinghouse of research information is receiving 20–30,000 hits per month.
 - Aboriginal groups in the Kimberley and Cape York Peninsula are using centre research findings in developing management plans.
 - Heytesbury Pastoral Co. is now using Centre's research findings on sustainable grazing and fire management.
-

Extent nationally and internationally of Centre involvement and influence in natural resources management and policy development

- ERA applied Landscape Function Analysis and wet season burning techniques at sites on the Ranger Uranium Lease.
 - The Centre will coordinate a major component of the Ord-Bonaparte Program.
 - The vertebrate biodiversity research of the Centre is being increasingly used by agencies and other interested groups in land-use planning and land management, e.g. in planning for the Daly Basin; in planning for sustainable pastoralism in the Mitchell Grasslands; in the Environmental Management Plan for the Bradshaw Field Training Area.
 - The Centre is involved in NLWRA projects that will influence policy in the area of land condition and biodiversity monitoring in the rangelands.
 - The ADF has received fire management advice for Bradshaw from Project 2.4.1.
 - Data from Project 2.2.3 were incorporated into fire planning in conservation areas on Cape York Peninsula.
-

Extent of communication and participation with stakeholders and industry

- Advice given to NT Pastoral Board on land condition monitoring.
- Two contracts secured with NLWRA: on developing frameworks for rangelands land condition and biodiversity monitoring.
- The Centre's newsletter *Savanna Links* goes to more than 2800 stakeholders from all sectors.
- Centre researchers are advising the Western Australian Water and Rivers Commission on the ecological water requirements of the lower Ord so that it can construct a water allocation plan for the Ord River dams.
- Strategic planning by NABRC and Heytesbury Beef pastoral company was facilitated by the Centre.
- Centre researchers have assessed the impact of military and pastoral activities at the Townsville Field training Area use by the ADF in Qld.
- Monitoring of German Creek mine for Capricorn Management Pty Ltd.

APPLICATION OF RESEARCH

Indicator

Level of economic and other benefits to savanna stakeholders stemming from Centre research, communication and education

Assessment

- A method for determining these benefits at the enterprise and regional levels is being developed.
- Strategies for sustainable management have been developed with Desert Uplands landholders.
- Assessment of benefits of conservation planning have been developed with Barkly Tableland pastoralists.

MANAGEMENT AND BUDGET

Indicator

Establishment of procedures to monitor and report on research progress and other achievements of the Centre

Assessment

- Twice yearly technical and financial project reviews.
- In the course of compiling the internal newsletter, *Topical Savannas*, project leaders are asked for regular updates on achievements that can be publicised internally and externally.
- Communication coordinator on management group and is in a position to regularly monitor progress of projects with a view to internal and external publicity.

Extent to which activities of the Centre are modified in line with new knowledge or changed expectations of stakeholders

- Strategic planning process involved partner agencies and stakeholders on Board and Consultative Committee and was partly undertaken in response to feedback from savanna users.
- Survey of educational and training needs led to development of Grad Dip.
- Centre responded to tourist industry requests in developing tour guide seminar series and Savannah Guide training.
- Centre responded to stakeholders' feedback in developing its communication strategy and in developing the Savanna Information Clearinghouse (Project 5.2.3).
- Centre responded to suggestion of Bushfire Authorities to facilitate North Australia Rural Fire Managers Forum.
- Fire managers from across the savannas have been able to use the North Australia Fire Management Workshop to shape the Centre's fire-management research.

MANAGEMENT AND BUDGET

Indicator

Extent to which the activities of the Centre are integrated across state, territory and sectoral boundaries

Assessment

- The Centre's research program is now integrated into research themes that ensure savanna-wide, cross-sectoral approaches are taken. Several integrated outputs are being produced.
- 13 research projects involve substantial collaboration between researchers in either the NT and WA, the NT and Qld, or all three states.
- A number of projects have project leaders managing research outside their organisational jurisdiction.
- The North Australia Rural Fire Managers Forum involves the CEOs of the rural fire agencies from Qld, NT and WA.
- The Aboriginal land management studies integrate western science and Aboriginal culture.
- Project 2.4.1 involves personnel representing the pastoral, Aboriginal, defence and conservation sectors.
- The VRD Management Study currently involves people from the pastoral, Aboriginal, and conservation sectors, through the VRD Conservation Association.
- The Desert Uplands Management Study involves people from the pastoral and conservation sectors together with socio-economic researchers.
- The Burdekin Management Study involves the pastoral, conservation and defence sectors.
- The Land Administration and Management Forum brought many different sectors and all jurisdictions together.

Accuracy of recording and reporting financial transactions, the balance of expenditure against budget and the efficiency of the audit process

- Financial management system implemented, accounting conforms to Australian standards, reports have met required timeframes.
- A project management system incorporates internal review of technical and financial performance.

Abbreviations and Acronyms

ABA	Abscisic Acid
ACIAR	Australian Centre for International Agricultural Research
ACF	Australian Conservation Foundation
ADF	Australian Defence Force
AGSO	Australian Geological Survey Organisation
AGWEST	Agriculture Western Australia
AHC	Australian Heritage Commission
AirSAR	Airborne Synthetic Aperture Radar
ANIC	Australian National Insect Collection
ANU	Australian National University
APA	Australian Postgraduate Award
AQIS	Australian Quarantine & Inspection Service
ATSIC	Aboriginal and Torres Strait Islander Commission
AUSLIG	Australian Surveying and Land Information Group
AVHRR	Advanced Very High Resolution Radiometer
BFCNT	Bushfires Council of the Northern Territory
BHERT	Business and Higher Education Round Table
CAEPR	Centre for Aboriginal Economic Policy Research at ANU
CALM WA	Department of Conservation and Land Management, Western Australia
CAPS	Common AVHRR Processing Software
CDEP	Community Development and Employment Program
CFCU	Caring for Country Unit, Northern Land Council
CINCRM	Centre for Indigenous Natural and Cultural Resource Management (NTU)
CRCA	CRC Association
CRC TREM	CRC for Tropical Rainforest Ecology and Management
CRES	Centre for Resource and Environmental Studies (ANU)
CSIR	Council for Scientific and Industrial Research (South Africa)
CSIRO	Commonwealth Scientific Industrial Research Organisation
CSIRO W&E	Commonwealth Scientific Industrial Research Organisation, Division of Wildlife and Ecology
CSIRO L&W	Commonwealth Scientific Industrial Research Organisation, Division of Land and Water
CSIRO MIS	Commonwealth Scientific Industrial Research Organisation, Division of Mathematics and Information Sciences
CSIRO TAG	Commonwealth Scientific Industrial Research Organisation, Division of Tropical Agriculture
CSIRO TERC	Commonwealth Scientific Industrial Research Organisation, Tropical Ecosystems Research Centre
CTLDEC	Centre for Teaching and Learning in Diverse Educational Contexts
CSVM	Council for Sustainable Vegetation Management
CYPLUS	Cape York Peninsula Land Use Strategy
DoD	Department of Defence
DOLA WA	Department of Land Administration Western Australia
DU	Desert Uplands
DUBDSC	Desert Uplands Build-Up and Development Strategy Committee Inc.

DXF	Drawing Interchange Format
EA	Environment Australia
EPA (Qld)	Queensland Environmental Protection Agency
ERA	Energy Resources Australia
ERIN	Environmental Resources Information Network
ERISS	Environmental Research Institute of the Supervising Scientist
FATSIS	Faculty of Aboriginal and Torres Strait Islander Studies (NTU)
FIMP-INTAG	Forest Inventory & Monitoring Program of the European Union-Indonesian Ministry of Forest and Estate Crops
FRDC	Fisheries Research & Development Corporation
FTP	File Transfer Protocol
GCTE	Global Change and Terrestrial Ecosystems (IGBP project)
GD/MTEM	Graduate Diploma and Master of Tropical Environmental Management
GIS	Geographic Information System
GLADA	Gulf Local Authorities Development Association Inc.
GLM	Grazing Land Management
IBRA	Interim Biogeographic Regionalisation for Australia
IGBP	International Geosphere Biosphere Program
ILC	Indigenous Land Council
IRDSC	Integrated Regional Development Sub-Committee
IT	Information Technology
IUSSI	International Union for the Study of Social Insects
JCU	James Cook University
JPL	Jet Propulsion Laboratory
KAPA	Kimberley Aboriginal Pastoralists Association
KCTWM	Key Centre for Tropical Wildlife Management
KLC	Kimberley Land Council
KRA	Key Result Area
LAI	Leaf Area Index
LaTrobe	LaTrobe University
LCCA	Landscape Cover Change Analysis
LFA	Landscape Function Analysis
LWRRDC	Land and Water Resource Research and Development Corporation
MODSIM	International Congress on Modelling and Simulation
MIM	Mount Isa Mines
MLA	Meat and Livestock Australia
MMS	Multispectral Scanner
MO-DSS	Multi-Objective Decision Support System
MOU	Memorandum of Understanding
NABRC	North Australian Beef Research Council
NAP	North Australia Program
NARFMF	North Australia Rural Fire Managers' Forum
NARGIS	North Australian Remote Sensing and Geographic Information Systems
NARU	North Australia Research Unit (ANU)
NASA	National Aeronautics and Space Administration (US)

NASDA	Japanese Space Development Agency
NATT	North Australian Tropical Transect
NDVI	Normalised Difference Vegetation Index
NHT	Natural Heritage Trust
NLC	Northern Land Council
NLWRA	National Land and Water Resources Audit
NMSU	New Mexico State University
NOAA	National Oceanic and Atmospheric Administration (USA)
NRIC	National Resource and Information Centre, part of the Bureau of Rural Sciences
NRS	Natural Reserves System
NTCA	Northern Territory Cattlemen's Association
NTDLPE	Northern Territory Department of Lands Planning and Environment
NT DPIF	Northern Territory Department of Primary Industry and Fisheries
NTDME	Northern Territory Department of Mines and Energy
NTPAWA	Northern Territory Power and Water Authority
NT Rural ITAB	Northern Territory Rural Industry Training Advisory Board
NTTC	Northern Territory Tourist Commission
NTU	Northern Territory University
OAD	Office of Aboriginal Development
PACRIM	Pacific Rim
PWCNT	Parks and Wildlife Commission of the Northern Territory
PMP	Property Management Planning
QBII	Queensland Beef Industry Institute
QCU	Queensland Cattlemen's Union
QDNR	Queensland Department of Natural Resources
QDPI	Queensland Department of Primary Industries
QFD	Quality Functions Deployment
QFRA	Queensland Fire and Rescue Authority
QPWS	Queensland Parks and Wildlife Service
REC	Rural Extension Centre, a joint venture between UQ and QDPI
RIRDC	Rural Industries and Research Development Corporation
RMIT	Royal Melbourne Institute of Technology
SA DEHAA	South Australian Department of Environment, Heritage and Aboriginal Affairs
SIT	Royal Institute of Technology, Sweden
SOE	State of the Environment
SPAEG	Scientific Program Advisory and Evaluation Group
SPOT satellite imagery	Satellite Pour l'Observation de la Terre (French government remote sensing agency)
TAC	Technical Advisory Committee
TCA	Tourism Council of Australia
TESAG	Tropical Environment Studies and Geography (JCU)
TFTA	Townsville Field Training Area
TS-CRC	Tropical Savannas Cooperative Research Centre
UO	University of Oxford

UCD	University of California, Davis
UDALT	Upper Daly Aboriginal Land Trust
UNEP-GRID	United Nations Environment Program, Global Resource Information Database
UQ	University of Queensland
UWA	University of Western Australia
VRD	Victorian River District
VRD CA	VRD Conservation Association
WA FESA	Western Australia Fire and Emergency Services Authority
WID	Weed Information Deck
WA WRC	WA Waters and Rivers Commission
WWF	World Wide Fund for Nature