

Overview

In this the final year of the CRC for Sustainable Development of Tropical Savannas, the outstanding work of the Centre's staff has resulted in achieving our performance targets set four years ago. Major efforts in coordinating research, education and communication delivered useful outputs for tropical savanna managers and users.

The purpose of the CRC Program is to promote closer ties among the proponents of science and education, to facilitate cooperation and synergy among collaborators in a specified field, to enhance the involvement of business and commerce in the exploitation of science and to provide benefits for Australia. This CRC was successful in meeting all these requirements.

The Centre developed an enviable reputation in meeting the requirements of the variety of stakeholders with an interest in Australia's tropical savannas. An understanding of production and environmental issues in relation to indigenous land management, pastoral production, conservation of natural resources and systems and sustainability requirements for mining, defence and tourism has been developed. We have a sound definition for landscape health to use as a basis for monitoring and adaptive management of the tropical savannas. We have both modelling and monitoring tools that are being used in natural resource management for both production purposes and biodiversity conservation.

The Centre has had an important role in supporting the development of synergies between indigenous and scientific knowledge in both documenting ethno-ecological knowledge and supporting indigenous people in using this knowledge in the management of their country.

The pastoral industry is addressing issues of production efficiency within sustainable use and conservation of natural resources. The Centre's program of research and communication provided the tools for designing and implementing adaptive land management, which incorporates both planning and monitoring.

The Centre's education program now has a comprehensive range of units able to be delivered fully externally as a Masters in Tropical Environmental Management. A significant number of students have completed their PhD studies and are employed in areas supporting the sustainable management of Australia's natural resources.

Savanna Information, the Centre's web-based information clearing house, is receiving an increasing number of visits and is extensively used both within Australia and overseas. The entire communication program has a comprehensive coverage of stakeholders and service providers throughout northern Australia.

Our Fifth Year Review had this to say about the Centre and its program:

The CRC for Tropical Savannas is clearly the largest, and leading, body of savanna researchers in Australia and the world.

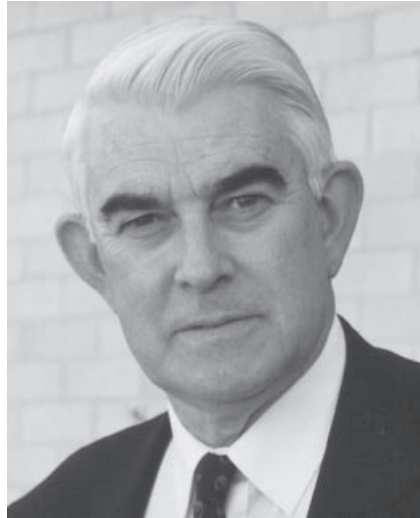
The Masters coursework program is at the leading edge of similar courses offered internationally.

The Centre has done an excellent job in establishing a set of projects which match the needs of a diverse set of stakeholders.

The performance in communication and education is outstanding; it is a model of best practice.

The Tropical Savannas CRC made considerable progress towards meeting its mission of achieving sustainable use and conservation of Australia's tropical savannas through excellence in collaborative research, communication and education.

The Centre now commences a new seven-year phase as the Tropical Savannas Management CRC. It does so with an excellent platform of scientific, communication and educational achievement and expertise. The prospects for further benefits to our stakeholders are excellent.



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. Overall, in the sixth year of what was originally a seven-year program, the Centre made substantial gains and significant progress towards achieving the majority of targets.

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	Documents for scientists and stakeholders have been published
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 has been 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 has developed and tested 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	Model of fire, grazing and rubber vine have been developed and management guidelines formulated

Target	KRA	Theme	Achievement of Target	Comment
6. Pragmatic fire management strategies	KRA 3	EM LP	Completed In Progress Waiting on resources or personnel	A comprehensive publication has been produced.
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	Parameters for conservation plans for granivorous birds are being developed from detailed ecological studies
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 was released and is continuously updated with research results.
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. Four units are completed.
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, landscape assessment and landscape management
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 have been 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 continuing to conduct 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 of national relevance have been completed: 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 continue to be developed

Highlights 2000–2001

Many research projects, integrated by the Theme Structure, were completed. These included projects on Aboriginal land use; a vegetation map of northern Australia and a network of fire-management studies established across northern Australia.

The Centre's links with user groups continued to expand and strengthen. Examples of research applications included:

- pastoral companies that adopted research outcomes;
- major consultancy for NLWRA completed;
- Northern Grassy Landscapes conference, considered major success by all accounts;
- Bushfires forums which continue to generate interest and attendance; and
- formation of the Northern Alliance of Aboriginal Land Councils.

There was also great progress in the education, extension and communication activities improving access for people across northern Australia to land-management research. Highlights included the expansion of the Centre's Masters course from the Northern Territory University in Darwin to James Cook University in Townsville, the development of Grazing Land Management courses for Meat & Livestock Australia, the success of several publications and the popularity of the web-based Clearinghouse.



Credit: Dominic Taylor-Hunt

Building capacity in indigenous communities: Wanga Djakamirr Rangers from the Arafura Catchment in the NT meet to discuss land management. Standing clockwise from left: Dick Fisher, Danny Smith, John Nudumul and Ranger Coordinator Wayne Barbour. Sitting is Phillip Gutmaygutmay (left) and Larry Yawulkpuy

INDIVIDUAL HIGHLIGHTS

Research

- Aboriginal land-management projects 4.3.2 (3) *Overview of weeds on Aboriginal land in the Northern Land Council Area*, 4.3.2 (4) *North Kimberley Traditional Owners' land and sea management planning* and 4.3.2 (5) *Cape York collaborative planning* were completed. As well as producing publications, the projects built capacity in indigenous communities to manage landscapes more sustainably.

- An innovative framework for savanna health, developed by the Centre with user groups, was used as a framework for the Burdekin Management Study.
- The first unified vegetation map of northern Australia at a scale of 1:2,000,000 was completed and is being distributed.
- The Centre's research in areas such as biodiversity monitoring and landscape condition monitoring continued to be integrated across northern Australia, and was used by national bodies.
- Centre researchers received national and international recognition through major awards.
- The Centre extended its research program with a successful re-submission bid for a new Cooperative Research Centre for Tropical Savannas Management. The new Centre will extend the research program of the current Centre to cover socio-economic issues of the tropical savannas and will focus on applying the research results gathered over the last six years in specific land-management, planning and policy contexts.

Links with User Groups

- Major pastoral companies implemented the research outputs of the Centre.
- The Centre completed two contracts with the National Land and Water Resources Audit (NLWRA) involving rangeland condition and biodiversity monitoring. This should enhance the capacity of planners to use the Centre's research outputs.
- A conference on Northern Grassy Landscapes organised by the Centre and largely funded by Environment Australia, was held in August 2000 and drew around 240 land managers, researchers and other research users.
- The Centre's project on fire management established regional fire-management studies from the Kimberley to the NT and Cape York. These studies developed a network of productive linkages between researchers from dozens of organisations and land managers from diverse sectors across north Australia.
- 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 Centre, together with other groups, was involved in the setting up of the North Australian Indigenous Land and Sea Management Alliance which brings together representatives of the Kimberley, Northern and the Cape York Development Corporation.

Education, Extension and Communication

- Our education program continued to provide qualifications from Masters to Certificate levels. As well as allowing access to remote users, courses were extended to JCU.
- Our web-based information clearinghouse, *Savanna Information*, continued to thrive. One of most popular research websites in northern Australia with between 20–40,000 hits per month, It was also selected as a preferred link on savannas for two major US educational institutions.
- 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 land-management best practice and the design of a grazing land-management module for extension services.
- Publications on landscape health and land-management strategies for the Victoria River District went to second print runs; new publications on weed management, pastoralist learning and land administration and management were produced. These publications integrated across disciplines and sectors. All copies of the publication on pastoralist learning *More than can be said* were sold or distributed.

Structure and Management

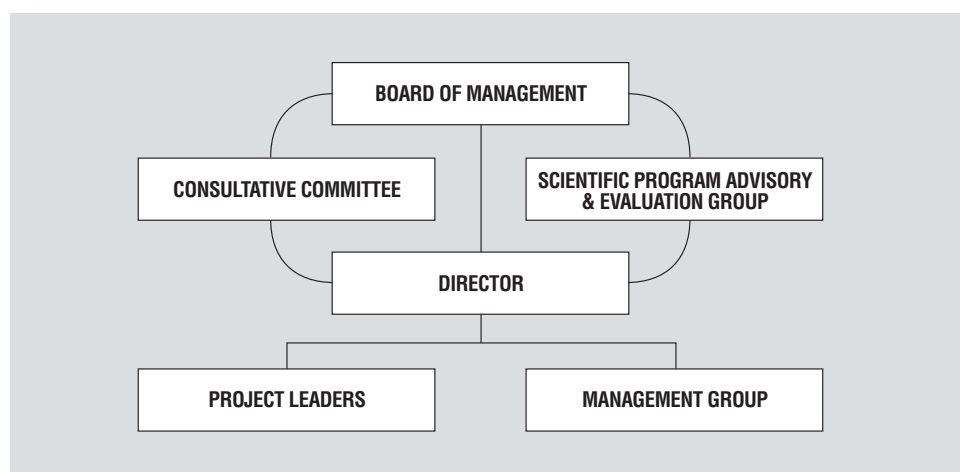
STRUCTURE

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

- CSIRO Division of Land & Water (CSIRO L&W)
- CSIRO Division of Sustainable Ecosystems (CSIRO SE)
- Department of Agriculture Western Australia (AGWEST)
- Department of Conservation and Land Management (CALM WA)
- Environment Australia, Biodiversity Group
- 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 Primary Industries (QDPI)
- Queensland Department of Natural Resources & Mines (QNRM)
- Queensland Parks and Wildlife Service (QPWS)

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 1: 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.

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 2001):

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

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	North Australia Indigenous Land & Sea Management Alliance
Mr Darryl Pearce	Chair of the Consultative Committee
Mr Tom Stockwell	North Australia Beef Research Council (pastoral industry)
Dr Tony Milnes	ERA Environmental Services (mining industry)
Mr Rick Murray	Australian Tourism Council (tourism industry)
Ms Michelle Bowe	World Wide Fund for Nature (conservation sector)

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

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 include Aboriginal and conservation interests as well as 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 stakeholder base of the Consultative Committee was broadened this year to include representatives from the defence sector and the Indigenous Land Corporation. The Consultative Committee met three times during the past year in Townsville and Darwin.

Membership (as at 30 June 2001)

Mr Darryl Pearce (Chair)	Indigenous Management Group, Perth, WA
Mr Tony Law	Department of Defence, Darwin, NT (Defence Sector)
Ms Jann Crase	Environment Centre, Darwin, NT*
Mr Roger Landsberg	Trafalgar Station, Charters Towers, Qld (Pastoral Sector)

Mr Ross Brunckhorst	Pastoral Enterprises, Yeronga, Qld (Pastoral Sector)
Dr Phil Price	Land & Water Resources R&D Corp. Canberra, ACT
Dr Laurie Corbett	EWL Sciences Ltd, Darwin, NT (Mining Sector)
Mr Len Stephens	Meat & Livestock Australia (Pastoral Sector)
Mr David Epworth	Balkanu Cape York Development Corp., Cairns, Qld (Aboriginal Sector)
Mr Paul Styles	Tourism Council of Australia, Darwin, NT (Tourism Sector)
Mr Mark Horstman	Kimberley Land Council, Derby, WA (Aboriginal Sector)
Dr Sonia Tidemann	Batchelor Institute of Tertiary Education, Batchelor, NT (Education Sector)
Mr Paul Jenkins	Indigenous Land Corporation, Adelaide, SA
Ms Kerryn O'Connor	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.

SCIENTIFIC PROGRAM ADVISORY AND EVALUATION GROUP

The annual review of the Centre's research program, conducted by the Scientific Program Advisory and Evaluation Group (SPAEG), did not fall within the financial year under report. It conducted its last annual review of the Centre's program from 3–4 April 2000. The next review was held in August 2001.

Membership (as at 30 June 2000)

Prof. Jon Altman	Centre for Aboriginal Economic Policy Research Australian National University, 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 seven 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 2001)

Dr Alan Andersen	CSIRO SE, Darwin, NT
Mr Rod Applegate	NT Department of Lands, Planning & Environment, Darwin, NT
Mr John Childs	Director, TS–CRC, Darwin, NT
Mr David Epworth Balkanu	Cape York Development Corporation
Prof. Greg Hill	Human Capability Development theme leader, NTU, Darwin, NT
Dr Peter Jacklyn	Communication coordinator, TS–CRC, 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 John Woinarski	Parks and Wildlife Commission of the NT, Darwin, NT

Cooperative Linkages

Cooperative Linkages are a vital part of the Centre's success. They overcome the isolation experienced by research groups from different sectors and disciplines scattered over the tropical savannas; they are also used to break down the cultural, disciplinary and sectoral barriers that separate the diverse groups of researchers involved with the Centre. The year 2000–01 saw the many links created by the Centre continue to develop and strengthen.

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

- Links between researchers across disciplines and sectors (e.g. between ecologists and grazing researchers) help produce sustainable land-management research that achieve a whole-of-savannas perspective and address problems not dealt with by individual agencies.
- Links between agencies that make research more useful for land managers and other users.
- Links between researchers across regions and countries are used to develop better exchange of ideas.
- Links with educational institutions that improve access to research for students.

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. Highlighted below are a selection of links listed under each goal.



From left, Dr Lindsay Hutley (Project Leader, 1.2.1) with Dr Jason Beringer, Mr Andrew Coutts and Mr Andrew Kerley of Monash University, undertaking field measurements at Howard Springs NT, during the Savanna Fire-Flux experiment (SAFE), dry season 2001

Links that produce a whole-of-savannas perspective to fill information gaps

In 2000–01 the research themes followed on from the workshops of last year to produce a number of important outputs that used cooperative linkages.

- The booklet *Defining and measuring the health of savanna landscapes* was produced by the North Australia Landscapes Theme and used linkages between NTU, CSIRO and PWCNT to bring together stakeholders and people from various agencies including the several authors to assemble the ideas in the booklet.

- The Publication *Savanna Burning: Using and Understanding Fire in the Northern Australia* was coordinated under the Ecosystem Management Theme and used linkages between BFCNT, CSIRO, NTDPIF, Environment Australia, PWCNT, CALMWA, QNPWS among others to produce the book, due out in late 2001.
- Researchers from the Queensland Herbarium, NTDLPE, AgWA and CALM WA met to sort out differences involved in producing a vegetation map of Northern Australia that was completed this year.

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

Links that make research easier to use

The Centre's three Management Studies continued to develop cooperative linkages in their respective regions—linkages that revolve around the practical issues and those managing for them on the ground.

Highlights were:

- The publication *Managing for healthy country in the VRD* summarised sustainable land-management research relevant to the Victoria River District in a practical way. It was produced in September 2000 by the VRD Management Study and brought together the wide range of agencies involved in the study.
- The Burdekin Management Study is undertaken collaboratively with QDPI and CSIRO L&W and Sustainable Ecosystems. A one-week workshop of technical specialists from the above agencies as well as QNRM and JCU, provided the first draft of the integrated information and guidelines on sustainable land management. The Study is also linking to the Rangelands to Reef initiative (Dalrymple Landcare Committee, QDPI); the Burdekin Rangelands Strategy Implementation group and regional vegetation management through the EPA's mapping work based in Townsville.
- Project 2.4.1 *Fire and savanna landscapes*, built linkages between a range of researchers, land managers and organisations across the sectoral spectrum (e.g. pastoral, indigenous, conservation, defence) as a result of ongoing collaborative projects undertaken in Cape York (Qld), western Arnhem Land and the Sturt Plateau/VRD regions (NT), and Kimberley (WA). Further, the TS-CRC actively supported an integrated approach to fire research and management across the northern savannas through its hosting of the North Australia Fire Manager's Forum (NAFMF), which met twice during the year. Membership of the NAFMF includes all three northern Australian rural fire authorities, as well as the TS-CRC.
- Projects dealing with Aboriginal land management continued to develop important linkages with Aboriginal land-management agencies across northern Australia, and helped those agencies develop better links with other government land-management agencies. The Centre played a role in the formation of NAILSMA—the North Australian Indigenous Land and Sea Management Alliance—a cooperative linkage of the major Aboriginal land and sea management groups from across northern Australia. The alliance now has a representative on the Board of the new CRC.
- The TS-CRC, through Project 2.1.1 *Vertebrate biogeography*, provided an appropriate avenue for extending the BioGraze project (involving collaboration between SA DEH, CSIRO and PWCNT), which explores options for the management of biodiversity on pastoral lands. This extension has involved a range of consultative meetings with pastoral stakeholders, with high levels of acceptance and encouragement for cooperative research and management projects.
- Project 2.2.3 *Decline of Crimson and Star Finches in Queensland*, developed links with the Biodiversity Planning section of the Queensland Environmental Protection Agency to help ensure the findings of the work are incorporated immediately into policy and planning.

- The TS–CRC, through Project 4.3.5 *Sustainable grazing in the Burdekin River Catchment*, and through the TS–CRC Extension Coordinator, cooperated with several organisations (QDPI, QNRM, NTDPIE, CSIRO, MLA) in the development of a grazing land-management education program for beef cattle producers in northern Australia. This promoted coordination of R&D work on the GRASP pasture growth model, on the financial assessment of grazing options, and on the collation and synthesis of information relating to sustainable management of grazing lands.
- Project 5.2.2 *Extension, vocational education and training* continued to build links between weed researchers, Aboriginal Land Councils, educational institutions and a number of NT government agencies to finalise production on a practical video for Aboriginal communities on weed management.

Links across regions and jurisdictions to produce better exchange of ideas

- Project 3.1.1 *Assessing landscape health*, involves collaborative work between partner agencies AGWEST, CSIRO MIS, CSIRO SE and NTDLPE which continued in 2000—01. To facilitate this collaboration, a significant amount of project funds were allocated to further develop linkages between project personnel. Future collaboration and research opportunities have resulted from this cooperation.
- Important cooperative linkages continued to be developed by Project 2.1.1 *Vertebrate biogeography*. This project supported the application of conservation planning software for at least two bioregions in the Queensland savannas, with application and training from PWCNT to EPA (Qld). It developed a collaborative approach to assess changing status in native mammal fauna across northern WA, the Top End of the NT and the tropical savannas of Queensland. The project also worked collaboratively with CSIRO Sustainable Ecosystems (Townsville) and the Department of Defence to assess biodiversity in the Townsville Field Training Area.
- Project 3.2.1 *Invertebrate indicators of biodiversity and ecological change*, developed links with EPA; PWCNT on tree clearing and fragmentation in central Queensland; with PWCNT on Tiwi Islands and Darwin fragmentation studies; NTDLPE, PWCNT on rangeland condition and biodiversity. In addition, the project has cooperative linkages with staff from QNRM and NPWS (NSW) which are using ants as bio-indicators in their monitoring programs.
- 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.
- 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

- Researchers linked with the National Land & Water Resources Audit produced reports on monitoring landscape health in the rangelands and on developing a monitoring framework for biodiversity. TS–CRC researcher Paul Novelly, Department of Agriculture WA, represents the TS–CRC on the Rangelands Coordinating Committee.
- Linkages at the national level were developed through Project 2.4.1 *Fire in Savanna Landscapes*, and the undertaking of consultancy projects for Environment Australia’s State of Environment (SOE) Unit (*Assessing fire patterns and their environmental impacts for national SoE reporting*), and the Rural Industries Research & Development Corporation (*Developing a sustainable satellite fire monitoring program for rural northern Australia*). Both projects involve collaboration with researchers from a number of agencies and organisations.

- The Centre contributed to the Ord-Bonaparte Project with director John Childs representing the TS–CRC, 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 2000.

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 continued their strong links with the International Geosphere–Biosphere Programme (IGBP). Project leader Dr Williams collaborated with Dr Joe Craine, University of California at Berkeley, on native grass morphological and physiological traits. Drs Ahmad and Menges collaborated with Dr Jacob van Zyl from NASA on applications of radar as a remote sensing tool.
- Dr Lindsay Hutley, Project 1.2.1 *Water and carbon exchange of savannas*, formalised teaching and research links via the development of a Memorandum of Understanding between the University of Botswana and NTU/TS–CRC. Both institutions have overlapping teaching and research interests (savanna ecology and management) and it is hoped that mutual benefit will be gained from a formal link.
- Project 2.4.1 *Fire and savanna landscapes*, was involved in the development of a collaborative fire management and training program in eastern Indonesia, funded primarily through ACIAR. As indicated above, a five-year program is due to be implemented in 2002.
- Project 2.4.1 is also engaged in collaborative research with the Japanese Space Development Agency (NASDA), and the University of California at Irvine, concerning their interests in biomass burning in the SE Asia region. This collaboration has resulted in the preparation of a number of joint papers, and a potential ongoing interest in a major funding initiative under the auspices of the Commonwealth's Greenhouse Gas Abatement Program.
- The fire project also made contacts with the NASA and the European Space Agency concerning the potential involvement of a northern Australian study area as part of verification studies for international fire mapping and monitoring initiatives. The project hosted a student, Mr Tomas Wissell, from the University of Stockholm, in late 2000.
- 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.
- Collaborative work in Project 4.3.4 *Modelling and landscape change*, continued through the development of the Savanna Au model, through linkages with Dr Mike Coughenour. A formal MOU with Dr Coughenour and the Natural Resources Ecology Laboratory at Colorado State University, USA, will be established. This project also has linkages and exchanges with other international savanna modelling groups, such as with the SCOPE tree-grass balance project led by Bob Scholes, South Africa, and Steve Archer, USA.

Links with educational institutions

- As a result of links developed by Project 5.1.1 *Higher Education*, NTU students are able to select units at JCU as electives during their NTU candidature, and vice versa. By the end of this financial year nine students elected to take a total of 10 units at JCU as electives in the GD/MTEM course. JCU, NTU and other CRC staff collaborated closely on the development of the *Land & Sea Managers* unit, now offered at JCU. This unit was promoted as an elective unit in the GD/MTEM program, and in Semester 2 2000, three students travelled to JCU to take the unit. JCU staff were included in the proceedings of the GD/MTEM steering committee at NTU, and there is potential to continue to develop these academic and administrative connections.
- The choice of electives in the GD/MTEM proved a valuable forum for other collaborations. Many GD/MTEM students also take elective units from the Graduate Certificate in Tropical Wildlife Management (offered through the Key Centre for Tropical Wildlife Management at NTU) and there was a similar flow of Key Centre students into GD/MTEM units. We jointly promoted courses to our respective students. Units within the new Graduate Diploma of Resource Management, offered by the Faculty of Aboriginal and Torres Strait Islanders Studies (FATSIS), NTU, were also stimulating interest among GD/TEM students.
- The Batchelor Institute of Tertiary Education expressed an interest in using the GD/MTEM units as a resource for teaching staff involved in the development of units at undergraduate and diploma level. Discussions are under way to develop and implement an agreement between NTU, the Batchelor Institute and the TS-CRC for use of these learning materials.
- Project 1.2.1 *Water and carbon exchange of savannas*, began cooperative work with researchers from Monash University to examine the role of fire and burn scars in modifying surface heat and moisture fluxes to the atmosphere—two significant drivers of atmospheric processes. The impact of fire on carbon fluxes and the recovery of tree water use following fire will also be assessed.

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 SE, late '95	✓	✓			University of Wageningen, The Netherlands NASA IGBP CSIR South Africa		1.2.1 2.1.1 2.4.1 3.2.1	Carbon CRC NTDLPE ANU NTDPIF
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; north-west Qld	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 CSIR South Africa		1.1.1	NTDLPE PWCNT CSIRO LAW CSIRO SE PAWA Monash Univ.
2.1.1 Vertebrate Biogeography, PWCNT, late '95	✓	✓				Various Stations in Central Queensland, Barkly Tableland, NT	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 SE QEPA SA DEH KCTWM
2.2.2-3 Grassland patterning and habitat suitability for granivorous birds Decline of Crimson and star finches in Queensland, QDEPA, late '95	✓	✓	✓			Traditional owners in Cape York Peninsula	2.1.1 2.4.1 3.3.2 4.5.3	EA NTU PWCNT QEPA 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 LWA FRDC CSIRO SE 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 Japanese Space Development Agency (NASDA) University of California, Irvine NASA European Space Agency Texas A&M University	BFCNT VRD regional committee Sturt Plateau Best Practice Group	2.1.1 4.5.1	CSIRO SE NTU JCU Murdoch Uni EA DoD NLC PWCNT NTDPIF Balkanu KAPA Jawoyn Assoc. EPA (QEPA) QNRM 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			✓			VRD land managers, ADF Bradshaw Station	2.1.1 2.4.1 3.2.1 4.3.4 4.5.1	AGWEST CSIRO MIS CSIRO SE QDPI NTDLPE BFCNT Sturt Plateau Technical Group QNRM NLWRA
3.2.1 Invertebrate indicators of biodiversity and ecological change, CSIRO SE, late '95	✓				Various American and European Museums	Mining industry	1.1.1 2.1.1 2.1.2 2.4.1 3.1.1-2 4.5.1	PWCNT DoD NTDLPE ANIC
3.3.2 Fire and Rubbervine, CSIRO TAG, QNRM, late '98	✓	✓				Seventy Mile Range Catchment Group Mt Cooper Bushfire Brigade	2.3.1 2.2.1-3	QEPA JCU
4.2.2 Aboriginal pastoralists in the Kimberley, late '98	✓		✓			Various Landowners in the Kimberley		KAPA NLC KLC ILC

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
4.3.2 (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 QNRM 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		PWCNT (Herbarium)
4.3.3 Arafura Catchment Management, NLC, late '98			✓	✓		Raminginning Homelands Resource Centre		EA NTU (FATSIS) NARU PWCNT NTDLPE
4.3.4 Modelling landscape Changes, CSIRO W&E, late '98		✓	✓		Dr M. Cougenhouer, University of Colorado, USA CSIR South Africa		1.1.1 1.2.1 1.2.3 2.4.1 4.5.1	AGWEST WA DOLA BFCNT NTDPIF QNRM
4.3.5 Sustainable Grazing Management in the Burdekin, QDPI, late '98			✓	✓		Various landholders in the catchment through QDPI extension Dalrymple BeefPlan producer group		CSIRO L&W CSIRO SE EPA GBRMPA NTDLPE NHT MLA NTDPIF QNRM

TABLE 2 COOPERATIVE LINKAGES

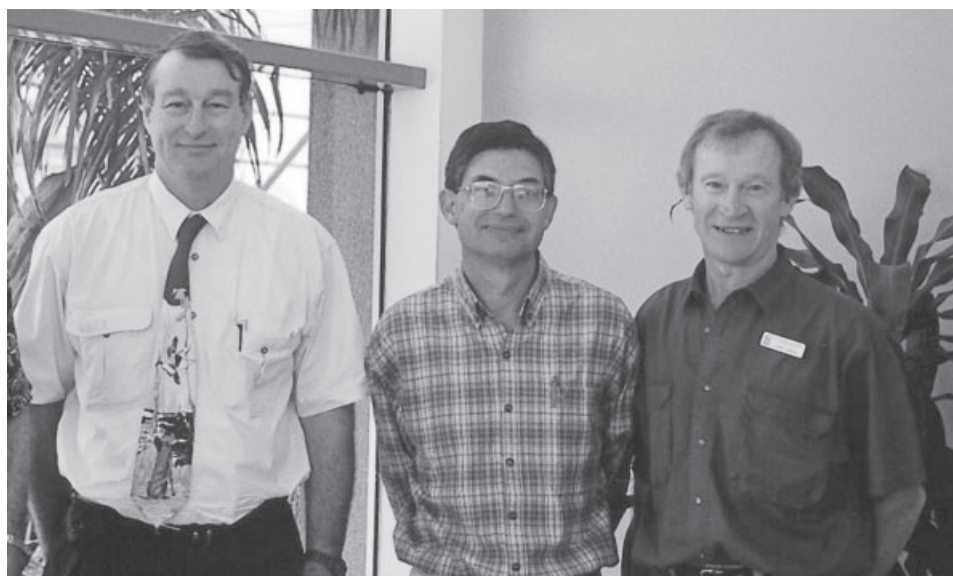
Project (No. Name, Location, Date Began)	Themes				Cooperative Linkages			
	NAL	LP	EM	HCD	Overseas Contacts	Landowners	Other CRC Projects	Other Australian Agencies
4.5.1 Victoria River District Management Study, CSIRO SE, late '97	✓	✓	✓	✓	Dr M. Cougenhouer, University of Colorado, USA CSIR South Africa	BFCNT VRD regional committee Sturt Plateau Best Practice Group	1.1.3 2.1.1 3.1.1-2 3.2.1 2.4.1 4.3.4	PWCNT BFCNT NTDLPE NTDPIF NTU CSIRO SE
4.5.2 Desert Uplands Management Study, JCU, 1996	✓	✓	✓	✓	University of Buenos Aires	Various Landowners through the DUBDSC	2.1.1	DUBDSC EPA (QEPA) QNRM
4.5.3 Burdekin Management Study, CISRO, QDPI, late '98	✓	✓	✓	✓		Various landholders in the catchment through QDPI extension	3.1.1	ADF EPA (QEPA) JCU QPWS TWRC (QNRM) Aust. Centre Tropical. Freshwater Research
5.1.1 Higher Education, NTU 1996				✓	Universities of Florida, Georgia and Botswana			JCU Batchelor Institute KCTWM
5.2.2 Extension and Vocational Education and Training NTU, 1999				✓	WWF, Tropical Wetlands of Oceania Program	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 SE MLA EPA (QEPA) QNRM QDPI NWAS NLC NTBFC NTDPIF NTDLPE PWCNT REC
5.2.3 Learning Processes of Pastoralists, NTU, 1998				✓		Various Landowners across northern Australia		AGWEST QDPI NT Rural ITAB
5.3.2 Information Clearinghouse NTU, JCU 1998	✓	✓	✓	✓	NSTA, USA Lightspan, USA	Various land managers		CSIRO SE PWCNT QDPI BFCNT Optus C&W 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. Each theme integrates the research of several projects as shown in Table 2, with some projects contributing to more than one theme. 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.



Kathryn Thorburn

The TS–CRC's theme leaders: Prof. Greg Hill (Human Capability Development), Dr Paul Novelly (Ecosystem Management) and Dr John Ludwig (North Australia Landscape Landscape Processes)

NORTH AUSTRALIA LANDSCAPE

Theme leader: Dr John Ludwig, CSIRO Sustainable Ecosystems, Atherton



Theme focus

This theme aims to synthesise and collate new and existing information on savanna landscapes and make this information available to all stakeholders in the savannas of northern Australia.

Outputs are provided in many forms for example, by face-to-face discussions in workshops and conferences, by written reports and booklets, and through the web-based clearinghouse.

This Theme makes important contributions to the TS–CRC's Key Result Areas. For example, it has held workshops and forums that have produced a booklet defining our perspective on what is a healthy savanna landscape (KRA 1). Projects within this Theme devised new methods for assessing savanna health (KRA 2).

Achievements

Northern Grassy Landscapes Conference and Workshops

In August 2000 a regional forum was held in Katherine, NT that brought together a mix of participants from across the north. These participants were, for example, from Aboriginal agencies, conservation organisations, extension workers, pastoral properties, policy makers, and scientific groups. Presenters addressed most of the key issues and factors affecting savanna landscapes, including fire, grazing, clearing, weeds, feral animals and climate change. Issues were discussed in sessions and workshops which followed on from the presentations. As expected, participants had different approaches to issues, but all agreed that the conference and attendant workshops were necessary for the future success of savanna management and promoting cross-sectoral understanding.

Savanna Vegetation Map in Print

A 1:2 000 000 map of 'The Vegetation of the Australian Tropical Savannas' is now available. This product provides the first seamless map of the savannas at this scale—that is, mapping using a consistent methodology across Queensland, the Northern Territory and Western Australia. The project was led by Ian Fox at the Queensland Herbarium and a large team of botanists from across northern Australia. This colourful product provides the viewer with a tapestry of vegetation patterns across the savannas. For those who want to do more than look and study these maps, a 1:1000 000 scale map in digital form will be available in late 2001. A document describing the mapping methodologies and the different vegetation types used in producing the maps is also being produced.

Savanna Health Publication

The publication *Defining and measuring the health of savanna landscapes: a north Australian perspective* was released this year and was aimed at land-management agency staff and planners among others. It offers a framework for sustainable land management in the tropical savannas and an approach to the range of different perceptions and values of savanna users. The first print run of 300 was not sufficient to meet demand, and a second print run is in progress.

Framework for Monitoring Biodiversity Report

The 600-page report *Developing an Analytical Framework for Monitoring Biodiversity in Australia's Rangelands* was written by the Centre for the National Land & Water Resources Audit. It outlines a framework for using existing monitoring resources and some additional initiatives to effectively monitor the status of biodiversity across Australia's rangelands. It will allow various land-management agencies to better plan strategies for monitoring the status of biodiversity in this large area.

Environmental Changes in the Victoria River District

Environmental historian Darrell Lewis completed a draft of a fascinating account of landscape changes in the VRD since European settlement. This account describes how creeks and rivers in the VRD have changed in shape (geomorphology) and in vegetation (tall, thick reeds, once abundant, are gone). Woody thickening is another phenomenon of change in the VRD. Mr Lewis produced pairs of historic and recent photos of the same location to document this thickening. His written account and a selection of paired photos is to be produced by the TS-CRC.

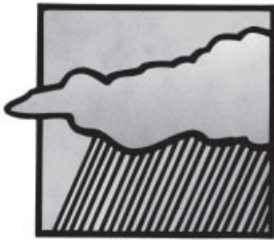
Other initiatives of the theme, such as continuing input into the website Savanna Information are described under individual project entries.

Future directions

With the successful bid for a second round Tropical Savannas CRC the North Australia Landscapes Theme is now combined with Theme 2 (Landscape Processes) to form a new Theme on Landscape Ecology and Health. This new Theme will continue to synthesise, integrate and coordinate activities that develop our knowledge and understanding of savannas, and communicate this new information to our stakeholders.

LANDSCAPE PROCESSES

Theme leader: Dr John Ludwig, CSIRO Sustainable Ecosystems, Atherton



Theme focus

The aim of this theme is to synthesise new knowledge gained from TS–CRC projects for a better understanding of how healthy savanna landscapes function. As a working definition, healthy savannas are those landscapes that function to: retain and use limited resources such as water and nutrients; provide food and shelter for fauna; support viable populations of native plants and animals, and meet the material, aesthetic and spiritual needs of people.

Achievements

Progress centred on three major activities:

1. synthesising and presenting information for the Fifth Year Review;
2. developing a portfolio of projects to include in the Submission for the CRC's Selection Round; and
3. planning the initiation of projects for the new Tropical Savannas CRC.

These activities contributed to a positive report from the Fifth Year Review Panel, successful submission for a second-round Tropical Savannas CRC, and a set of new research projects with well-defined objectives and deliverables.

During 2000–2001, a number of TS–CRC research projects contributed to Theme 2 by improving our understanding of landscape processes that define healthy savannas. For example, Projects 1.1.1 *Savanna form and function at landscape scales* and 3.1.1 *Indicators of landscape health using ground assessment with remote sensing*, in collaboration with students and staff at NTU, demonstrated that a variety of different remote-sensing tools, including aerial videography and satellite imagery (SPOT, TM, radar), have the potential to remotely measure a number of indicators of landscape health (e.g., tree and perennial grass cover, and the extent of bare soil). The accuracy of these indicators was verified by ground-based measurements in the Victoria River District.

Also contributing to Theme 2, the research of Projects 2.1.1 *Vertebrate biogeography* and 2.2.2–3 on the biogeographic distributions and habitat requirements of granivorous birds including the Partridge Pigeon, Crimson Finch and Star Finch. Findings from these projects clearly document that these species require specific configurations of high quality habitat patches at landscape scales, depending on their individual food and nesting requirements, and home ranges. Declines in these species appear to be related to reductions in the spatial and temporal availability of high-quality vegetation patches because of the impacts of grazing, fire and tree clearing at critical scales.

A set of fire projects also contributed to the theme. Project 2.4.1 *Fire and savanna landscapes*, provided insights into how patch burning can be used to regulate pasture use at the paddock and local landscape scales.

Project 3.3.2 *Fire in the management of rubber vine*, determined some of the advantages and disadvantages of using fire in riparian landscapes to control exotic weeds such as rubber vine.

Future directions

With the commencement of the new Tropical Savannas CRC, many of the research initiatives of this Theme will be taken over by the new Landscape Ecology and Health Theme. This Theme will provide an understanding of the landscape ecosystem processes and functions of the tropical savannas. It will further develop and validate a sound working definition of landscape health based on scientific, experiential and indigenous knowledge. It will use predictive models and time series monitoring to test and refine the definition and its application.

ECOSYSTEM MANAGEMENT

Theme leader: Dr Paul Novelty, AGWEST, Kununurra



Theme focus

Ecosystem Management is defined 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 contributed to all four Tropical Savannas CRC Key Result Areas (KRAs) during 2000–01, but particularly to KRA1—*Definitions of healthy landscapes at spatial and temporal scales useful to landholders, managers and users*, KRA2—*Assessing Landscape Health* and Area 3—*Management Options for Sustainable Use and Conservation*. It did this 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 proactive decisions.

Research progress

All projects linked to the Ecosystem Management theme continued to progress well during 2000–01.

Fire is a major issue in both the North Australia Landscapes and the Ecosystem Management themes, and substantial progress was made over the past year in Project 2.4.1 *Fire and savanna landscapes*. Fire-management projects undertaken in the western Arnhem land region and the Sturt Plateau/Victoria River District (VRD) are both nearing completion, while the Kimberley Regional Fire project (only in its second year) and the Cape York Queensland study continue to link in strongly with this project. These activities involve a number of TS–CRC partners, other agencies and organisations, and regional communities. They are funded mostly through the Natural Heritage Trust (NHT), with the VRD component also funded through the TS–CRC as part of its VRD Management Study. The linkages provided by studies such as these and the coordinated outputs contribute substantially to the theme meeting its objectives.

Other projects nearing completion include:

1. National assessment of real-time fire monitoring and associated mapping, funded through Environment Australia's State of Environment (SoE) program;
2. Associated verification and assessment of satellite-based monitoring and mapping systems funded through the Rural Industries Research and Development Corporation (RIRDC);
3. Ongoing development of a collaborative fire research and training program in eastern Indonesia involving TS–CRC partners and a range of organisations and agencies, continued over the past year although progress was slow. This project, with funding primarily from the Australian Centre for International Agricultural Research (ACIAR), is now due to be running by mid-2002;
4. Project 3.3.1 is providing useful information on the impacts of both wet-season and dry-season burning on rubber vine density, clearly demonstrating that fire can be used to effect in the management of riparian rubber vine.

Cooperative linkages continued between Western Australia's Department of Agriculture, CSIRO Division of Mathematics & Information Sciences, NT Department of Lands, Planning & Environment and the National Lands Water Resources Audit in remotely sensed rangeland monitoring in the assessment of rangeland condition and trend across northern Australia. The key finding is the ability to detect and report changes at a range of scales from fence line to region. The project led to this technique being used in the Northern Territory by the NTDLPE and it is being tested at the catchment scale (the Ord River Catchment) in the East Kimberley prior to entering operational use.

With regard to indigenous stakeholders, Project 4.3.2(5) gathered indigenous knowledge relating to land and sea management with the traditional owners in the north Kimberley, as well as more specific ethnobotanical knowledge. This project has produced some excellent results. Similarly, the Northern Land Council in Darwin worked on Upper Daly Aboriginal land-management outcomes in Project 4.3.2(2). The project raised awareness and increased Aboriginal community capacity to deal with the many problems faced when managing the large tracts of unsettled land with relatively little infrastructure. Also, the Northern Land Council worked on an overview of weeds on Aboriginal land in NLC area. The report contains some 30 major recommendations relating to the requirements under upcoming legislation and is the first survey of its kind on the weed status of these areas. It identifies the way forward for collection, storage and mapping of weed data on these lands as well as discussing future management, training and community awareness issues. The final document *Not from here: plant invasions on Aboriginal lands of the Top End* was published by the TS-CRC in early 2001. The report contains some 30 major recommendations relating to the requirements under upcoming legislation and is the first survey of its kind on the weed status of these areas. It identifies the way forward for collection, storage and mapping of weed data on these lands as well as discussing future management, training and community awareness issues.

Highlights

The highlights were the continued linkage between parties to the TS-CRC, projects and external agencies and, consequently, an integration of regional natural resource management research. Projects such as the regional fire projects, and the linkage of the TS-CRC projects with the National Land & Water Resources Audit, brought together agencies involved in natural resource management across northern Australia and so added value to the work of individual researchers and agencies.

The association of the TS-CRC with other agencies continued beyond the project phase, with the TS-CRC becoming an increasingly important voice in many of the issues associated with natural resource management policy.

Challenges

Amongst the challenges that the theme (and the CRC as a whole) faces, a major one continues to be the wide geographical spread of the TS-CRC and the broad range of issues and stakeholders with whom it works. Within the Ecosystem Management theme in particular, the emphasis continues to be on ecological considerations; the ongoing challenge is, however, to increasingly incorporate the socio-economics of practical land management into the theme's focus.

However, it is becoming increasingly obvious that the TS-CRC has addressed these issues and, while they are not resolved, significant progress was made. In particular, the inclusion of projects incorporating indigenous aspirations, the linkage to other broad-based activities as the Land & Water Resources Audit, and the actual integrating nature of much of TS-CRC's own research substantially added to the sense and the reality of cooperation across the north.

Future directions

With the finalisation of activities from the TS-CRC the coming year will see a major move within the theme towards the finalisation and, where possible, the operationalization of many of the outputs developed through the projects. This will involve the Commonwealth and State agencies that are party to the CRC, as well as those on the ground ultimately responsible for land management and monitoring across the savannas.

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.

With the benefit of six years of research, development and service activities behind us, the Human Capability Development theme has seen its diverse range of projects mature and deliver their promised benefits to stakeholders and the wider community. The reports from the project leaders, representing the various components of the TS–CRC’s education, training and communication activities, attest to the consolidation that has occurred over the last year. They also signal that the theme is ready to move on to new challenges and directions as the TS–CRC enters a transitional phase between reflecting on the goals and aspirations of the original centre and the new focus for the future. A crucial aspect of the outputs from this theme was the identification of new priority areas for research into learning mechanisms for key stakeholder groups. In addition to this, the tangible outcomes such as new learning assessments, materials and opportunities have created an expectation of further development. There is enormous scope to provide new and exciting services to the people who live in the savannas.

The theme is pleased with its performance over the life of the Tropical Savannas CRC. As stated in the report of the Fifth Year Review:

The panel also considers the Centre is outstanding in its approach to a performance on communication and education; it is a model of best practices.

The theme plans to match this accomplishment in the years ahead and make further progress in human capability development in the tropical savannas of Australia and geographically similar environments overseas.

Postgraduate students

TS–CRC PhD graduates are dispersing to a range of university and industry roles where their training within the Centre will stand them in good stead and add to the future study and management of tropical savanna environments. They are already making their mark as outstanding young researchers.

The enrichment programs (short courses) developed by the Centre for its research students are now of great interest across the tertiary education sector where new policies will direct that all postgraduate research students receive additional coursework that better prepares them for the workplace.

Coursework Masters (Project 5.1.1)

These courses succeeded in filling the educational gap 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. The postgraduate coursework program is now making its impact felt through graduates holding key positions in research and management agencies across northern Australia. As 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, they will continue to produce graduates well equipped for research and management agencies across the north.

The educational products developed through the TS–CRC are now being used as benchmarks for development of similar units at an undergraduate level and in the coming year will be used in technology transfer programs to universities in Indonesia’s eastern provinces where tropical savanna environments predominate.

Extension and Training (Projects 5.2.2 and 5.2.3)

The extension and training program succeeded in using research outcomes and management applications developed in other themes by developing information and technology transfer packages targeting specific user groups. The process of developing 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. Outputs include modules of a Grazing Land Management course for pastoralists, developed for MLA; a weeds’ awareness video for Aboriginal communities; sections of the major publication *Savanna Burning* and a series of information sheets for land managers now on the Queensland Department of Primary Industries’ CD–ROM Prime Notes.

This work was supported by the excellent research provided by Project 5.2.3 *Learning Processes of Pastoralist Stakeholders in the Tropical Savannas* led by Dr. Allan Arnott. The research challenged traditional models of extension practice and provided original research data on a stakeholder group that in reality manages the majority of land in the tropical savannas. The demand for the project’s report *More than can be said* went beyond the initial 200 printed, requiring a new print run.

Communication

The communication project in the Human Capability Development theme continues to set the pace in delivering relevant information to a diverse client base, and demonstrating best practice via a diverse range of communication strategies. This year saw a number of very successful publications join the exiting suite of communication activities—the website, newsletter, and clearinghouse.

The publications such as *Managing for Healthy Country in the VRD*, *More than can be said: a study of pastoralists’ learning* and *Not From Here: plant invasions on Aboriginal lands of the Top End* epitomise the Centre’s approach: transforming research into practical information for land managers and land-management agencies. It is gratifying to see that these publications are so popular they require extra print runs.

The circulation of the Centre’s newsletter, *Savanna Links*, continued to rise with a readership of around 3000 people across the savannas, many of them land managers. The award-winning website and clearinghouse (Project 5.3.2) received between 20–40,000 hits per month. Both the website and newsletter are integrated and provide TS–CRC stakeholders with better access to savanna research generally as well as highlighting the Centre’s research. The Masters and Graduate Diploma students also used the website as a resource and by the Extension, Vocational Education and Training project.

The Human Capability Development Theme has had continuing success over the previous six years and is having palpable effects on the way land is managed in northern Australia. The next challenge is to translate this success into the new environment of the Tropical Savannas Management CRC with an increased emphasis on working with communities and enterprises, regional planning and social and economic considerations.

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. The Centre's project portfolio aims to complement rather than duplicate the research of its partner agencies. Projects are selected that link between different disciplines, sectors or jurisdictions.

PROJECT 1.1.1 SAVANNA FORM AND FUNCTION AT LANDSCAPE SCALES

Project Leader: Dr Dick Williams, CSIRO Sustainable Ecosystems

Project overview and aims

This project is researching the ways in which savanna form, composition and function vary along landscape-scale gradients of moisture, soil texture and fertility, and disturbance. The focus of the project is the North Australian Tropical Transect (NATT), one of several 1000 km-scale transects through the world's savanna biome. This project will quantify the range in savanna attributes relating to ecosystem structure and diversity and the sensitivity to disturbance across broad-scale gradients in rainfall (humid to semi-arid) and soil texture (sands to clays).

Research progress

Regression models relating savanna characteristics to annual rainfall and soil texture along 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. Parameters from models based on the NATT were compared with those derived from other datasets in the Northern Territory, (e.g. the NT vegetation map; PWCNT fauna datasets). There is little difference in the parameters between datasets, indicating the NATT is representative of the savannas of north-western Australia. Preliminary regressions linking grass biomass to grass leaf area were developed for half a dozen or so key grass species along NATT.

Work in the Victoria River District using a variety of remotely sensed imagery (SPOT, MMS, Radar) has shown the potential of high-resolution imagery for predicting savanna attributes such as tree cover, grass cover, and land unit/type. Woodlands on red loam soils and grasslands on cracking clays have a distinctive combination of spectral signals. Work with videography in the VRD demonstrated the potential for this technology to measure tree cover and tree biomass quite accurately.

Future directions

Likely Future directions include use of LAI measurements in models of carbon stocks at landscape scales, and determination of tree population size 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 aimed to map the variation in the structure and floristics of vegetation across Australia's tropical savannas. Tropical savannas occur across the northern third of Australia, spanning Western Australia, the Northern Territory and large areas of Queensland. Biological inventory and regional management of ecological systems across the whole of the Australian savannas were restricted in part by a lack of compatible vegetation mapping data.



John Neldner (left) and Ian Fox in the field. The map took more than two years to produce

Since late 1998, botanists from the Queensland Herbarium have worked in collaboration with botanists from the Northern Territory and Western Australia with the aim of producing a map of the vegetation of the Australian tropical savannas. Intended outputs included a seamless 1:1 million scale digital map and a hard copy map at 1:2 million scale. This project is now complete, with a seamless hardcopy map (three sheets) at the scale of 1:2,000,000 now available from the TS-CRC.

Research progress

A number of mapping datasets were available for use in the project, but the diversity of interpretation techniques, variations in scale from one map to the next and the lack of adequate edge-matching between maps meant that a whole of region approach was problematic. In order to join the individual maps together, the project had to develop methods to modify those maps to conform to a uniformity of scale, floristic and structural description and environmental information.

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

The final phase in the production of the map was the development of a consistent set of map unit descriptors for each State and Territory before grouping those descriptors to produce the final maps. The grouping required a synthesis of the 439 State and Territory map units. Once relational tables between the various map units had been developed, GIS was used to dissolve polygons to the required scale. Draft maps were printed and circulated for comment before completion of the maps in June 2001. This project provides a broad overview of the floristic, structural and landscape diversity of the savannas, and hence permits more localised projects, management practices or problems to be seen in context.

Future directions

Although the release of the map means that the project is completed, the availability of the data will be a valuable research tool for a considerable time into the future.

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

Project overview and aims

This project assessed structural change in tropical woodlands over two widely spaced areas: the Victoria River District 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 sought to calibrate structural field measurements with quantified measurements of tree and shrub cover as determined from the photography. It then used 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 also documented a recent dieback event in north Queensland that coincides with a particularly intense drought.

Research progress

In Queensland, sample sites were examined using the 40-year aerial photo record. Tree stocks declined overall because of clearing but increased for areas that have not been cleared. An assessment of the uncleared vegetation revealed that thickening has occurred in recent decades.

Cover change data were modelled against management data generated by a landholder questionnaire, climatic data and the baseline tree stocks. The findings suggest that thickening is most likely to occur if tree stocks are relatively low and are enhanced with relatively high rainfall. Management variables (fire frequency, intensity, season of burning and distance to watering point) had virtually no effect on tree stocks in our dataset.

Field measurements from randomly generated site locations in north Queensland suggest nearly 30 per cent of tree basal area died in the early 1990s as a result of drought. The drought in this area was the worst on record based on figures for north Queensland. Rainfall data from some central and southern districts in Queensland suggest that the 1990s drought was relatively less severe. Historical records indicate substantial tree death in other areas during severe droughts earlier in the 20th century.

For the NT–WA study area, the calibration of aerial cover with field cover verified the same major findings as for the Queensland area and implicated photo-scale as an important determinant of aerial photo cover.

Thickening has occurred at virtually an identical rate and verifies the indications of Darrell Lewis's historical photo-comparisons. However, the thickening rate in the NT–WA study area also seems to be related to cycles of drought and above average rainfall.

In this area there were droughts during the 1930s and 1960s and relatively wet times since. Most of the thickening has occurred since the 1960s. The thickening evident in the aerial photo record would seem to be primarily a product of recovery from events early in the century that depleted tree stocks, possibly enhanced by a period of above average rainfall.

The project is essentially completed and comprises five manuscripts that were directly a product of this project, as well as other works that are subsidiary. The results have also been incorporated in to the integrated outputs of the North Australia Landscape Theme.

Project Leader: Dr. Lindsay Hutley, 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 the balance and exchange of carbon in 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.

Research progress

Work examining tree-water use of a range of savanna vegetation types

(Eucalypt-dominated open forests and 'low-lying' communities such as *Melaleuca* swamp forests and monsoon vine forests) continued. Earlier work, which concentrated on tree-water use of Eucalypt trees, was broadened to examine seasonal patterns of soil water dynamics. Soil water content was tracked over a wet-dry cycle at a range of depths to 3.9 m. Dry season (June to September) data were of particular interest as the spatial pattern of tree-water use could be examined—critical information to determine whether groundwater or soil water is being used by trees during the dry season. These data suggest that the bulk of the water use of dry-season trees came from deep in the soil profile, between 1 and 5 m and all water extracted by the trees was from this volume of soil. This suggests that there would be little use of groundwater from the water table, approximately 9 to 10 m below the soil surface, at this time of the year.

Tree-water use of *Melaleuca* swamp forests and monsoon vine forests was also examined. 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. TS-CRC PhD student Ms Georgina Kelley was responsible for these aspects of the work and she will be submitting her thesis for examination in August/September 2001.

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



Andrew Coultres

Andrew Kerley and Jason Beringer install radiation sensors on the savanna flux tower at Howard Springs, NT, to measure the reflectivity of the fire scar created following an experimental savanna burn

These measures were integrated with data describing the seasonal patterns of tree growth and litter-fall into a complete carbon balance for the tropical savannas.

Work also started on gas exchange, productivity and growth properties of native and invasive grasses (Gamba grass) which has the potential to become a major weed problem in the tropical savannas.

Future directions

Future directions include further collaboration with the NT Department of Lands Planning & Environment which will contribute vegetation and soil water data to a groundwater modelling effort for the Howard East catchment area. Integration of data arising from this study will help set sustainable extraction rates.

Fire is probably the greatest natural and anthropogenic environmental disturbance in Australia's vast tropical savannas and a collaborative study will continue with researchers from Monash University to examine the role of fire and burn scars in modifying surface heat and moisture fluxes to the atmosphere—two significant drivers of atmospheric processes. The impact of fire on carbon fluxes and the recovery of tree water use following fire will also be assessed.

PROJECT 2.1.1 VERTEBRATE BIOGEOGRAPHY

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



Alex Kutt

TS-CRC PhD student Alex Kutt surveying for fauna in the Desert Uplands



Alex Kutt

*The discovery of the Julia Creek dunnart, *Sminthopsis douglasi*, in outlying *Astrebla* grasslands of the Desert Uplands was a bonus that extended its known range*

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

Progress was made on a number of fronts during 2000–2001. Highlights included:

- providing substantial input to the TS-CRC's documentation of landscape health;
- completing a detailed analysis of the relationship of grazing intensity to biodiversity in the Mitchell grasslands of Queensland and the Northern Territory;
- helping to complete a major review of the trends in biodiversity across all Australian rangeland bioregions and providing a framework for biodiversity conservation in the northern grassy landscapes;
- reporting on biodiversity condition in landscapes subjected to pastoralism, military use, and no use, at Townsville Field Training Area;

- commencing surveys of mammal fauna at sites surveyed previously in Kakadu National Park and central Queensland;
- extending the BioGraze project to explore options with pastoral managers about balancing conservation and production values in the rangelands;
- completing a major report on land-use options in the Daly–Basin bioregion;
- analysing a range of conservation scenarios in the Desert Uplands bioregion, and coordinating the exchange of technological capability among PWCNT and EPA (QLD).
- contributing to the production of information on the TS–CRC’s clearing house/website, and to a range of TS–CRC publications (including the VRD Management Study, the Northern Grassy Landscapes Conference, and publications on fire);
- providing a range of presentations and lectures, to diverse groups including Savanna Guides, teachers, guest lectures at NTU courses, and pastoral stakeholder groups;
- continuing to provide supervision and/or collaboration to postgraduate students.

Future directions

The project will continue as is until the end of 2001. This period will serve to consolidate the major biogeographic analyses prepared during the life of the project, and will complete a large series of publications.

The project will also evolve into a series of more focused avenues, including projects within the new TS–CRC on (i) decline of mammal fauna, (ii) biodiversity monitoring and assessment; and (iii) off-reserve conservation initiatives and options.

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 has been exploring the use of relatively new high-resolution imagery, such as IKONOS data, that has not previously been applied in the area of grassland patterning. This has meant that all analysis using this imagery has been exploratory, new and innovative.

The down side of exploratory analysis has provided the greatest challenge to this research, in that there is never any guarantee that the results will be useful. Problems with the timing of data collection of the imagery meant that the area had dried off and burning had occurred or was in the process of taking place. The resolution of the imagery also provided a challenge in that the multispectral data is only available at 4m. Problems also had to be faced surrounding the relevance of the linear point field data that had been collected for ground truthing the imagery.

These problems largely centre round the ability to locate exact points on the ground using the GPS and then relating these to the same location on the imagery. Errors in the geo-referencing of both these data sources are major issues that are difficult to resolve.

In order to be able to classify high resolution imagery such as IKONOS data and therefore produce a two dimensional surface representative of pattern in the Yinberrie hills landscape that could be used to assess landscape health it will be necessary to make sure that the date of imagery capture and field data capture correspond as much as possible. Also to be able to identify individual species of grass from an image such as this would require coordinates of ground truth areas that are monospecific of each grass type being identified.

Project 2.2.3

Field work for the project was completed in October 2000. The work included two dry seasons and one wet season on Cape York Peninsula with studies being undertaken on populations at both Pormpuraaw on the west coast and Lakefield National Park on the east coast. A wet season and part of a dry season were also spent at Kununurra in Western Australia where both species were present together. At each site observations were made of habitat, breeding ecology and behaviour. In addition large samples were netted at both sites and comparative measurements taken of morphometrics and crop samples taken to determine diet. The results suggest that both species have a broad diet, though there may be less variation, particularly between sexes, among the rarer subspecies. The data is fully databased and mostly analysed. Comparative data was also collected on a number of other finch taxa. This has also been analysed. Eight draft manuscripts have been prepared that are currently being edited for publication. Remaining funds are to be used to prepare recovery plans for the two taxa and facilitate indigenous joint management of populations on Lakefield National Park.

Threatened species management in Australia has been built around the concept of Recovery Planning, a process that has been increasingly formalised through legislation. Enough information is now available on the two taxa to allow a recovery plan to be prepared for both species. When this is endorsed by the Commonwealth Minister for the Environment it will ensure that the requirements of the two species are considered in any major developments within their home ranges.

Crimson Finches appear to have disappeared from Aurukun and Lockhart River, both areas largely managed by their traditional owners. Discussions are under way to determine whether there is interest among these communities in reintroduction from the nearest intact populations of the birds in association with management that will promote their survival.

Project Leader: Dr Tony Start, WA 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. Knowledge of these regimes is essential for a broader understanding of the general health of riparian landscapes.

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

The construction and operation of dams created three new hydrological regimes. Knowledge of the effects of these regimes contributes directly to understanding their effect on the health of riparian landscapes. This is of strategic value to managers of the Ord system and the current process of developing a water allocation plan incorporating environmental water requirements. The WA Water and Rivers Commission is using this plan to determine environmental water requirements and a water allocation plan for the lower Ord. It will also be of savanna-wide value because it will contribute to the capacity of those developing new regulations to design systems that better provide for riparian health.

Hydrology and the mobilisation, transport and deposition of sediment control many aspects of the development, structure and stability of riparian communities. Understanding them is, therefore, fundamental. A team from Department of Geography, University of Western Australia led by Dr K H Wyrwoll is examining those issues. Under Dr Wyrwoll's supervision, one Honours thesis has contributed to the work undertaken by Dr Wyrwoll and two PhD studies that commenced in 1999. Simultaneously Dr Start is documenting the biological resources and studying the influence of other disturbers (weeds, exotic herbivores, fire etc.) on these resources.

Other activities include:

- the continued acquisition and collation of existing but widely dispersed data sets to be combined with data collected by fieldwork as the basis for an interactive, electronic Atlas of the Ord on an ARCVIEW platform (acquired during the year); and
- the 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. Duplicate specimens are being lodged in Perth and Darwin.

Future directions

This coming year is the final year of the project. Some field work remains. Plant identifications will be completed, specimens entered on a database and lodged in a regional Herbarium in Kununurra (a component of the project) with duplicates in the Darwin and Perth herbaria. An electronic atlas of the Ord's resources will be established. Long-term geomorphological and biotic monitoring transects will be established for the Water and Rivers Commission.

Riparian work proposed for the new TS-CRC will progress. This will be a joint venture with NT Department of Lands, Planning & Environment because project proposals for the new TS-CRC are complementary and there is value in integration across institutions and jurisdictions. The involvement of the University of Western Australia will continue.

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

Simon, Kathryn will choose pic, caption to come. It will be from the fire book.

Project overview and aims

This project examines the sustainable use of fire as a management tool in pastoral, indigenous, conservation and military land-use contexts. It is focused on setting up regional fire-management studies across the tropical savannas, and involving a range of fire managers and researchers.

Research progress

Substantial progress was made over the past year, particularly with the drawing to completion of fire-management projects undertaken in the western Arnhem land region, and the Sturt Plateau/Victoria River District (VRD), of the Northern Territory. Both projects involved a number of TS-CRC partners, other agencies and organisations, and regional communities. These projects are funded mostly through the Natural Heritage Trust (NHT), with the VRD component also funded through the TS-CRC as part of its VRD Management Study. Further, major regional fire-management studies, funded mostly through the NHT but with considerable TS-CRC involvement, have commenced in the Kimberley region of Western Australia, and Cape York in Queensland.

Other ongoing projects now drawing to completion include:

1. national assessment of real-time fire monitoring and associated mapping, funded through Environment Australia's State of Environment (SOE) program; and
2. associated verification and assessment of satellite-based monitoring and mapping systems, funded through the Rural Industries Research and Development Corporation. The final reports for these projects are nearing completion.

Ongoing development of a collaborative fire research and training program in eastern Indonesia, involving TS-CRC partners and a range of organisations and agencies continued, albeit gradually, over the past year. This project, with funding primarily from the Australian Centre for International Agricultural Research, is now due to be running in mid-2002.

Future directions

Goals for the year ahead include:

- assessment and write-up of field programs, particularly for Northern Territory regional projects, and undertaking a major pastoral and fire-management workshop in the VRD region in May 2002;
- further development of programs already in operation in Cape York, the Kimberley, and eastern Indonesia;
- publication of a practical guide for fire management in the tropical savannas, *Savanna burning: understanding and managing fire in northern Australia*;
- staging a joint international conference with the TS-CRC and Key Centre for Tropical Wildlife Management at NTU that focuses on fire management and habitat patchiness issues in July 2002. Proceedings from the fire component are to be published as a special edition of the *International Journal of Wildland Fire*, and possibly also as a book.
- completing the current program, and providing ongoing assistance to the development of a new set of fire-management and research projects in the reconstituted TS-CRC.

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 Robert 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; and
- establish data management and reporting processes.

In these projects historical Landsat data is used to provide a retrospective view of change occurring in tropical savannas. In an integrated monitoring system the knowledge acquired from a limited network of ground sites is extrapolated across the landscape using the spatial and temporal capabilities of remote sensing. Ground measures of landscape function and floristic species diversity provide insight into landscape processes with respect to seasonal variability and disturbance from fire and grazing. Specifically these include distance between plant patches and size of patches, abundance of perennial plants within a site, and the cover over the ground. These indices combined give an estimate of the level of function at a site relative to other sites of differing levels of condition within like landscapes. Additionally, measures of species abundance and diversity provide an understanding of how species changes relate to the different levels of landscape function.

Research progress

The key finding was the ability to detect and report changes at a range of scales from fence line to region. The research was applied in different bioregions across northern Australia and focused on extensive grassland and open woodland used for cattle production (the East Kimberley and Victoria River District in north-west Australia; the adjacent Sturt Plateau of the NT; and the Burdekin River Region of Queensland near Charters Towers). Methods were adapted to examine change to other areas of ecological significance and databases set up which can be interrogated for other purposes. These datasets form a comprehensive baseline for research.

Regional information products for reporting changes in the landscape in the East Kimberley and VRD were produced from the projects' time-series image mosaic covering some 265,000km². Time-series data were also produced for the Sturt Plateau, the Barkly Tablelands and the Burdekin River Region. Information products include summary maps and graphs for interpreting land condition and landscape change. These products were provided to land managers and land administrators to help develop management options with regard to sustainability.

Project outcomes include the following.

- Methods were documented for ground-site data collection and processing image data sequences, producing temporal trend summaries, and integrating ancillary data.
- Databases for study areas included multi-temporal calibrated imagery, ancillary data and ground-site data. The East Kimberley-VRD dataset covers an area of nine Landsat scenes from 1987-2000; it includes virtually all of the Victoria Bonaparte and Ord Victoria Plains IBRA regions. Satellite data sets were produced for the Sturt Plateau, Burdekin River region and the Barkly Tablelands.

- Information products for each area were produced from these data and include summary maps and graphs of condition and change.
- Land-cover unit mapping at 100K was produced for the Sturt Plateau to assist in landscape planning.
- Comments and recommendations were made on data issues such as data accuracy and availability for sharing between agencies.
- A visualisation CD of the project and outputs was produced for the VRD region.

Future directions

- Assist land managers on the Sturt Plateau in developing management options through delivery of land cover mapping and monitoring information products at a range of scales.
- Provide spatial information products for Heytesbury Beef–Pigeon Hole Utilisation project, the Defence Force Bradshaw Field Training Area and other properties in the tropical savannas as well as other researchers in the TS–CRC.
- Present papers at an international conference and articles in appropriate journals.
- Produce rangeland monitoring manuals for field data collection, data analysis and description of savanna landscapes.
- Revise the Land Function Analysis Manual—Assessment of Soil Condition of Tropical Grasslands.

PROJECT 3.2.1

INVERTEBRATE INDICATORS OF BIODIVERSITY AND ECOLOGICAL CHANGE

Project Leader: Dr Alan Andersen, CSIRO Sustainable Ecosystems, 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;
- describe their responses to land use;
- examine their reliability as bioindicators;
- develop protocols for their efficient use as bioindicators.

Research progress

- A VRD grazing gradient study was completed, a paper on ant responses was published, and a draft paper on spider responses was almost completed.
- Invertebrate contributions to PWCNT Tiwi Islands (ants) and Darwin region fragmentation (grasshoppers) studies were completed.



*An illustration from Alan Andersen's recent book, **The ants of northern Australia: A guide to the monsoonal fauna**. Illustrations are by Peter Jacklyn*

- An analysis of effectiveness of simplified ant sampling protocol was completed, and a paper was submitted for publication.
- Consultancies at German Creek and Callide mines were completed.

Highlights included: a simplified ant sampling protocol was shown to be reliable; a new ant genus for the Northern Territory (*Anonychomyrma*) was found; and the first Australian record of possibly a New Guinean group within the ant genus *Rhytidoponera* was found in central Arnhem Land; NTU–CRC student Ben Hoffmann’s PhD thesis on the responses of ant communities to disturbance was completed and conferred; the book *Ants of Northern Australia* was published; papers were published on grasshoppers as indicators of disturbance in the Kakadu region, and responses of beetles to fire at Kapalga.

The challenges have been managing a wide variety of activities distributed across northern Australia and managing the vast number of specimens and species generated by the project.

Future directions

During the last year of this project, the relationship between invertebrate assemblages and other measures of ecosystem health will be further investigated.

PROJECT 3.3.2

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

Project Leader: Dr Tony Grice, CSIRO Sustainable Ecosystems, Townsville

Project overview and aims

Rubber vine (*Cryptostegia grandiflora*) is an exotic woody weed that poses a significant threat to the savanna landscapes of northern Australian. 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

This experiment was designed to incorporate burning treatments at a scale that is relevant to the practical management of rubber vine. To achieve this, each of the three replicate experimental sites encompassed 2 to 3 km of creek line and the adjacent uplands.



Mike Whiting

Rubber vine burning in north Queensland. The project explores fire management strategies to control the vine

Each site is located on a separate tributary of the Burdekin River. At each site, five plots were established in 1999 and, following collection of baseline data, prescribed fires were imposed. Each of five burning regimes was imposed on one of the five plots at each site. These treatments were (1) unburned; (2) burned once on the dry season; (3) burned once in the wet season; (4) burned twice in successive dry seasons; (5) burned twice in successive wet seasons. Initial burning treatments were imposed in the 1999–2000 wet season and the 2000 dry season.

In spite of the varying character of the prescribed fires, their overall impact on rubber vine was considerable. For example, a single wet-season fire reduced the density of rubber vine from 2147 to 1165 plants per ha. These fires did not cause significant changes in the densities of most species of native trees and shrubs. Most shrub species sprouted from the base even when they had been subjected to intense fires. The fires stimulated germination of *Acacia* spp., notably *Acacia holosericea*. After burning, the herbaceous layer remained dominated by the exotic stoloniferous grass *Bothriochloa pertusa* (Indian couch) and native perennial tussock grasses, though there was an increase in the abundance of native legumes. In the dry season after burning, herbaceous biomass was lower on burned plots than on unburnt plots.

There were obvious interactions between the effects of burning and the effects of grazing. These interactions would need to be considered in developing practical management strategies for rubber vine that used fire. Importantly, the concentration of cattle on the unfenced experimentally burnt plots meant that the annual burning regimes of the design could not be followed. Although the paddocks carried sufficient fuel to support a fire, the low fuel loads meant that the fires would not have been effective against rubber vine. It is preferable to delay the second round of fires to give two years between fires. A regime consisting of fires in years one and three of a 10-year cycle would allow for two fires of adequate intensity and sufficiently close in time to be very effective against rubber vine. For rubber vine management on pastoral properties it will always be essential to link a fire-management program with a grazing management plan.

Future directions

By December 2001 the full complement of planned wet-season experimental fires will have been imposed; our current plan is to complete dry-season burning by October 2002. Their effects should be documented over the subsequent 12 months.

The results of this project raise the importance of the interactions between grazing and fire. This lies in the impact that grazing has on the landholder's capacity to impose fires of a type that will have a useful impact on populations of rubber vine. Another issue that should be considered involves the interactions between weed species. Most savanna systems are under threat from more than one weed species. Management that targets one species may open opportunities for invasion by others. This demands that attention be given to understanding and managing 'weed complexes' that may include species of a variety of growth forms and functional responses.

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 examined 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. This project is now complete.

Taking the theme of savanna as society, this project explored four interconnected social and cultural aspects of Aboriginal pastoralism. Firstly, it inquired into social organisational factors affecting decision making on stations. It sought to understand men and women's participation in pastoralism, focusing on the recruitment of young men to the industry. Thirdly, it explored the associations and uses of land that are unique to Aboriginal pastoralists. Fourthly, it located 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 was developed of Aboriginal pastoralism as it intersects with indigenous sociality and culture, state systems of governance and commodity market systems. This project was relevant for planning future strategies of Aboriginal cattle and land management.

Research progress

- The project developed alternative cattle management strategies to those used at present, to better integrate cattle management with Aboriginal social objectives.
- It extended research to Aboriginal organisations.
- It established international linkages with organisations representing and delivering services to indigenous pastoralists in rangeland regions.
- It published 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 Aboriginal Land Trust is an area of about 4500m², adjoining the Daly River and reaching west as far as the Daly River/Port Keats Aboriginal Land Trust. Some areas of land east of the Daly River are to be handed back in the near future. The land belongs to the Wagiman and the Labarganyayn language speakers.

The project has focused on assessing how landowners wish to use and manage their land and planning and implementing those objectives. Through the project, many landowners have spent long periods of time on their country over the past 12 months and carried out controlled burns, weeds surveys, revisited country and held family camps on country. Contracts for safari work, mustering cattle and a pet meat operation are also under negotiation.

The project has raised awareness and increased Aboriginal community capacity to deal with the many problems faced when managing the large tracts of unsettled land with relatively little infrastructure such as access tracks or communications.

Research progress

The past 12 months has seen strong Aboriginal involvement in many land-management activities on the Upper Daly Aboriginal lands. During July about 30 Wagiman landowners camped on Sawmill block near the Daly River and made many trips onto the Wagiman and Upper Daly Aboriginal Land Trusts. Some Wagiman people remained at the camp and CDEP workers regularly returned to the Land Trust to survey the land and check for weed infestations.

An incursion of *Parkinsonia aculeata* was recorded but early rains postponed treating the weed until this dry season. A meeting was held with Bushfires Council of the NT and the local fire warden to familiarise Wagiman people with permit procedures required for controlled burning. This year the Wagiman have carried out some early dry-season burns and have surveyed cattle and feral animal numbers and locations. Contracts for cattle mustering, developing pet meat operations and safari hunting are all in the final stages of negotiation for a two-year trial period. All contracts involve opportunities for employment of Wagiman and some minor infrastructure developments such as fencing, grading access tracks and equipping a bore. The development of eco-tourism projects was also discussed.

About 10 Wagiman people enrolled in the Certificate 1 course in Land Management to be delivered by NTU FATSIS on country. The commencement of this training has been slow due to a shortage of teaching staff but is now under way. Specific training for shooting licences for a pet meat operation is also being planned.

In September 2000 about 15 Labarganyayn people visited their land in the north-west corner of the Upper Daly Land Trust and Fish River Station. Finding important sites and travelling the country was difficult because of the long periods of absence, poor quality of tracks, erosion and thick spear grass. The Labarganyayn expressed a strong desire to live at the old Fish River buildings and establish an outstation so that people can again manage these lands. However, it is difficult to gain support for the establishment of an outstation in this region. The track to the area is only accessible late in the dry season and the only airstrips are on Fish River Station.

Future directions

The Wagiman have grappled with the enormous problems of trying to manage their large tracts of land with few resources and little knowledge of modern land management practices. They have been encouraged by the work of other Aboriginal Ranger Programs and are trying to establish employment opportunities and an economic base for sustainable land management practices.

The CFCU has identified the need for an ongoing land management facilitator to work with the Wagiman and Labarganyayn people and is investigating possible funding sources for such a position. The facilitator would build on initiatives already begun and continue to support the capacity building of Aboriginal people to manage their own lands.

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, NTDPIF, 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.

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;
- make an assessment of existing land-management capacity; and
- provide recommendations on survey requirements, data collation and storage, training and resourcing and improved collaboration between agencies.

Research progress

A final draft of the weed overview document by the principal researcher, Nick Smith, was presented to the TS-CRC in May 2000 for editing and publication.

The document had received input from the CFCU, as well as staff of the Australian Quarantine and Inspection Service North Australian Quarantine Strategy (AQIS NAQS), the NT Department of Primary Industry and Fisheries (DPIF), the Parks and Wildlife Commission of the NT (PWCNT), the Northern Territory University (NTU), CSIRO TERC, Parks Australia North and Greening Australia.

The final document *Not from here: plant invasions on Aboriginal lands of the Top End* was published by the TS-CRC in early 2001.

The report contains some 30 major recommendations relating to the requirements under upcoming legislation; the collection, storage and mapping of weed data; weed management; training; and community awareness.

Future directions

The Overview is currently being used as a resource for the development of a Vegetation Management Strategy by the CFCU and will be used as the basis for the CFCU to develop a weed-management strategy for all NLC lands.

PROJECT 4.3.2 (4) CAPE YORK COLLABORATIVE PLANNING

Project Leader: Mr David Epworth, Consultant, Cape York Development 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

This year the final report from this project, *Collaborative Research Possibilities in Cape York*, was presented to the TS-CRC.

It found that the 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 landholders, 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).

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 begun, and a campaign of establishing fires near hatching turtle nests to deter pigs was also instigated.

These land-management issues arose as a result of European influence and would benefit from an approach combining western scientific and traditional practices. Commercial development of resources is also an area of interest. However, the report argues that if western scientific researchers wish to form constructive, collaborative research relationships with indigenous people, then new, socially relevant methods of doing research must be adopted. Collaborative research must take into account different, but equally valid knowledge systems in order to be beneficial. This issue of knowledge transfer has become vitally important as traditional knowledge is in danger of being lost and the need to formally educate Wik, Wik Way and Kugu youth in such knowledge was identified as an urgent priority.

PROJECT 4.3.2 (5) NORTH KIMBERLEY TRADITIONAL OWNERS' LAND AND SEA MANAGEMENT PLANNING

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 resides 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. Poorly managed and rapidly growing tourism is one of the most urgent issues in the north Kimberley. For Wunambal people at Ngauwudu (Mitchell Plateau), the pressures are particularly acute. Land and waterscapes sacred to Wunambal people, such as Punamii-unpuu (Mitchell Falls and surrounds), are also spectacular magnets for tourists. The number of visitors annually has increased ten-fold in recent years, and at current rates will nearly double within four years.

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

- benchmarks and indicators for sustainable land and water use and management on their country (terrestrial and marine); and
- 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 Aboriginal Traditional Owners of Ngauwudu (Mitchell Plateau) produced their own Management Plan in November 2000, with the assistance of the Kimberley Land Council. The plan, *Land of Wandjina and Wunggurr—Ngauwudu (Mitchell Plateau) Management Plan*, addressed sustainable savanna management by starting with the immediate issues of visitor impacts and sacred site protection.

The guiding principles of the plan were the maintenance of traditional Wandjina-Wunggurr Law, and the protection of areas like Punamii-unpuu (Mitchell Falls and surrounds) in their natural condition. The plan was presented to a range of government and non-government agencies identified as potential partners for management. The support of these agencies was sought to form partnerships for on-ground management action, and the response was very positive.

The plan was welcomed by the WA Minister for the Environment and the WA Conservation Commission, and is regarded as the basis for ongoing management planning and implementation in the North Kimberley region. Prior to the publication of their Plan, Wunambal people felt marginalised in the management of their traditional country.

A final report on this project was also completed this year. The findings were based on the views expressed by the Balangarra and Wunambal-Gaambera Traditional Owners, and made the following recommendations:

- Traditional biological knowledge, which currently resides with senior elders of the north Kimberley, should be conserved.
- Traditional knowledge should form an integral part of the framework for contemporary land management.
- Traditional owners' role in management regimes should be expanded considerably in the short term.
- The unregulated visitor regime on Wunambal-Gaambera country needs to be managed and regulated in the very short term.
- Visitors to Balangarra country need to be monitored, and possibly regulated, both in marine and terrestrial areas.
- The use of marine resources needs to be monitored, regulated, and mechanisms for traditional owner compensation explored.
- Traditional owners' access to country needs to be improved so that it forms the basis of a monitoring regime for the north Kimberley.
- Monitoring of mineral operations needs to be undertaken regularly by traditional owners with biologists or scientists.



Glenn Wightman



Glenn Wightman

Aboriginal people regard country as healthy when patterns of food production remain predictable. William Bunjuck (left) harvests inner stems from Fan Palms, Jack and Lily Karadada (right) dig for water chestnut

Future directions

A proposal is under consideration to undertake similar ethnoecological and management planning work with all major Aboriginal groups in the Kimberley, to complete a regional program over the next seven years.

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 invasive weeds, particularly mimosa, or from feral animals. The Caring for Country Unit of the Northern Land Council 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 formal land-management program, the Wanga Djakamirr ('looking after the land') Rangers, continues to operate in the Ramingining area to the north of the Arafura Swamp. This program was initiated in 1998 partly using the TS-CRC grant. The program is currently funded through the NHT. The Rangers are receiving formal training in land management.
- On-ground work primarily to do with weeds, feral animals, fire and erosion was undertaken according to landowner' priorities and the extent of community resources.
- The Wanga Djakamirr program complements longer established community-based land-management programs in the south-east part of the Arafura Swamp and its catchment.
- Recent changes in the governance of Murwangi pastoral enterprise resulted in traditional landowners taking a more active interest in the management of the western Arafura Swamp which could result in a community-based land management program in that area.
- As yet there has been no push toward a catchment-based approach for the region. Rather the emphasis is placed on developing the land-management capacity of the different landowner groups.
- The Wanga Djakamirr Rangers continued their involvement in the NHT-funded PWCNT flora and fauna surveys.
- Wanga Djakamirr Rangers and Rangers from the south-east of the Swamp participated in the annual Top End Indigenous Rangers Conference, this year hosted by the Yugal Mangi Landcare Group, out of Ngukurr in August 2000.
- A participatory planning course was conducted for a group of 12 Top End Aboriginal land-management facilitators early in 2001. Apart from its usefulness as practical training, the course resulted in the development of a support network for the expanding network of land-management facilitators.
- Wanga Djakamirr Rangers undertook a field trip in May 2001 to meet other Aboriginal community-based land managers and to view the issues they are dealing with in situ.
- A new coordinator for the Wanga Djakamirr Ranger Program was recruited through the Ramingining Homelands Resource Centre.

Future directions

Sustainable, effective management of the Arafura Swamp and surrounds is dependent on the capacity of Aboriginal landowners and community agencies to deliver that management. 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. CFCU will continue to further a catchment-based approach to management over time.

The project fits into the CFCU-assisted development of a network of Aboriginal community-based land management programs. Through involvement in such programs and through participation in the annual Indigenous Rangers Conference and other initiatives Aboriginal people are driving the development of this loosely formalised land management structure that is rapidly expanding across the Top End.

PROJECT 4.3.4 MODELLING AND LANDSCAPE CHANGE

Project Leader: Dr John Ludwig, CSIRO Sustainable Ecosystems, Darwin

Project overview and aims

The primary aim of this project is to integrate the new knowledge gained from our TS-CRC projects with existing knowledge about savannas. Computer simulation models are the main tools for integrating these elements. After verification and validation, these models have been used to predict how different land-use practices (burning, clearing, grazing) affect the functioning and health of tropical savannas. These impacts are being modelled at range of spatial scales from local landscapes to across regions using different models designed for application at these scales.

At the local landscape scale (e.g., hillslope and paddock), the *Savanna* model (version 4b) was used to address the potential for woody thickening in savanna pastures in the Victoria River District, and to predict the best trade-off between fire and grazing so that fire can be used to manage this thickening. Also at this scale, the *Flames* model was used to explore how savanna tree populations may change with different fire regimes in the long-term.

At the enterprise or pastoral property scale, the *Arena* model was used to explore how pasture productivity and composition may change with different grazing regimes in long term. Also at the property scale, the *HerdGrasp* model was linked to the *Arena* and *Flames* models to estimate the costs and benefits of using fire as a pastoral management tool.

At the national scale, the *Aussie GRASS* model was used to predict fuel loads (forage production), grass curing states and wildfire risks across savanna regions (e.g. the Gulf (NT) and Kimberley, WA).

All these models predict how savanna landscapes may change with different fire and grazing regimes, thereby serving as useful tools to help land managers maintain and improve savanna health into the future.

Research progress

This project is integrating results from a number of different TS-CRC projects that are improving our understanding of how healthy landscapes function over a range of spatial and temporal scales:

- The *Savanna* model 4b was used to address the potential for woody thickening and spread in paddocks typically found in the VRD, and how grazing and fire can be used to control this thickening. This modelling was done in collaboration with Dr Mike Coughenour, from Colorado State University, who developed *Savanna* 4b. A paper describing this modelling study was prepared for the MODSIM 2001 Conference.

- The *Flames* model, developed by Garry Cook and Adam Liedloff, was used to explore long-term climatic trends in savanna tree populations, and how these populations are likely to respond to different fire regimes. A paper describing these trends was also written for MODSIM 2001.
- The *Arena* model, developed by Matthias Boer and Mark Stafford Smith, uses a plant functional approach to explore long-term competition in grazed landscapes in response to different management regimes and environmental factors.
- *Arena*, *Flames* and the *Grasp* pasture production model were linked to a whole property economics model to investigate the long-term ecological and economic impact of different fire regimes on a typical pastoral property located in the tropical savannas. The costs and benefits of using prescribed fires and controlling wildfires are included in this modelling study, which involves collaboration between modellers.
- *Aussie GRASS* modelling is being used to predict fuel loads (as grass production), grass curing states and wildfire risks across all the savanna regions of northern Australia. A final *Aussie GRASS* report on the NT and Kimberley region was completed.

The project is also providing savanna management options aimed to maintain production goals while conserving natural resources (vegetation, soils and biota):

- The *Savanna 4b* model was used to predict which combinations of fire and grazing are best to control woody thickening in savanna pastures. The best combinations provide options in guidelines for pastoralists and other savanna land managers who want to use fire to control woody thickening.
- The *Flames* model was used to explore the impact of different fire regimes (i.e. frequency, seasonality) on savanna tree populations. Land managers can then use those fire regimes that maintain a desired tree-grass balance.
- The *Arena* model was used to simulate long-term competition between different plant functional types (i.e. annual/perennial grasses, woody shrubs/trees) in response to different pasture management regimes and environmental factors. Those management regimes that maintain valuable pasture species can be used by pastoralists.
- The *Aussie GRASS* model was used to predict grass fuel loads, grass curing states, and fire risks across savanna regions. This information helps fire control agencies make better decisions.

Future directions

A major challenge is to modify the *Savanna 4b* model so that it better suits our future needs. This model (*Savanna-Au*) will have a number of improved or new features, including an improved graphical display interface; GIS 'look-up' capability for soils; land units and digital elevations; an improved water infiltration and redistribution component; a new nutrient dynamics component; an expanded set of plant functional types; new fauna responses to habitat suitability functions; and new economic indicators.

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 that 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 (e.g. land types, current condition, infrastructure) of individual paddocks and properties, initially for Dalrymple Shire, and then for Bowen Shire.

Information and data is being collated and evaluated from past and current research work and from producer experience. 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 relevance of general relationships to specific land types in terms of pasture production, land condition and carrying capacity. Interaction with producer groups is taking place during the development of these guidelines and decision tools, but the major impact of results will be via a grazing land management education program being developed in cooperation with several other organisations (See Extension section for more information, p. xx).

Research progress

Our early work in the project established the adequacy of the available land type mapping in Dalrymple Shire for analysis and planning of grazing management at the paddock scale. In cooperation with CSIRO Land and Water and the EPA, a land-type framework is being developed for the Bowen Shire.

GRASP, a pasture growth computer model, is being used to provide estimates of pasture production for the more than 70 land types in the upper Burdekin. The past year saw the collection of sufficient data on pasture growth and soil water characteristics to permit development of eight core models that cover the range in productivity in the region. Each land type was associated with one of these core models based on expert opinion and available data.

A framework for land condition based on four categories ('ABCD' model) was developed. For a given paddock or land type, various indicators of condition are used to decide the appropriate condition category. The condition categories provide a way of ranking various vegetation states (e.g., as described in 'State and Transition' models) in terms of potential pasture growth, with pasture growth in condition categories 'B', 'C' and 'D' discounted relative to 'A' condition.

Combining the GRASP output and the condition category framework permitted production of pasture growth tables for each land type in relation to both land condition and tree cover. These pasture growth estimates form the basis of long-term carrying on a paddock-by-paddock basis. This provides a reality check on landholders' perceptions of sustainable carrying capacity, as well as identifying production incentives to improve land condition. Future work will road-test and demonstrate the application of these tools in developing sustainable grazing management plans for landholder participants in the 'Rangelands to Reef' project.

The application of Breedcow/Dynama economic software was tested and streamlined to grazing land management. Several detailed case studies were developed to demonstrate the likely financial implications of improved land condition.

Our outputs have fed directly into the Grazing Land Management education program, the core component of which is a three-day workshop covering all aspects of sustainable grazing land management. This program is currently being piloted and evaluated, and should be available for landholders in early 2002.

Future directions

- Extrapolation to other regions.
- Broadening the emphasis to cater for all aspects of savanna health.
- Moving to more active participation of land managers in a Best Practice framework.

PROJECT 4.5.1

VICTORIA RIVER DISTRICT MANAGEMENT STUDY

Leader: Dr John Ludwig, CSIRO Sustainable Ecosystems, 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.

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.

A great deal of work has been undertaken by the TS-CRC to further our knowledge and understanding of the district's natural environment. In particular, 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; and developing and recommending local and regional fire and grazing strategies that meet the needs of both production and biodiversity conservation.

Research progress

A major outcome of the study in 2000–2001 was the publication of *Managing for Healthy Country in the VRD*. Based on workshops held in late 1999, it is a plain English summary of TS-CRC land-management research and resources relevant to the VRD, edited by Maria Kraatz. It is divided into three sections:



Researchers from QDPI, QNRM and NTDPIF working in the field in the Victoria River District

NTDPIF

- What we know: descriptions of the natural environment of the VRD, its land use and ongoing developments in the VRD and surrounding regions.
- Improving our knowledge and understanding: an overview of our ecological understanding of the landscape processes in the VRD, a description of the impacts of grazing and fire regimes, and a summary of monitoring and modelling issues.
- Managing for the future: a summary of current best practice management which needs to be adopted in the region, and a summary of the sustainable land-management issues in the VRD.

An initial print run of 200 was exhausted by demand and a second print run produced.

Another major outcome for 2002–2001 was a final report on a study of a *Regional Land Condition and Trend Assessment in Tropical Savannas*. This study was largely based on field and satellite data from the VRD, but also included study areas in WA and Qld. The final report was prepared by Bob Karfs, Rod Applegate and others for the Rangeland Monitoring Implementation Project of the National Land and Water Resources Audit.

Also, environmental historian Darrell Lewis completed a draft of an account of landscape changes in the VRD since European settlement, which describes how creeks and rivers in the VRD have changed in shape (geomorphology) and in vegetation (tall, thick reeds, once abundant, are gone).

Summaries of ongoing research in the VRD, as well as many of the research findings on grazing, fire and biodiversity, can now be found on the TS–CRC’s website section, Savanna Explorer.

PROJECT 4.5.2 DESERT UPLANDS MANAGEMENT STUDY

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



Alex Kutt

The northern velvet gecko (Oedura castelnaui) hides under heavy bark of tree such as gidgee and black gidgee during the day, coming out at night to feed on a variety of insects and spiders



Alex Kutt

One of the smallest mammals in Australia, if not the world, the inland forest bat, Vespadelus baverstocki. It weighs between 3–5 g, and is found in the south-western parts of the Desert Uplands. Consuming 1–1.5 times its body weight in insects per night, it has an essential regulatory role in the ecosystem

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 Centre’s involvement in the Desert Uplands Management Study wound down during 2000–2001, but the study still operated as part of the Desert Uplands Build-Up and Development Strategy Committee, which is run by the land managers of the region. Project outcomes have contributed to a policy framework for economic, social and environmental development of the region.

Research aims included:

- 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;
- carry out enterprise-level investigations on sustainable management in conjunction with cost-benefit analyses of options; and
- initiate ecosystem health indicators in case studies within the region.

The GIS first developed through the TS-CRC was updated further this year. PhD student Alex Kutt, based at JCU, has almost completed the first comprehensive fauna survey of the region. His project also characterised the region's biogeographic position within the Queensland landscape. These data will be used the draft Desert Uplands Conservation Strategy undertaken by the QEPA. Plans to create an atlas of vertebrate fauna for the Desert Uplands are being considered as is a simple field guide to the fauna and habitats and their management in the region.

PROJECT 4.5.3

BURDEKIN MANAGEMENT STUDY

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 initial focus of the study is to achieve and communicate a multi-disciplinary overview of landscape and catchment processes in the Burdekin grazing lands and to develop spatially explicit guidelines for sustainable resource management. This will occur in two stages:

- In the first stage—almost complete—data and information is integrated 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.
- In the second stage—to begin in early 2002 (and likely to be part of the new TS-CRC project on best practice management of grazing lands)—the outcomes of Stage 1 will provide a platform to develop integrated landscape-based guidelines. These will 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:
 1. review existing policies, regulatory and institutional arrangements;
 2. assess the state of current knowledge of the social and economic factors that are relevant to resource sustainability in the area; and
 3. identify needs and opportunities for R&D and other learning opportunities.

Research progress

An initial workshop involving local R&D users and providers provided feedback and endorsement of the study's overall directions, process and planned information products. The outcomes of the workshop were incorporated into a work plan. A communication plan was also prepared to coordinate information-sharing activities among the participants.

A one-week workshop of technical specialists in July 2000 provided the first draft of the integrated information and guidelines on sustainable land management in respect to:

- Soil, water and nutrient processes;
- Dynamics of the grass layer;
- Tree-grass balance;
- Weed ecology and management;
- Aquatic ecosystems;
- Biological diversity;
- Whole-of-catchment processes.

This draft is still in the process of being edited.

Future directions

A complete technical synthesis of available information on sustainable land management in the region will be produced. The study will also move to more active participation by land managers in a Best Practice framework.

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. 53.

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. xx.

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 report, *More than can be said: a study of north Australian pastoralists' stories of change and learning* was completed in June 2000.

Research progress

This report outlined stories of learning and change from pastoralists, which were analysed to provide characterisation of the learning process.

The report contains information that provides us with directions for the enhancement of pastoralists' learning practices. Some of these, which particularly affect the ways in which educators and others work with pastoralists, include:

- becoming or using an 'esteemed source'. in other words, either becoming known personally to a group of pastoralists, and/or using a highly regarded information source (such as the journals, newspapers, etc noted in the report) to convey a message;

- establishing contact and developing one-to-one relationships where feasible or possible;
- engaging in practice where possible and thus grounding concepts and ideas in practical exercises on pastoralists' properties;
- using groups to encourage and facilitate informal learning processes as well as to provide credible sources of information and information exchange;
- highlighting informal learning processes and practices within a range of formal education and other programs;
- assisting and supporting pastoralists to be able to access and manage information easily; and
- providing information in a relevant, timely, accessible, personalised, and succinct way.

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.67.

Education and Extension

EDUCATION

Summary

The Higher Education program focuses on both postgraduate research and postgraduate coursework programs. This dual focus has been unusual among general CRC education programs, and was adopted in light of needs' analyses undertaken during the early formulation of the TS-CRC (Benson & Arnott 1996). The TS-CRC has supported PhD, Master and Honours research with scholarships, operational funding, and/or training at Northern Territory, James Cook and Australian National Universities. It has also funded and coordinated the development of the coursework Graduate Diploma and Master of Tropical Environmental Management (GD/MTEM) offered at NTU.

The objective is to develop higher education programs that meet the needs of TS-CRC stakeholders. It does this by addressing gaps in the skills and qualifications of savanna managers (GD/MTEM and research degree program). It all provides a structure through which outcomes of TS-CRC research can be communicated to stakeholders (GD/MTEM program). In return, direct links to research projects ensure high-quality and up-to-date content of units. Extra resources have been provided 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.

A complementary and equally significant outcome of this process has been capacity building within regional educational institutions, and the fostering of links between the NTU in Darwin and JCU in Townsville. It has also fostered links between these universities and the regional agencies that host TS-CRC research postgraduate students.



Graduation May 2001: Left to right Guy Pardon (MTEM Graduate, now employed in a new position as researcher with the Key Centre for Tropical Wildlife Management), Kristen Skertchley (MTEM Graduate, employed in an ongoing position with the NT Department of Lands Planning & Environment), Penny Wurm (Higher Education Project Leader) and Martin Armstrong (MTEM Graduate, employed in an ongoing position with NT Parks & Wildlife Commission), all smiles at the May 2001 graduation ceremony

Postgraduate research program

At the beginning of 2001 the Centre provided funding for two new PhD students and three Honours projects and one Master student. Overall PhD enrolments now comprise 17 PhD, two Honours, and one Masters.

Postgraduate research students continued to perform at a very high standard. PhDs have now been conferred on five students: Myf Runcie, Carl Menges, Ben Hoffmann, Fiona Fraser and Catherine Mobbs. All of these candidates are employed in a variety of research areas at agencies and universities including CSIRO, Northern Territory University and Australian National University.



TS–CRC Honours student Natalie Rossiter in front of a stand of Gamba grass, now spreading outside pastoral areas and into upland savannas and riparian habitat. Natalie's work will help understand what this increase might mean for the savanna ecosystem

Graduate Diploma and Master of Tropical Environmental Management

The GD and Masters are fully articulated. A student may exit after completing 80 credit points with a Graduate Diploma or undertake a further 40 credit points to complete the Masters qualification, with at least 20 of those points comprising a research project. Students must take at least four of the total six core units. These core 500 level units are:

- Ecology & Management of Tropical Savannas (TS–CRC unit now offered at NTU);
- Managing Northern Landscapes (TS–CRC Unit now being trialled at NTU);
- Flora & Fauna Survey Techniques (NTU/TS–CRC unit now offered at NTU);
- Tropical Wetland Management (NTU unit);
- GIS Applications in Environmental Studies (NTU unit);
- Design & Analysis of Environmental Studies (NTU unit).

Electives may be then chosen from the NTU undergraduate program at 200 level or above, other NTU postgraduate programs or JCU's TESAG postgraduate program. The TS–CRC has also invested in two postgraduate units at JCU:

- Land & sea managers: indigenous peoples and tropical Australian environments (TS–CRC unit offered at JCU)
- Environmental policy (TS–CRC unit in development at JCU)

The original brief for the postgraduate program was to offer a course that was available in flexible delivery mode. This means that it is available to savanna managers wherever they lived in northern Australia or elsewhere. To that end, all six of the core units are now available externally. GIS Applications in Environmental Studies (a NTU-owned unit), and Managing Northern Landscapes (a TS–CRC-owned unit) will be offered externally for the first time using online learning materials in Semester 2, 2001. A number of TS–CRC researchers were involved in the development of the unit Managing northern landscapes and will participate as expert tutors during online classes. At JCU, the TS–CRC unit Land & Sea Managers: Indigenous peoples and Australian tropical environments was offered for the first time online in Semester 2, 2000. The online learning materials were augmented by an intensive residential session on Cairns campus.

A unit evaluation instrument was developed at NTU and applied to MTEM units at NTU and JCU. The unit evaluation results were pooled across units and evaluated on an annual basis by the GD/MTEM Steering Committee. Preliminary results indicated high satisfaction with the quality, relevance and currency of the units.

Lynda Wallace was appointed as a researcher at JCU to write a new unit in environmental policy. This subject area was identified by postgraduate coursework students as an area of priority for unit development. This unit will be offered at JCU in 2002.

Enrolments have continued to increase with a record number of enrolments in postgraduate coursework. Four students graduated this financial year. Thirty-six students are now enrolled in the GD/MTEM: 17 in the Graduate Diploma and 19 in the Masters. Employment destinations for graduates, where known, include: PWCNT; NTDCC, NTDPLE, NTDME, organisations in Africa, Cambodia and the US, Aboriginal community work; mining companies; University of Hong Kong, NTU, and new NHT-funded positions.

There was an increase in EFTSU load (Equivalent full-time student unit) during the past year. This calculation is used to ascertain the equivalent of full-time students among those undertaking part-time study. The load shows that the course is attracting good numbers, and that it is heading towards financial self-sufficiency (e.g. 14.5 EFTSU supports one staff member in the Faculty at NTU).

TABLE 3 EQUIVALENT FULL-TIME STUDENT UNIT (EFTSU) LOAD

Graduate Diploma and Master of Tropical Environmental Management yearly (GDTEM commenced in 1998.)

Course	1996	1997	1998	1999	2000	2001
GDTEM	-	-	6	11	3.375	7.75
MTEM	5	7.25	12.25	9.125	6.25	6.5
Total	5	7.25	18.25	20.125	9.625	14.35

Future directions

Intellectual property issues will be a challenge within the project. The intellectual property rights to the educational ‘products’ are not easily measured. This is likely to become an issue if units are to be franchised for offer at other institutions. The complexities of measuring IP arise due to the gradational nature of in-kind partner contributions and TS-CRC contributions. This issue will be dealt with on a case-by-case basis as it arises.

Integration of research outcomes and maintenance of educational products is ongoing.

Completed TS-CRC products are being promoted among TS-CRC partners and stakeholders, as well as with overseas institutions. To date discussions have begun with University of Florida and University of Botswana, with the aim of developing a Memorandum of Understanding to foster staff and postgraduate student exchanges.

With its emphasis on online delivery, this course is at the cutting edge of educational technologies and teaching practice. Ongoing evaluation and quality audit 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 ongoing application of customised evaluation instruments, the ongoing inclusion of upgrade and revision as project milestones, and proactive course advisory committees.

There is an increasing demand for external electives, to complement the increasingly external nature of the course work program—in fact the shortage of externally available electives is limiting the candidature of some students. Consequently, customising existing undergraduate or postgraduate units for external study, or the development of new external units, will be investigated.

Work will continue on streamlining and strengthening cross-institutional arrangements between JCU and NTU. This may include the development of a formal MoU.

EXTENSION, VOCATIONAL EDUCATION AND TRAINING

Summary

Project 5.2.2 aims to answer the question: 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 the broader purpose of ensuring the end-user is 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:

1. 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;
2. have landholders and users understand the management practices consistent with the research undertaken in the four themes of the TS-CRC: landscape processes, ecosystem management, north Australia landscape and human capability development;
3. have landholders and users adopt appropriate technology under the themes of fire, weeds, grazing sustainability and conserving biodiversity to meet their needs;
4. 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; and
5. design and apply appropriate monitoring and evaluation procedures to enable progress to be measured and evaluated.

Progress

Weed Management

Three learning packages and materials on weed management were developed this year. They were:

- video on weeds management in Aboriginal lands;
- weed identification deck for the Top End; and
- weed management case studies.

A video on weed management resulting from the research in Aboriginal communities was largely completed by July 2001. The video aims to raise awareness about the spread of invasive weeds on Aboriginal land in northern Australia, with a focus on mimosa. It involved collaboration between NTDLPE, NTDPIF, NLC, NTU, PAN and PWCNT. Final editing is being undertaken and the video should be ready for distribution by late 2001.

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. This project was placed on hold pending a review of the Centre's extension program.

Several case studies on weed management were written. These were published in QDPI's Prime Notes series on CD-ROM. They are also available on the TS-CRC'S website. Weed Management-case studies will also feature in the Burdekin Management Case Study's 'Green Book'.

Fire Management

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

- Fire management book;
- Case studies of practical fire management.

The book *Savanna Burning: Understanding and Using Fire in Northern Australia* will be published late in 2001, and will feature a number of fire-management case studies assembled by this project. The 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'.

Fire-management case studies will also appear in the Grazing Land Management learning packages.

Grazing Management

A major project is also under way to develop learning packages and materials in grazing land management/sustainability. Meat and Livestock Australia commissioned a learning package in Grazing Land Management (GLM) which was developed and pilot-tested.

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

The Development Consortium which wrote and tested the package included TS-CRC, QDPI, CSIRO and NTDPIF. The project gained approval from all key agencies in Queensland, Western Australia and Northern Territory.

The literature available on the TS-CRC web-based clearinghouse (around 1800 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 Quality Functions Deployment Reference Group which will enable development of the GLM as a distance education /interactive learning module.

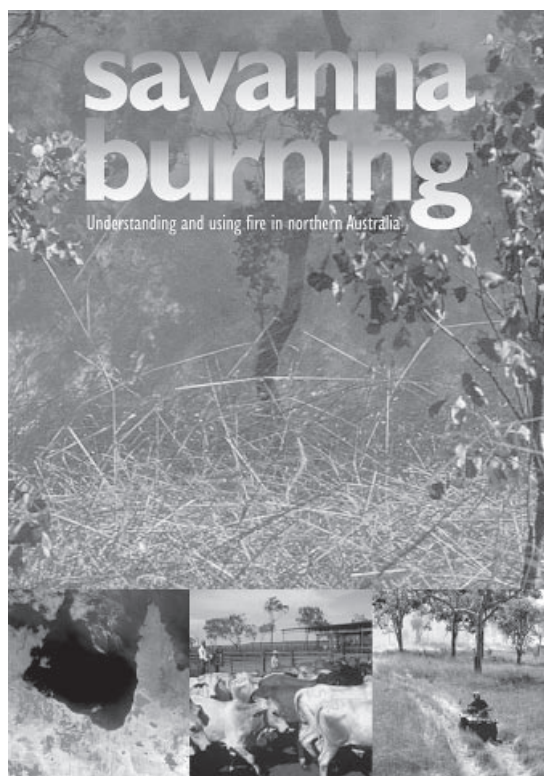
Data are being collected and analysed on weed control, feral animal control, fire management and soil erosion management from properties in the VRD to form the benchmark for future work with the VRD Conservation Association.

Biodiversity and Conservation

Learning packages and materials on biodiversity and conservation were developed. Sarah Moon, was employed by the Centre to assemble a learning module for pastoralists entitled *Biodiversity in a Pastoral Setting*. The module looks at what constitutes a 'healthy savanna' by identifying indicators of savanna health and explores some of the ways these could be monitored in a pastoral setting.

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.



Savanna Burning is a new book on understanding and using fire in northern Australia. Written by fire ecologists, scientists and land managers from across the north, it describes the effects of fire on these vast ecosystems

Future directions

The new CRC for Tropical Savannas Management will appoint a new leader for the Human Capability Development Theme, a position that will be split with a new Chair in Distance Education at NTU. Once this position is filled the Extension, Vocational Education and Training project will be reviewed.

TS–CRC WORKSHOPS, SYMPOSIUMS AND MEETINGS

2000

- TS–CRC, QDPI, CSIRO, QPWS and JCU workshop for contributors to the ‘Green Book’ for the Burdekin Management Study 24–28 July, Townsville. The Green Book brings together research undertaken on sustainable land management of the Burdekin Catchment in north Queensland.
- *North Australia Rural Fire Managers Forum*, 27–28 July, Broome. Chaired by the TS–CRC, the Forum provides a way for bushfire agencies of the tropical savannas to meet and exchange useful information and strategies on fire management, and work towards managing fires and landscapes sustainably in the north. Issues addressed included:
 - national and state awards for fire management in the landscape—used in NT—agreed to in principle in qld, will be pursued in WA;
 - satellite imagery of hot-spots now available through QNRM;
 - increased aerial burning now being carried out by FESA together with increased participation by landowners;
 - the importance of making a contribution to a legislative review of the bushfires act and fire brigades act in WA;
 - the launch of a recent fire safe dry season campaign which included fire awareness brochure from previous forum meetings; and
 - the establishment of new NHT projects in the Kimberley and Cape York.
- *Northern Grassy Landscapes Conference*, 29–31 August, Katherine NT. The conference theme was ‘Striking a balance between production and conservation in the grassy landscapes of north Australia’. More than 220 people attended including extension officers, pastoralists, park rangers, researchers—around 100 more people than initially expected. A CD of the conference proceedings was sent to all who attended. The conference was sponsored by the Federal Government’s Bushcare program, organised by the TS–CRC, and supported by Agriculture WA, Department of Conservation and Land Management WA, Greening Australia, NT Department of Lands, Planning & Environment, NT Department of Primary Industries & Fisheries, Parks & Wildlife Commission of the NT, Queensland Parks & Wildlife Service and the Heytesbury Pastoral Company
- *Fifth Year Review Stages 1 and 2, 12–13 July and 12–13 September*, Darwin NT. In Stage 1 the Centre was reviewed for the quality of its research and outputs. The Theme leaders delivered the main presentations with highlights from relevant projects. During Stage 2 the Review panel met with the Management Group, The Board, the Chair, the Consultative Committee, students, staff and the Director.
- *Intensive writing workshop*, 2–6 October, Darwin. This intensive writing workshop for scientists and students of science was convened by the TS–CRC and presented by Robert Brown of Write Way Consulting. The workshop was attended by 12 people, including PhD students, CSIRO staff and NTU staff. Attendees worked over five full days on one manuscript each for publication. This work was interspersed with sessions on common style problems, analysing published papers, answering reviewers’ criticisms and with participants preparing critiques of each other’s manuscripts.

- *Meat and Livestock Australia: Review of North Australia Program (NAP)*, 3–7 October Rockhampton. This peer review of resource management projects funded by MLA in Queensland heard presentations from each project leader. As external reviewer, the Director, TS–CRC, made recommendations on project conduct and future direction.
- *Media Skills Course*, 23–24 November 2000, CSIRO Darwin. The TS–CRC and CSIRO Sustainable Ecosystems in Darwin ran jointly this media skills course for researchers in Darwin. It was presented by Jenni Metcalfe and Toss Gascoigne from Econnect Pty Ltd, and drew participants from the PWCNT, CSIRO, Parks Australia North, CINCRM and the TS–CRC. The workshop aimed to give scientists an insight into the workings of the media and the constraints and motivations of journalists. Presentations covered various forms of media – television, radio and print, and the priorities and pitfalls associated with them. Journalists also attended and carried out interviews and provided advice on gaining maximum impact and controlling the agenda when dealing with the media.

2001

- *Participatory Planning Course*, 27 February to 1 March, Darwin. A group of 12 Top End Aboriginal land-management facilitators attended. Apart from useful practical training the course resulted in the development of a support network for the growing number of land-management facilitators.
- *Institute of Australian Tourist Guides (IATG) School*, March 10–11, Noonamah, NT. Financially supported by the TS–CRC, this was the inaugural school for the NT branch of IATG. The school brought together tour guides and operators for a weekend of intensive knowledge exchange. Various speakers and local experts gave presentations on a range of topics including: Top End rainforest diversity and conservation; identifying birds by sight and sound; spiders and snakes; fire; wildlife conservation; communication and interpretation techniques; food handling and hygiene and more. Invited speakers included Ian Morris, Greg Miles, Jenny Webber and Rory Chappell.
- *Heytesbury Planning Workshop* 3–4 April, Darwin. Coordinated and facilitated by the TS–CRC, this workshop aimed to incorporate the Centre’s research results into property management planning regime of Heytesbury cattle properties. A number of TS–CRC researchers presented results on their work.
- *North Australia Rural Fire Managers Forum*, 1–3 May, Townsville. This group incorporates the heads of the rural bushfire services from Queensland, Northern Territory and Western Australia together with scientific and communication support from the TS–CRC. Reports were made on:
 - the state of fire management in each jurisdiction;
 - how approaches had shifted since the previous forum in July 2000 including how changes in local politics had affected government support for Bushfires councils;
 - high fuel loads meant an extremely high fire danger in the coming dry season across northern Australia;
 - Members of the forum were also treated to presentations on the NHT Fire project on Cape York, fire and rubber vine research and local cooperative inter-agency fire management.
- TS–CRC field trip, ‘Virginia Park’ Station, 30 May, Charters Towers region. The field trip examined guidelines and decision tools for grazing management. Attendees included the TS–CRC Board and Savanna Advisory Committee.
- *Tropical Savannas Management CRC Planning workshops*, held in the last week of February and first week of March, in Townsville and Darwin. These workshops developed broad Theme and Project frameworks for the seven-year term of the new Tropical Savannas CRC, and detailed fixed term and focused projects.

TABLE 4 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
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	APA TS–CRC PWCNT
W. Hillman	Ecotourism in northern Australia—interpretive guided tours	JCU	R. Hynes (JCU/CRC) R. Wilkinson (JCU)	1999	TS–CRC
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 JCU
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) S. Williams (JCU) C. Johnson (JCU)	1996	TS–CRC PWCNT QEPA
C. Macgregor	Achieving sustainable urban communities in the Australian Savanna by ecological planning and community participation	JCU	R. Hynes (JCU/CRC) D. King (JCU) M. Fenton (JCU)	1996	TS–CRC
R. Firth	Ecology and conservation status of the Brush-tailed Rabbit-rat (<i>Conilurus penicillatus</i>)	NTU	R. Noske (NTU) J. Woinarski (PWCNT) P. Whitehead (NTU) T. Griffiths (NTU)	2001	TS–CRC
M. Watson	Vertebrate monitoring and re-sampling in Kakadu National Park	NTU	J. Woinarski (PWCNT)	2001	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
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 (NTU)	2000	TS–CRC ARC

* Operational funding only

TABLE 4 STUDENT RESEARCH DETAILS: PHD STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
T. Vigilante	An assessment of the effects of fire regime on plant species, plant communities and indigenous natural resources around Kalumburu, North Kimberley, WA	NTU	D. Bowman (NTU) N. Williams (NTU)	1998	TS–CRC APA
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
Y. Zhang	Spatial patterning of resources for graminivore—developing a model for habitat management	NTU	P. Whitehead (NTU) W. Ahmad (NTU)	1999	TS–CRC NTU

TABLE 4 STUDENT RESEARCH DETAILS: MASTERS STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
L. Valentine	Faunal responses to alterations in plant community structure in tropical savannas of Northern Queensland	JCU	C. Johnson (JCU) L. Schwarzkopf (JCU) T. Grice (CSIRO)	2000	TS–CRC JCU

TABLE 4 STUDENT RESEARCH DETAILS: HONOURS STUDENTS

Student	Project Title	Uni.	Supervisors	Start Date	Funding
N. Rossiter	Aspects of the physiology and fire ecology of Gamba grass	NTU	S. Setterfield (NTU) L. Hutley (NTU) M. Douglas (NTU)	2001	TS–CRC ARC NTU
S. Brown	The effect of carbon dioxide concentration on tree-grass interactions in an Australian tropical rangeland	JCU	J. Holtum (JCU) A. Ash (CSIRO)	2001	TS–CRC JCU
R. Funnell (withdrawn)	The demography of grey crowned babbler (<i>Pomatostomus temporalis</i>) in habitat fragments of the tropical savannas	NTU	R. Noske (NTU) O. Price (PWCNT)	2001	TS–CRC PWCNT

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
G. Calvert	<p>This research project is currently nearing completion. Research revealed a broad range of impacts of cattle grazing on plant communities. Conclusions include:</p> <ul style="list-style-type: none"> • A correlation between grazing and increased rate of tree dieback during droughts, especially of larger trees. Dieback will still occur to some degree independently of grazing pressure. • All levels of cattle grazing caused some deleterious effects on vegetation communities. Some sites could be easily rehabilitated through strategic manipulation of grazing intensity. • Highest diversity is reached under intermediate grazing regimes; conditions being more favourable than either total herbivore enclosure or unrestricted grazing. Macropod grazing was responsible for this level of disturbance. • Diversity and composition of a pasture is determined primarily by soil and climate, and secondly by grazing pressure and timing. • Changes to species diversity depend on the dominant grass species. • Native perennial tussock grasses are often the first to decline with increasing grazing pressure, and are generally replaced by exotic grasses and unpalatable species such as forbs and woody plants. • Many native legumes increase in abundance, while exotic pasture legumes usually decline. • Grazing reinforces domination of a site by Indian couch or Buffel grass. • Buffel grass can dominate pastures, causing a decline in pasture diversity. 	LP EM

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
A. Dee	<p>This project aims to take a holistic approach to the development of a feral pig management plan for the Arafura Swamp, north central Arnhem Land, by integrating scientific research with contemporary Aboriginal knowledge and aspirations. Feral animals and weeds are relatively new to this part of the Top End, an area with a history of uninterrupted traditional Aboriginal land management. As such they represent a new challenge to traditional land-management practice. In addition to exploring questions around feral animal control on Aboriginal lands, the project considers the disparate values of feral pigs to various stakeholders. It also seeks to understand how local Aboriginal people perceive feral pigs and their affect on bush foods and on country in general. This ethnographic perspective is essential if management plans developed as an outcome of the research are to be adopted by people on the ground.</p>	EM HCD 4.3.3
M. Fegan	<p>In this project, the automated integration of Remote Sensing and GIS is data is combined with the goal of producing output information of higher quality than obtainable from a single source. Progress included:</p> <ul style="list-style-type: none"> • The spatial correspondence between reference GIS data and spectral classes from an unsupervised image classification were estimated by GIS overlay and cross-tabulation; • Cover types were characterised by a texture measure and the similarity between a pixels immediate spatial neighbourhood and cover type texture templates is estimated; • Spatial properties of cover type (such as probability of adjacency, average area, perimeter, width) derived from reference mapping within GIS were exploited in Image Classification; • The use of Inductive Learning algorithms was commenced to attempt to select from multiple data set those most discriminating for the cover type mapping required and to infer possible classification rules. • The use of SAR imagery to attempt to map inundated areas and thus shore lines on flood plains was commenced with a view to generating effective contours for the generation of a DEM within a GIS. 	EM
F. Fraser	<p>The Partridge Pigeon <i>Geophaps smithii</i> is now extinct from vast areas of its pre-European range. It is one of many granivorous and ground-feeding savanna birds identified as having declined in northern Australia since European colonisation and Aboriginal displacement. The mechanisms of decline of these species are poorly understood, but are probably associated with widespread changes to the savanna understorey due to altered fire regimes and the impacts of pastoralism.</p> <p>The focus of the research was on patterns of habitat use which were related to variations in the savanna understorey associated with grazing by introduced herbivores and burning practices. 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.</p> <p>This PhD project was submitted in October 2000 and was approved by examiners.</p>	NAL LP EM 2.2.2
W. Hillman	<p>This research investigates the ways ecotourism is practised within the tropical savannas and outback regions of northern Australia. Its purpose is to explore the ways ecotourism practitioners perceive the environment of the area and how they sustain and interpret this fragile ecosystem during the course of their business. As such, the project explores the development of nature- and culture-based tourism through the investigator's association with ecotourism operators. An exploration of activities aimed at environmental awareness; education and training of guides is also being undertaken. The research is using qualitative research techniques such as participant observation and in-depth interviewing. Interaction with the subject group is an ongoing process, carried out over the entire timeframe of the candidature.</p>	EM HCD

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
H. Khwaja	This research has had some success in achieving its aim of developing image-processing techniques to map variation in savanna land cover. A methodology involving spectral signature extrapolation and GIS for mapping large areas of the region was developed and more than 15000 km ² area of savannas in the northern Victoria River District of the Northern Territory was mapped. Procedures for improving mapping accuracy were also identified in the study. The methodology developed in the study can be used for mapping and monitoring large areas of savanna landscape in northern Australia if the proposed recommendations are met. The research is now complete and the thesis will be examined in the second half of 2001.	NAL LP 1.1.1
J. Jackson	This research has sought to address two questions relating to the exotic pasture grass <i>Cenchrus ciliaris</i> (buffel grass). Firstly, what are the impacts of this species on the herbaceous species richness of the habitats in which it is found and, secondly, can we manipulate the abundance of this species using different fire regimes? While it is commonly stated that exotic plants impact negatively upon ecosystem components and processes there are few studies that actually quantify such impacts. The effects of buffel grass on herbaceous species richness has proved a particularly challenging issue to investigate given the difficulty of separating out plant effects from other factors, such as grazing and soil type, which may influence species richness. Data analysis is ongoing but preliminary results indicate that the presence of buffel grass has little impact on the herbaceous species richness of the habitat being investigated. The other aspect of the research, which aimed to investigate the effects of different season of burning on buffel grass abundance, was carried out in conjunction with the Queensland Parks and Wildlife Service. However the analyses to date suggest that season of burning has only minor impacts on the two communities. Further work is required to assess management of these habitats using fire.	LP EM
C. Macgregor	The emerging 'global economic playing field' has for some towns in northern Australia offered economic opportunities as never before and, as a result, they are growing rapidly. On the other hand, the global economy has worked against other towns and they are experiencing rapid decline. In short, different sustainability issues emerge depending upon circumstances. At the heart of this research lies an analytical model which was developed to assess community support for sustainability initiatives at the local level. The model was developed with local government in mind and it was used to compare and contrast a sample of towns from across the northern Australia region. The collected data were then used to validate the analytical model and ascertain community capacity to attain sustainability in each town. The model clearly has applications in other contexts and at different scales. The research is all now complete and will be submitted in September 2001.	NAL HCD
K. Pfitzner	Research and write-up to date focused on the use and analysis of hyperspectral remotely sensed images over abandoned mine sites to determine the usefulness and suitability of hyperspectral remote sensing to assess abandoned mine-site rehabilitation. Rum Jungle (NT) and Captains Flat (NSW) were chosen as study areas. As an example, results at Captains Flat showed that with appropriate corrections for atmospheric contributions and with field spectrometer readings, minerals produced as a result of acid-generating processes, such as jarosite, ferrihydrite, and shwertmannite, could be detected. Hyperspectral remote sensing techniques also allow determination of vegetation cover and health. Writing of the thesis ceased in 2001 due to full-time employment, but will resume part-time in 2002 for completion.	NAL LP

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
G. Kelley	<p>This project concentrated on the ways in which soil properties and plant physiological characteristics affect fluxes of water in the soil-plant-atmosphere continuum. Study sites were contained within the Howard River East catchment, in conjunction with other activities of Project 2.1.1. Work examining tree water use of a range of savanna vegetation types (Eucalypt dominated open forests and 'low-lying' communities such as Melaleuca swamp forests and monsoon vine forests) continued. Soil water content was tracked over a wet-dry cycle at a range of depths to 3.9 m beneath this ecosystem. Dry season (June to September) data suggest that the bulk of the dry-season trees water use came from deep in the soil profile, between 1 and 5 m and all water extracted by the trees was from this volume of soil. This suggests that there would be little use of groundwater from the water table, which is at approximately 9 to 10 m below the soil surface during this time of the year. Tree water use of Melaleuca swamp forests and monsoon vine forests were examined. 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.</p>	<p>NAL LP 1.2.1</p>
A. Kutt	<p>Field surveys were undertaken in the Desert Uplands between 1997 and 2000, and were predominantly designed to identify fauna assemblages of the regional ecosystems (the lowest level bioregional planning unit sensu Sattler and Williams 1999), to describe the patterns of the variation in distribution, diversity and abundance of these assemblages. The project also characterised the region's biogeographic position within the Queensland landscape. Given that it is a predominantly unsurveyed bioregion, it was no surprise that there were a number of unexpected finds and range extensions including Spinifex birds and Painted finches, rodents and dasyurids such as the Lakeland Downs mouse <i>Leggadina lakedownensis</i>, and numerous reptiles. Less expected was the discovery of two new species, both reptiles: <i>Ctenotus terrarossa</i> sp. nov. (the etymology identifying the deep red sandy habitat in which it was found and is seemingly restricted to), currently being described in conjunction with the Queensland Museum; and <i>Lerista</i> sp. nov., still awaiting a formal classification. Cat gut analysis and grazing/fire study are now complete, and in process of being written up.</p>	<p>NAL LP 2.1.1</p>
B. Sharp	<p>Anecdotal historical evidence (historical photos of vegetation change in the Victoria River District) suggests that significant and, in some places, dramatic changes may be occurring in savanna landscapes in the VRD. However, the nature and extent of these changes have not been assessed systematically, and the causes of observed changes are unknown. This research project systematically examines patterns of woody vegetation change across a range of savanna environments in the Victoria River region with explicit consideration of the site-specific management (i.e. burning and grazing) history of the area, such that the causes of observed changes can be determined. The study is located on Bradshaw Field Training Area, near Timber Creek, NT. Historical (1948) and recent (1993–97) aerial photographs were digitally processed and analysed to assess woody vegetation change over the past 50 years. A variety of vegetation surveys were conducted on the ground to verify the results of the air-photo mapping and to identify the mechanisms responsible for observed changes. These indicate that there are clearly different change mechanisms operating on three distinct savanna habitats within the study area: alluvial floodplains, lowland habitats and sandstone plateau. The thesis and attendant papers are in the process of being written, the former for submission by the end of 2001.</p>	<p>LP EM VRD-MS</p>

STUDENT RESEARCH HIGHLIGHTS

PHD STUDENTS

Student	Research Highlights	Theme/Project
T.Vigilante	This research project aims to examine aspects of traditional and contemporary landscape burning regimes in the north Kimberley region. It is based around Kalumburu and includes areas under claim by Balangarra and Wunumbal-Gaambera native titleholders. Fieldwork was completed over the past 12 months and considerable progress made on data analysis. The project benefited greatly from the contributions of a number of Traditional Owners from Kalumburu and Mitchell Plateau whose involvement was facilitated by an AIATSIS grant. In recent years, there has been ongoing conflict between players in the Kimberley with relation to land access and use. Mining companies, state government departments and other private companies as well as Aboriginal people have been involved. As a result this research is becoming increasingly topical in the context of land management, including fire, and the role Traditional Owners will play in the future as Native Title comes into effect. Trips made with Traditional owners were rewarding experiences both personally and in terms of providing insights into traditional fire management practices and rationale.	LP 4.3.2 (5)
R. Firth	This project examines the ecology and conservation status of the Brush-tailed Rabbit-rat, the only extant member of its genus. Its sole congener <i>Conilurus albipes</i> became extinct at the end of the 19th century before any but the most superficial of studies could be carried out on its ecology. There are three recognised subspecies of the Brush-tailed Rabbit-rat; <i>C. p. randi</i> (New Guinea), <i>C. p. melibius</i> (Bathurst and Melville Islands) and <i>C. p. penicillatus</i> (Top End and Kimberley). Its decline from its core mainland range to promontories and islands suggests a successional pattern of extinction. Consequently some long-term ecological information on this species is vital so that management plans and strategies can be devised and implemented to prevent further decline and possible extinction. This project aims to provide information concerning habitat preference/ use, shelter requirements, movements, population dynamics, life history parameters, diet and the possible causes of decline. Due to its relative accessibility and large population of Rabbit-rats, the study is mainly being conducted at Gurig National Park (Cobourg Peninsula).	NAL LP 1.2.1
C. Xiaoyong	The aim of this research was to produce a carbon balance for tropical savannas describing plant biomass, carbon accumulation and distribution, seasonal patterns of root growth and soil respiration and carbon stocks in soil. By combining such measures, a carbon balance can be constructed for the eucalypt open forest savannas of northern Australia. This knowledge will be useful in ascertaining the national and global carbon balance and in measuring global climate change. The thesis was submitted for examination in mid-2001.	NAL LP 1.2.1
Y. Zhang	This project is developing a model to manage fire in the habitat of granivorous birds. Using satellite imagery, it is seeking to establish patterns of burning at Yinberrie Hills, NT, open woodland communities dominated by <i>Eucaplyptus tintinnans</i> and <i>Eucaplyptus tectifca</i> . These vegetation communities are likely to be burnt, and are also among those considered particularly important habitat to granivorous birds. To examine changes in vegetation patterns over the fire season, binary grid fire maps were generated in a GIS and these were used to compute spatial pattern indices: number of patches, mean patch size, mean shape index, and mean patch fractal dimension. These provided a preliminary analysis of the landscape change during the fire season. Fluctuations in these indices suggested significant changes in vegetation patterning of those landscapes affected by dry-season burning. This mapping will be further used in habitat analysis and modelling for granivorous birds of these savanna zones.	NAL EM LP 2.2.2

STUDENT RESEARCH HIGHLIGHTS

MSC STUDENTS

Student	Research Highlights	Theme/Project
L.Valentine	The research is using study plots set up under Project 3.3.2, which is investigating the effectiveness of fire in controlling rubber vine. This project provides an excellent foundation from which to examine the impact these two factors (fire and exotic species) on the structuring of native animal populations in savanna communities. Infestations of rubber vine appear to be highest within riparian systems of savannas. If fire is to be used as a management tool in such environments, we need to determine how animals respond to modifications in the plant structure of communities. This study will provide quantitative data on changed biodiversity in riparian habitats through fire control of rubber vine. Data obtained will be used to define effective control measures for rubber vine, and, through collaboration with CSIRO Sustainable Ecosystems, will directly enhance management strategies for tropical savannas.	EM LP 3.3.2

HONOURS STUDENTS

Student	Research Highlights	Theme/Project
N. Rossiter	At present there is little information on what effect the replacement of native grasses by exotic species such as Gamba grass may have on ecosystem processes such as the fire regime and water and carbon cycles. This project will examine three related aspects of Gamba grass ecology: (1) plant physiological characteristics, particularly assimilation rates; (2) above-ground biomass production (fuel load), and (3) characteristics of fire regimes. Results for Gamba grass will be compared with the native grasses <i>Sorghum intrans</i> and <i>Heteropogon contortus</i> . The results of this study will contribute to a greater understanding of the consequences of altering the composition of the savanna grass understorey.	EM
S. Brown	This research aims to quantify the growth responses of <i>Eucalyptus crebra</i> and <i>Acacia holosericea</i> in grass-dominated savanna rangeland exposed to varying concentrations of CO ₂ , under high and low nutrient regimes. The effects of elevated CO ₂ are expected to be greater for C3 (generally tree) species than for C4 (generally grass) species, owing to the near saturation of C4, as opposed to C3 photosynthesis, at ambient CO ₂ levels. For C4 species, CO ₂ benefits are expected to be driven more by increased water use efficiency due to reduced stomatal conductance and transpiration rates (Ghannoum et al., 2000). The plots in this research will be exposed to CO ₂ levels that mimic predicted atmospheric concentrations in 30 and in 50 years time. The observations will provide the basis for subsequent analyses of tree-grass interactions at the ecosystem-level, which may have broader implications for the sustainable management of tropical savannas.	LP EM

Communication and Public Outreach

The year 2000–2001 saw the Centre’s communication strategy achieved the goals established in 1997–1998: improved information provision to stakeholders; a more cohesive and distinctive identity for the centre; and improved information and training skills for Centre staff. The progress made towards each of these goals is outlined below.

During the year a number of major publications were produced aimed at stakeholders, which subsequently proved very popular. It also saw the reputations of the web-based clearinghouse *Savanna Information* and the newsletter *Savanna Links* enhanced and spread.

A major conference on northern grassy landscapes was held that brought researchers and stakeholders together from across the savannas to discuss issues of mutual interest.

The project provided considerable information resources to the Education and Extension programs of the Centre from web-based GIS maps for MTEM students to information sheets for pastoral land managers. Workshops on technical writing and media skills were provided for Centre students and researchers.

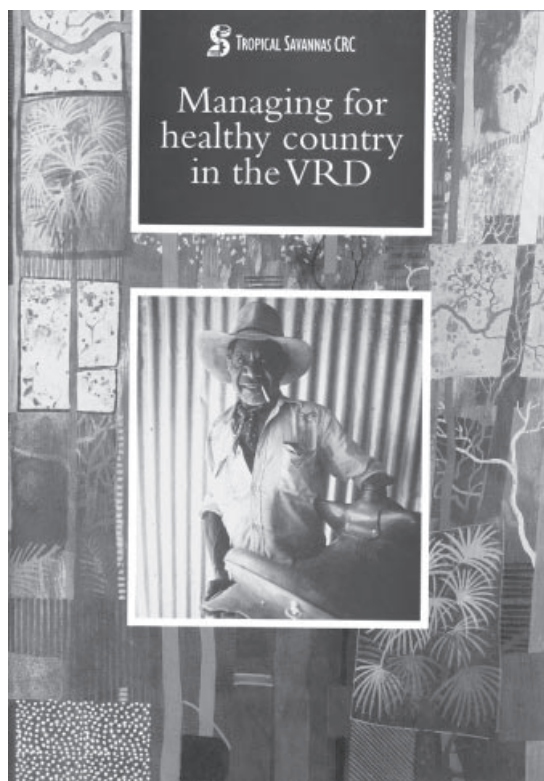
The Centre’s website continued to thrive and many other sites are now linking to it. The project also helped facilitate research, funded by Optus Networks, to develop web-based communication tools for stakeholders in remote areas.

GOAL ONE: IMPROVING INFORMATION PROVISION TO STAKEHOLDERS

Publications that integrate research for stakeholders

Eight new publications were released that used the work of TS–CRC themes or projects to bring together research findings on tropical savanna management for non-scientific audiences. As shown below, most of these publications were well received. If anything, demand was underestimated. In some cases new print runs were produced. Most publications were given a price, albeit a low one, and a substantial fraction were given away to land managers, students, agency staff and researchers associated with the TS–CRC.

1. *Managing for healthy country in the VRD*, 2000. Plain English summary of TS–CRC land-management research and resources relevant to the VRD, Edited by Maria Kraatz. Initial print run of 200 saw 60 sold and 140 distributed for free, many to land managers. Second print run of 200 produced.



Managing for healthy country in the VRD covers a large variety of land-management research relevant to the region

2. *Defining and measuring the health of savanna landscapes*, 2000. Technical report that summarises the approach taken by the TS–CRC to assessing and monitoring landscape health in the tropical savannas. All 300 printed hard copies were distributed. Will rely on online version until print revised edition.
3. *Land administration and management in the tropical savannas: A better way*, 2001. Proceedings of workshop held in February 2000 on this sensitive but important issue.
4. *Not from here: plant invasions on Aboriginal lands of the Top End*, 2001. Substantial 246–page report produced by TS–CRC Project 4.3.2(3), Nicholas Smith author. Details weed management issues for each catchment on Aboriginal Lands in the Top End of the NT. 200 printed, 105 distributed through Caring for Country Unit NLC to Aboriginal communities. 28 sold.
5. *More than can be said*, 2001. Report on TS–CRC pastoralist learning Project 5.2.3 which investigates the ways in which pastoralists acquire and use new information in managing land. Initial print run of 200 either sold or distributed by authors to land managers and interested parties. Further print run of 250 produced.
6. *CD of Northern Grassy Landscapes Conference Proceedings*, 2001. Proceedings of the August 2000 Northern Grassy Landscapes Conference. Contains all papers delivered in Microsoft Word format as well as selected Power Point presentation and a movie. 342 produced, approx 260 distributed to conference attendees and MTEM students.
7. *Hard copy of Grassy Landscapes Conference Proceedings*, 2001. Spiral-bound version of conference proceedings. 100 recently printed to meet demand from those uncomfortable with CD–ROMs. 11 distributed.
8. *Prime Notes CD information sheets*. 2001. The information resources of the communication program were used in various activities of the Centre’s extension activities, the major initiative being the production of 37 information sheets, mainly aimed at pastoralists, on fire and weed management in the savannas, as well as general land-management information. These were circulated on the QDPI’s Prime Notes CD. They are also available on the TS–CRC website.

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 2000–01. (See Education and Extension section, pp. xx for list of TS–CRC Workshops, Symposia and Meetings.)

- *Northern Grassy Landscapes Conference*. This major conference on northern grasslands, an ecosystem of interest to both conservation and pastoralism, was held in Katherine, NT, in August 2000. It received support from Environment Australia’s Bushcare. More than 240 land managers, researchers and agency staff attended.
- The Centre continued to host the *North Australia Rural Fire Managers Forum*, with meetings in Broome and Townsville. This forum brings together the three rural fire services of north Australia from Qld, the NT and WA, together with selected researchers and allows them to share information and coordinate strategies. It is now highly valued by these agencies.



Kate O'Donnell

One of the field trips at the Northern Grassy Landscapes conference. Here, a ranger at Edith Falls National Park explains the area’s fire-management issues to a group of conference attendees

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.

Three initial sections are now completed:

- *Savanna Explorer*. This area provides summaries of land-management topics for eight broad regions of the savannas with almost 200 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 thousands of papers, reports and articles on research in weeds, fire and grazing.
- *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.

Between 20,000 and 40,000 web-page downloads a month—mostly from Australian domains, mostly accessed during working hours. The *Savanna Explorer* section of the site is the most popular, followed by the *Savanna Search*, research, Savanna Links, and Savanna Map Maker sections.

The site was selected as a preferred link for information on savannas by two US-based educational organisations. It is also one of the main links for tropical savannas in the online *Encyclopaedia Britannica*. Savannah Guides, a major tourist organisation in the tropical savannas uses *Savanna Information* as the major source of information on its website.

To make the now large website easier to manage, it will be re-designed around an Oracle database during 2001–2002. In future, more emphasis will be placed on providing web-based communication tools for stakeholders. As an example of this, sections of the new website may be made available to stakeholders to use. In another major development, the Centre and partner NTU was secured a major contract from Optus Networks to develop web-tools that will allow users in low-bandwidth and remote areas to easily develop their own websites using rich information—such as GIS maps and images.

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, conservation and landcare groups and tour operators. It is now in its 18th issue. Circulation remains steady at around 3000, with primary readership across northern Australia, with a small but significant number in southern states and in research institutions overseas. Overseas readership includes agricultural and environmental agencies, universities, schools, farms and mining companies in the United States, England, South Africa, Papua New Guinea, Argentina, Venezuela, France, Zimbabwe, Indonesia, New Zealand, Iran, Thailand, Kenya, India, and Holland.

This year *Savanna Links* included issues of Tropical Topics, an interpretive newsletter for the tourism industry, published by the Qld Environmental Protection Agency and written and edited by Stella Martin. Two special editions on the dry tropics were produced for the TS–CRC: one on termites in northern Australia and the other on wetlands in the dry season.

Conservation research communication

A communication officer, specialising in conservation research, was employed from July 2000 to July 2001. This person wrote articles and summaries of the Centre's research relevant to conservation land management using the 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

In 2000–2001, the profile of the Centre was enhanced by the large number of stakeholder-targeted publications produced. Workshops that integrated research and encouraged cohesion among staff were also 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. 58 for TS–CRC Workshops, Symposia and Meetings.)
- The *Northern Grassy Landscapes Conference*, as well as providing links and information for stakeholders, was important in bringing a wide range of Centre staff together.

Media

This year saw the continued emphasis by Centre staff on organising specific workshops and meetings among key stakeholder groups to raise awareness of the Centre’s research and information resources. The focus was on *Savanna Links* and local or regional media outlets such as newsletters, regional radio, and information sheets to let key stakeholder groups know of the Centre’s research and information resources. Media outlets were also used and coverage increased in all areas—radio, newspapers and television—this year. The conservation communication officer played an important role here. The increased coverage also reflected the higher profile gained by Centre researchers over the past few years.

Other TS–CRC promotion

The Centre put on a number of displays in 2000–2001, see list below. This year, however, promotion of the Centre became more targeted, focusing on face-to-face presentations to key stakeholder groups and distribution of publications that are aimed at research users. As shown in the public outreach section below, various Centre staff continued to promote the Centre at a face-to-face level. Displays to more general audiences received a lower priority this year as this is seen to be less effective promotion.

GOAL THREE:

MEETING INFORMATION AND SKILLS NEEDS OF CENTRE STAFF

Links with Education and Extension programs

The savanna Map Maker for the VRD is now used by MTEM students. As already mentioned in this section, the information resources of the communication program were used in various activities of the Centre’s extension activities.

Topical Savannas

Fifteen issues of the staff email newsletter Topical Savannas were circulated during 2000–01 to more than 200 staff and associates of the Centre across northern Australia. More than 50 issues have now been distributed. This newsletter is linked to web-based information resources, and the highlights from each issue are now seen on the home-page of the Centre’s website. All newsletters are accessible from the Centre’s internal website.

Internal website

The internal website 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

A major week-long technical writing course was conducted for Centre students and staff in late 2000, run by Robert Brown. The course produced results soon after when one of the students, Zhang Yue, received an award at an international conference for presenting one of the best papers.

In November 2000, a media skills workshop conducted by Jenni Metcalfe and Toss Gascoigne, Ecconect Communication Pty Ltd, was jointly run with CSIRO SE in Darwin for Centre staff and other researchers. For more details of this workshop and the writing workshop see p.xx.

As part of the Fifth Year Review held in late 2000, selected staff were tutored in presentation skills.

PUBLIC OUTREACH

Andersen, A.N. 2000, 'Fire and invertebrates', presented to the Fire and Biodiversity workshop, Darwin, Sept.

Cook, G. 2000, 'Climate and landscapes of the Top End', presented to the NT Tour Guides Association, Darwin, March

Fraser, F., 2000, 'Habitat selection for a patchy understorey by a declining savanna bird: some implications for fire management', Seminar presented to the ESA, Melbourne, Nov.

Fraser, F., 2001, 'Habitat use by the partridge pigeon, a declining tropical granivore', Seminar presented to CSIRO, Darwin, 8 June.

Fraser, F., 2001, 'Nesting season habitat preferences of the partridge pigeon', numerous presentations to Kakadu staff, rangers and Traditional Owners, Jan.– June.

Fraser, F., 2001, Summary of results of PhD project: 'The ecology of the partridge pigeon and habitat impacts due to fire and grazing', presented to Kakadu Board of Management, Gunlom, NT, June.

Garnett, S. 2000, Talks on conservation of crimson and star finches, particularly in relation to fire and cattle management, given to Pormpuraaw Traditional Owners, Pormpuraaw, Dec.

Garnett, S. 2000, Talks on conservation of crimson and star finches, particularly in relation to fire and cattle management, given to leaseholders, western Cape York Peninsula, Pormpuraaw Deed-of-grant-in-trust Land, Dec.

Garnett, S. 2001, Talks on conservation of crimson and star finches, particularly in relation to fire and cattle management, given to leaseholders Princess Charlotte Bay, Princess Charlotte Bay, April.

Hall, W. 2001, Public address on Aussie GRASS, presented to the bi-annual Wesfarmers Landmark northern region branch/franchise managers workshop, Rockhampton, Qld, June.

Hutley, L.B., Eamus D. 2001, 'TS-CRC and Water Resource Research: Water and carbon exchange of savannas', Seminar presented to the Department of Lands, Planning & Environment, 27 May.

Kelley G., Hutley L.B. & Eamus D. 2001, 'Soil and tree water dynamics of wet-dry tropical savannas', Seminar to the Department of Lands, Planning and Environment, 27 May.

Mullin, D.J. 2001, 'Enhanced resource assessment of the Sturt Plateau region, land cover units derived from satellite imagery', NTDLPE Lunchtime Talk Seminar Series, Darwin, 18 June.

Neldner, J. 2000, Presentation to the Vegetation Mapping Workshop, Queensland Herbarium, Brisbane, June.

Neldner, J. 2000, Communicating Information, seminar presented to the Far North Queensland GIS Users Group, Cairns, Aug.

Peel, L.J. 2001, 'A comparison of grazing gradient results and how they are appropriate to pastoralists and monitoring in the Barkly Tableland and Alice Springs Districts', presented to the NT Cattleman's Association AGM, Alice Springs, 12 April.

- Peel, L.J. 2000, 'Implementation of a rangeland monitoring system: range monitoring from a paddock to the regional scale', Range Monitoring and Data Collection Workshop, AGWEST Workshop, Kununurra, 22–26 May.
- McCallum, B. 2000, 'Sustainable grazing management in the Upper Burdekin', presented at the Burdekin Regional Strategy Group, Charters Towers, Aug.
- McCallum, B. 2001, 'Sustainable grazing management in the Burdekin Region', presented at 'Swans Lagoon' Research Station Open Day, 14 June.
- Quirk, M. 2000, 'Future issues in sustainable use of grazing lands', presented at Producer workshop (BeefPlan), Charters Towers, 26 Oct.
- Quirk, M. 2000, 'Other research activities related to sustainable management of grazing lands', presented to the MLA review of research in northern Queensland, 'Virginia Park' Station, 9 Nov.
- Quirk, M. 2001, 'Overview of Grazing Management', presented at the Workshop on R&D issues in the Gulf Region, Charters Towers, 5 March.
- Quirk, M. 2000, 'Sustainable grazing management in the Upper Burdekin'; presented at the Burdekin Regional Strategy Group, Charters Towers, Aug.
- Quirk, M. 2000, 'Future issues in sustainable use of grazing lands', presented at producer workshop (BeefPlan), Charters Towers, 26 Oct.
- Quirk, M. 2000, 'Other research activities related to sustainable management of grazing lands'; presented to the MLA review of research in northern Queensland, 'Virginia Park' Station, 9 Nov.
- Quirk, M. 2001, 'Overview of Grazing Management', presented at the Workshop on R&D issues in the Gulf Region, Charters Towers, 5 March.
- Quirk, M. 2001, 'Guidelines and decision tools for grazing management', presented on TS-CRC field trip, 'Virginia Park' Station, 30 May.
- Quirk, M. 2001, 'Sustainable grazing management in the Burdekin Region'; presented at 'Swans Lagoon' Research Station Open Day, 14 June.
- Richardson, K. M. 2001, 'Satellite-based rangeland monitoring of savannas in north eastern Queensland: The Dalrymple Shire', NTDLPE Lunchtime Talk Seminar Series, Darwin, 18 June.
- Richardson, K. M. 2001, 'NLWRA Implementation Project (Burdekin River Region, Range Monitoring and Data Collection Workshop', AGWEST Workshop, Kununurra, 22–26 May.
- Russell-Smith, J. 2000, 'Caring for fire, and fire management across northern Australia', seminar presented to TERC–CSIRO, Darwin, Aug.
- Start, A. 2000, Weeds on the lower Ord, given to SEEKS (Save East Kimberley's Endangered Species), Kununurra, Sept.
- Start, A. 2000, Lower Ord Research update, given to SEEKS (Save East Kimberley's Endangered Species), Kununurra, Oct.
- Start, A. 2001, The effect of dams on the Ord River's riparian systems, given to a joint meeting of WA Naturalists Club/Wildflower Society/Kimberley Society, Kingston Rest, WA, May.
- Start, A. 2000, Lower Ord Research update and bellyache bush on the Ord, given to the East Kimberley Land Conservation District Committee, 'Carlton Hill' Station, Aug.
- Start, A. 2001, Fire management in the Kimberley, presented to the El Questro Fire Forum, 'El Questro' Station, Kimberley, May.
- Storrs, M.J., 2000, Towards strategic weed management for the Aboriginal lands of Australia's Top End, presented to the Asia-Pacific Wetland Managers Training Program, NTU Centre for Tropical Wetland Management, Darwin, 20 March.
- Storrs, M.J. 2000, 'The land needs its people: assisting contemporary Aboriginal wetland management', presented to Master of Tropical Environmental Management students, NTU, Darwin, 21 July.

Storrs, M.J. 2000, 'Towards strategic weed management for the Aboriginal lands of Australia's Top End', presented to the Asia-Pacific Wetland Managers Training Program, NTU Centre for Tropical Wetland Management, Darwin, 20 March.

Storrs, M.J. 2000, 'The land needs its people: assisting contemporary Aboriginal land management', ATSIC Yilli Rreung Regional Council Meeting, Mandorah, NT, 26 July.

Storrs, M.J. 2000, 'The land needs its people: assisting contemporary Aboriginal land management', ATSIC Katherine Regional Council Meeting, Borroloola, NT, 15 Aug.

Storrs, M.J. 2000, 'The land needs its people: the developing Top End Aboriginal community-based land management structure', NLC Darwin Daly Regional Council Meeting, Batchelor, 28 Sept.

Storrs, M.J. 2001, 'The land needs its people: the developing Top End Aboriginal community-based land management structure', Coomalie Landcare Group, Tortilla Flats, NT, 10 March.

Taylor Hunt, D. 2000, 'Participatory Planning in Australian Aboriginal Land Management, Lessons from the Upper Daly Land Management Project', presented to the Northern Land Council, 12 Oct.

Taylor Hunt, D. 2000, Participatory Planning in Australian Aboriginal Land Management, Lessons from the Upper Daly Land Management Project, presented to CSIRO, 13 Oct. 2000.

Williams, R.J. 2001, 'Vegetation of the Top End', presented to the Australian Tourist Guides Association, Darwin, March.

Williams, R.J. 2001, 'Revegetation issues at Nabarlek Uranium Mine', presented to the Nabarlek Workshop, Darwin, Apr.

Williams, R.J. 2001, 'Fire in the Top End', presented to the NT Fire & Rescue Service, Darwin, May.

DISPLAYS

2000

- Northern Grassy Landscapes Conference, 30–31 Aug., Katherine NT: Brochures and publications on show.
- Tropical Savannas CRC Stage 2, Fifth Year Review, 12–13 Sept., Darwin, NT: Display on TS–CRC communication efforts including publications, CD–ROMs; newsletters, brochures and website.
- NT Minerals Industry Environmental Workshop, 27–29 Sept., MGM Grand Hotel, Darwin: Publications and brochures on display together with a presentation on research of TS–CRC.



Visitors to the CRC's display at the Douglas Daly Research Farm Open Day check out the Centre's website

2001

- Institute of Australian Tourist Guides School, 10–11 Mar., Noonamah, NT: Brochures and publication were on show, and a presentation was given outlining all the useful information products available through the CRC for tour guides in the Top End.

- Science week, 1–4 May, Wulagi Primary school, Darwin, NT: TS–CRC organised a display on spiders of the savannas.
- NTU Indigenous Open Day, 31 May: TS–CRC displayed brochures, newsletters in information sheets. Attended by prospective indigenous students and employees of government agencies concerned Aboriginal affairs.
- World Environment Day, 2 June, ‘Windows on the Wetlands’, Arnhem Highway NT: Display for children about invertebrates and savannas.
- A presentation and display of the Centre’s work with NTU on web-technology was organized for Optus C&W on 14 June.
- CRCA Conference, 15–17 May, Perth: TS–CRC displayed its website, posters, CD–ROMs, newsletters and information sheets. Attended by CRC staff and researchers from across Australia.
- Douglas Daly Research Farm Open Day, 5 May: The focus of the TS–CRC display was Biodiversity in Pasture: input and output of nutrients.

NEWSLETTERS, BROCHURES AND INFORMATION SHEETS, CD–ROMS

Savanna Links

- Issue 15, July–Sept. 2000 (16 pp.)
- Issue 16, Oct.–Dec. 2000 (12 pp.)
- Issue 17, Jan.–Mar. 2001 (16 pp.)
- Issue 18, Apr.–June 2001 (16 pp.)

CD–ROMs

- Northern Grassy Landscapes Conference Proceedings, September 2000.

Brochures and Information sheets

Education

- Graduate Diploma and Master of Tropical Environmental Management

General

- Australia’s tropical savannas
- Living with fire in the tropical savannas
- Weeds in the tropical savannas
- New era for Aboriginal pastoralism
- Introduced grasses: poor master but useful servant?
- Savanna landscapes: defining health
- Landscape change in the savannas

Fire in the savannas

Arnhem Land

- Indigenous fire practice in western Arnhem Land: Lessons for today
- Traditional and non-traditional viewpoints: Arnhem Land fire stories

Kimberley fire case studies

- Aerial burning in the north-east Kimberley
- Burning black soil grasses to protect productive country

Queensland fire case studies

- Fire as a management tool in the semi-arid tropics

Northern Territory fire case studies

- Fire management at Ban Ban Springs
- Fire management on Elsey Station
- Fire management on Mataranka Station
- Sacrificial burns protect critical country
- Fire helps protect grazing country
- The 'how-to' of firebreaks and aerial burns

Weeds in the Savannas

- Mimosa in the NT
- Native grass species for revegetation
- How to attack mimosa on a grand scale

Weeds in the Burdekin Rangelands: General Issues

- An Overview
- Impacts
- Invasion processes
- Lifecycles
- Disturbance
- Principles of weed management

Weeds in the Burdekin Rangelands: Management

- Prickly acacia, mesquite and chinee apple
- Castor oil plant and bellyache bush
- Hymenachne
- Lantana
- Parkinsonia
- Giant rat's tail grass
- Parthenium
- Rubber vine

Managing rubber vine

- An experience-based approach to managing rubber vine
- Developing a rubber vine management plan
- Managing rubber vine in the Burdekin Rangelands

Biograzing

- Biograzing: managing watering points and wildlife

MEDIA

July 2000

Print

Ants as bio-indicators, *The Courier Mail*, featuring Alan Andersen, 7 July,

Ants as bio-indicators, *The Weekend Australian*, featuring Alan Andersen, 15 July.

Ants as bio-indicators, *Far Eastern Economic Review*, featuring Alan Andersen, 15 July.

Northern Grassy Landscapes Conference, *Pastoral Memo*, Vol 21, No 2, July 2000, p. 13

Kimberley Fire Management Project, *Pastoral Memo*, Vol 21, No 2, featuring Carol Palmer, July 2000, p. 33

'Striking a balance in the grasslands—production and conservation', *Savanna Links*, Issue 15, July–Sept., featuring Northern Grassy Landscapes Conference, pp. 1, 6–7.

'Thumbs-up for Centre in its fifth year', *Savanna Links*, Issue 15, July–Sept. featuring TS–CRC Fifth Year Review, p. 2.

'Managing for healthy country in the VRD,' *Savanna Links*, Issue 15, July–Sept. featuring new TS–CRC book, p.4.

'Training package on way for northern beef producers', *Savanna Links*, Issue 15, July–Sept., featuring TS–CRC's Grazing Land Management Training Package, p. 5.

'The last frontier: someone's backyard', *Savanna Links*, Issue 15, July–Sept, featuring TS–CRC research in the Kimberley, pp. 8–10.

'Rank grass and sugarcane provide succour to north's endangered finches', *Savanna Links*, Issue 15, Jul–Sept, featuring Stephen Garnett, p.11.

Spider research, *Ecos*, July–Sept. 2000, featuring Dr Tracey Churchill, pp 7–10.

Radio

Ants as bio-indicators at Mount Isa, ABC News Darwin featuring Alan Andersen, 6 July.

Ants as bio-indicators at Mount Isa, ABC National News featuring Alan Andersen, 6 July.

Ants as bio-indicators at Mount Isa, ABC News Alice Springs featuring Alan Andersen, 6 July.

Ants as bio-indicators at Mount Isa, ABC WA Statewide, featuring Alan Andersen, 6 July.

Ants as bio-indicators at Mount Isa, ABC News Sydney, featuring Alan Andersen, 10 July.

Ants as bio-indicators at Mount Isa, ABC News Newcastle, featuring Ben Hoffmann, 12 July.

Vegetation thickening in northern Australia, ABC Radio Mount Isa, featuring Peter Jacklyn, July 25.

Success of CRC Fifth Year Review, ABC Radio 8DDD, Darwin, featuring John Childs, July 31.

August 2000

Print

Species decline, *The Web Newsletter*, featuring Dr John Woinarski, 3 Aug.

Monitoring with Ants, *Greenweek Newsletter*, featuring Dr Alan Andersen, 15–27 Aug.

Wildlife fragments, *The Age*, featuring Owen Price, 18 Aug.

Wildlife fragments, *NT News*, featuring Dr Owen Price, Aug. 19

Northern Grassy Landscapes Conference, *Katherine Times*, 23 Aug.

Species Decline, *The Age*, featuring Dr John Woinarski, 31 Aug.

Green pastoralism, *The Age*, featuring Craig James, 31 Aug.

Northern grassy landscapes conference, *The Age*, featuring Dr John Woinarski, 31 Aug.

Northern Grassy Landscapes Conference, *Northern Muster*, August, Issue 68, p.19.

Northern Grassy Landscapes Conference, *Katherine Rural Review*, Aug.

Northern Grassy Landscapes Conference, *Greening Australia Newsletter*.

Radio

Northern Grassy Landscapes Conference, ABC News Townsville, featuring John Childs, 28 Aug.

Northern Grassy Landscapes Conference and ecotourism, 8DDD ABC Radio News, Darwin, featuring Mike Keighley, 28 Aug.

Wildlife fragments, ABC Radio 8DDD, Darwin, featuring Owen Price, 28 Aug.

Northern Grassy Landscapes Conference, ABC News Broome, featuring Peter Jacklyn, 28 Aug.

Northern Grassy Landscapes Conference, 8DDD ABC Radio Darwin, featuring Sharman Stone, 29 Aug.

Northern Grassy Landscapes Conference, ABC Country Hour, Darwin, 30 Aug.

Northern Grassy Landscapes Conference, Highlights from NT Country Hour, Other Regional Radio, 30–31 Aug.

Television

Wildlife fragments, ABC TV News, featuring Owen Price, 30 Aug.

Wildlife fragments, ABC TV, Stateline featuring Owen Price, 30 Aug.

September

Print

Grazing Land Management training package, *Katherine Rural Review*, Issue 104, Sept.

Species Decline, *The Age*, featuring Dr John Woinarski, 30 Sept.

Northern Grassy Landscapes Conference, *Caring for Catchments Newsletter*, No 7 Spring/Build-up, featuring Jim Forwood, p. 2.

Fire and mammal decline, *The Age*, featuring Dr John Woinarski, 27 Sept.

Mammal decline, *The Age*, featuring Dr John Woinarski, 30 Sept.

Flyer on TS–CRC book on the Victoria River District, *Greening Australia*, NT Newsletter, Dec.

‘New publications from the TS–CRC’, *Savanna Links*, Issue 16, Oct–Dec. p. 3.

‘Biodiversity impact a hot fire research issue’, *Savanna Links*, Issue 16, Oct–Dec., featuring potential CRC fire research projects, p. 3

‘Studies of learning and change in northern Australia’s pastoral industry’, *Savanna Links*, Issue 16, Oct–Dec., featuring TS–CRC research on pastoralists and learning, p. 4–5.

‘Feral challenge for Arnhem community’, *Savanna Links*, Issue 16, Oct–Dec., featuring research from TS–CRC student Anthea Dee, p. 9.

‘Ants key to new monitoring technique’, *Savanna Links*, Issue 16, Oct–Dec., featuring research of Dr Alan Andersen, p. 10.

Radio

CSIRO Files, (distributed science CD), Radio Daly Basin, featuring Dr Owen Price, 20 Sept.

Threatened species, ABC Radio National—The World Today, featuring Dr John Woinarski, 29 Sept.

October

Print

Mammal decline, *NT News*, featuring Dr John Woinarski, 7 Oct.

Mammal decline, *The Australian*, featuring Dr John Woinarski, 14 Oct.

Mouse spiders, *Katherine Times*, featuring Dr Tracey Churchill, 31 Oct.

Desert Uplands SLARA project, *Northern Muster*, Issue 69 Oct., p. 8

Kimberley NHT Fire Project, *Statements*, Issue 11, Oct., p. 7

Radio

Mammal decline, ABC News, featuring Dr John Woinarski, 2 Oct.

Mammal decline, ABC Drivetime, featuring Dr John Woinarski, 3 Oct.

November

Print

Northern Grassy Landscapes Conference, *Rangelands Management newsletter*, featuring John Childs, Nov.

Northern Grassy Landscapes Conference, *Greening Australia*, NT Newsletter, featuring John Childs, Nov.

Crimson and Star finches, *Litchfield Times*, featuring research of Dr Stephen Garnett and Mr Mick Todd, Nov.

December

Radio

Managing for healthy country in the VRD, ABC Radio, Country Hour, featuring Robert Karfs, 5 Dec.

January 2001

Print

Canetoads, *NT News*, featuring Dr John Woinarski, 18 Jan.

Canetoads, *The Australian*, featuring Dr John Woinarski, 18 Jan.

Canetoads, *NT News*, featuring Dr John Woinarski, 19 Jan.

Canetoads, *NT News*, featuring Dr John Woinarski, 22 Jan.

Success of new Tropical Savannas Management CRC, *NT News*, 22 Jan.

Canetoads, *Litchfield Times*, featuring Dr John Woinarski, 23 Jan.

Canetoads, *New Scientist*, featuring Dr John Woinarski, 23 Jan.

Radio

Success of new Tropical Savannas Management CRC, ABC Radio 8DDD News, featuring Mr John Childs, 17 Jan.

Success of new Tropical Savannas Management CRC, ABC Radio NT Country Hour, featuring Mr John Childs, 18 Jan.

Success of new Tropical Savannas Management CRC, ABC Radio Mount Isa, featuring Mr John Childs, 18 Jan.

Canetoads, 3AK—Drivetime radio, featuring Dr John Woinarski, 19 Jan.

Canetoads, ABC news, featuring Dr John Woinarski, 19 Jan.

Canetoads, BBC radio, featuring Dr John Woinarski, 23 Jan.

Success of new Tropical Savannas Management CRC, Radio 4QY, featuring Mr John Childs, 29 Jan.

Television

Canetoads, ABC news, featuring Dr John Woinarski, 17 Jan.

Canetoads, Channel 7 News, featuring Dr John Woinarski, 19 Jan.

February

Print

How wildlife copes with the Wet Season, *NT News*, featuring Dr Alaric Fisher, 24 Feb.

Habitat fragmentation for wildlife, *ECNT Newsletter*, February Issue, featuring Dr Owen Price.

‘Vegetation Recovery: Kidman Springs enclosure photos over 25 years’, *Range Management Newsletter*, vol. 00/2, featuring Gary Bastin, John Ludwig, Robert Eager, Adam Liedloff, Reg Andison, and Michael Cobiac. pp. 1–5.

Radio

Ants as bioindicators, ABC Longreach, featuring Dr Alan Andersen, 9 Feb.

Environment and wildlife of the NT, ABC 8DDD—Afternoon show, featuring Dr Alaric Fisher, 12 Feb.

How wildlife copes with the Wet Season, ABC 8DDD—Afternoon show, featuring Dr Alaric Fisher, 19 Feb.

Ants of northern Australia, ABC Radio news, Darwin, featuring Dr Alan Andersen, 23 Feb.

Ants of northern Australia, ABC Radio Hobart, featuring Dr Alan Andersen, 23 Feb.

Ants of northern Australia, ABC Radio Darwin, featuring Dr Alan Andersen, 26 Feb.

March

Print

CSIRO Sci-Files, Biograzed Project, featuring Dr Alaric Fisher, 9 Mar.

Canetoads, *Land Rights News*, featuring Dr John Woinarski, 16 Mar.

Habitat fragmentation for wildlife, *Nature Territory* (NT Field Naturalists Club). March Issue, featuring Dr Owen Price.

Habitat fragmentation for wildlife, *Litchfield Times*, featuring Dr Owen Price, Mar.

Habitat fragmentation for wildlife, *NT Horticulturalist Newsletter*, March Issue, featuring Dr Owen Price.

Habitat fragmentation for wildlife, *Caring for Catchments*, March Issue, featuring Dr Owen Price.

Nectar Maps, *Nature Territory* (NT Field Naturalists Club), March Issue, featuring Dr John Woinarski.

‘New Tropical Savannas CRC to go ahead’, *Savanna Links*, Issue 17, Jan–March, p. 2.

‘Savannas website a hit with US educators’, *Savanna Links*, Issue 17, Jan–March, p. 3.

‘The Ord, A river in transition’, *Savanna Links*, Issue 17, Jan–March, featuring TS–CRC research about the impact of changing hydrological regimes, p. 8–9.

‘Rising CO₂: what’s in store for the savannas’, *Savanna Links*, Issue 17, featuring TS–CRC Honours project, Jan–March, p. 10.

‘Illegal harvest blights traditional didjeridu trade,’ *Savanna Links*, Issue 17, Jan–March, featuring TS–CRC Honours project, p. 11

Radio

Ecology of the partridge pigeon, CSIRO Sci-Files, Radio, 7 Mar.

Success of new Tropical Savannas Management CRC, ABC 630 AM, Townsville, featuring Mr John Childs, 20 Mar.

Canetoads, ABC news radio, featuring Dr John Woinarski, 20 Mar.

April

Radio

Crazy ants, ABC Radio Queensland, featuring Dr Alan Andersen, 30 Apr.

Pastoralists’ Learning, ABC Radio News 8DDD, featuring Dr Alan Arnott, 27 Apr.

Pastoralists’ Learning, ABC National News Radio, featuring Dr Alan Arnott, 27 Apr.

Pastoralists’ Learning, ABC Radio News 8DDD, featuring Dr Alan Arnott, 28 Apr.

May

Print

Dr John Woinarski wins Eureka Prize for biodiversity research, *NT News*, 16 May.

Radio

Dr John Woinarski wins Eureka Prize for biodiversity research, ABC 8DDD—Afternoon show, 16 May.

Dr John Woinarski wins Eureka Prize for biodiversity research, ABC News, 15 May.

Pastoralists' Learning, ABC NT Country Hour, featuring Dr Alan Arnott, May.

Television

Dr John Woinarski wins Eureka Prize for biodiversity research, ABC Stateline, 18 May.

Dr John Woinarski wins Eureka Prize for biodiversity research, ABC Quantum TV Special, 15 May.

June

Print

Dr John Woinarski wins Eureka Prize for biodiversity research, *Palmerston Sun*, 6 June.

Dr John Woinarski wins Eureka Prize for biodiversity research, *Litchfield Times*, 6 June.

Safe stocking rate benefit, *Queensland Country Life*, featuring Brigid McCallum and Dr Mick Quirk, 21 June.

Radio

Biodiversity conservation issues, ABC 8DDD—Afternoon show, Darwin, featuring Dr John Woinarski, 4 June.

Biodiversity conservation issues, ABC 8DDD—Afternoon show, Darwin, featuring Dr John Woinarski, 5 June.

Biodiversity conservation issues, ABC 8DDD—Afternoon show, Darwin, featuring Dr John Woinarski, 6 June.

Decline of crimson and star finches in Qld, ABC 630 AM, Townsville, featuring Dr Stephen Garnett, 6 June.

Biodiversity conservation issues, ABC 8DDD—Afternoon show, Darwin, featuring Dr John Woinarski, 7 June.

Ecology of the partridge pigeon and the role of fire, ABC Drive Program 8DDD, featuring TS–CRC PhD Fiona Fraser, 7 June.

Biodiversity conservation issues, ABC 8DDD—Afternoon show, Darwin, featuring Dr John Woinarski, 8 June.

Water and carbon exchange in the savannas, ABC 8DDD Drive, Darwin, featuring TS–CRC PhD student George Kelley, 18 June.

Fire management in the Kimberley, ABC Radio National, Bush Telegraph, featuring TS–CRC PhD student Tom Vigilante, 21 June.

Fire ants, ABC Radio Darwin, featuring Dr Alan Andersen, 22 June.

Grazing management guidelines and decision tools, ABC Radio, Townsville, featuring Dr Mick Quirk, 29 June.

Radio 4T0, Townsville, ran 10 short science stories from the TS–CRC as part of an initiative from nine science/conservation organisations in the Townsville region to promote science in the north.

Television

Burning Strategies, ABC TV Landline, featuring Drs Paul Novelty, Alan Andersen and Tony Start, 9 June.

Utilisation and Application of Research

The sixth year of Centre operation saw the trend from the last two years continue: research findings were adopted by more groups of land managers and other research users and its outputs were increasingly used to raise public awareness of savanna research. This process was accelerated by the release of a number of publications that presented the Centre's research findings to land managers, agency staff and other research users.

These 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 improve 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 to ensure that research is user-driven.
- Making sure research is as accessible and easy to use for targeted groups.



PWCNT researcher Dr Alaric Fisher handles a northern quoll. Conservation agencies across northern Australia are partners within the TS-CRC, which improves their access to both research and land managers outside conservation reserves

CONSULTATION WITH, AND INVOLVEMENT OF RESEARCH USERS

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 sustainable 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. The VRD Management Study in the NT continued to involve user groups such as Heytesbury Pastoral Co. and the VRD Conservation Association in meetings in 2000–2001. This year saw those groups continue to adopt and test the Centre's research.

In Queensland, the Burdekin Management Study involved user groups (land-management agencies and selected land managers) in the development of its 'Green Book' that will bring together information resources for sustainable grazing in the region.

The Centre's involvement in the Desert Uplands Management Study wound down during 2000–2001, but the study still operated as part of the Desert Uplands Build-Up and Development Strategy Committee, which is run by the land managers of the region.

Northern Grassy Landscapes Conference

The Centre's Northern Grassy Landscapes Conference, held with the support of Environment Australia (Bushcare) in Katherine in August 2000, brought many research users and researchers together. In the course of the conference, these users were involved in workshops on the future of land-management research.

Project involvement

As seen in the cooperative links section, the other research projects also involved users in their research.

- Project 2.4.1 *Fire and savanna landscapes* has established 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.
- 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 involved 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.

The *Savanna Information Clearinghouse* project was set up in response to a survey of stakeholders and continually consults with user groups. The various publications aimed at research users produced by the Centre in 2000–01 all involved consultation with those users.

The *Extension, Vocational Education and Training* project continually consulted 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

General Public, All Stakeholders

Information on tropical savannas

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.

The website has three components: the *Savanna Explorer* section 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. This is now the most popular part of the Centre's website. The website as a whole over the past year received 20,000–40,000 page downloads a month. The Centre is now involved in a project for Optus C&W which aims to provide web-tools for research users in remote areas that will allow them to build web-sites that are quicker and more effective in accessing research information.

The TS-CRC Newsletter *Savanna Links* summarises the latest land-management research in plain language for a broad audience across the savannas.

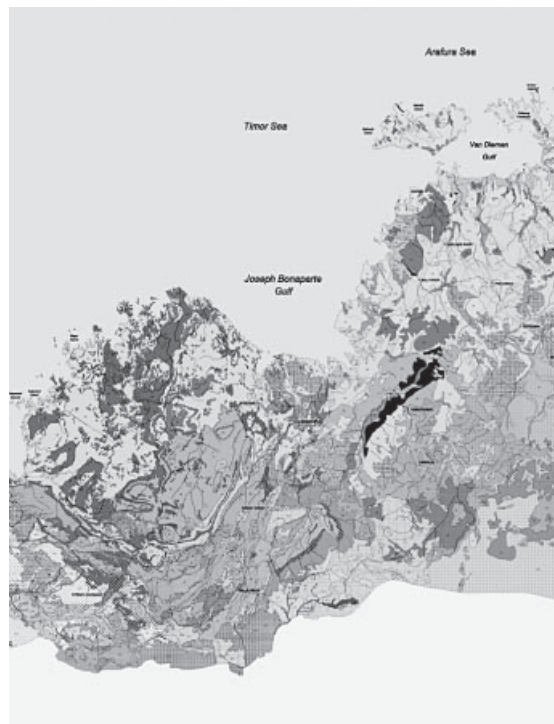
Planners

Savanna health

The publication *Defining and measuring the health of savanna landscapes: a north Australian perspective*, produced by the North Australia Landscapes Theme, was released this year and was aimed at land-management agency staff and planners among others. It offers a framework for sustainable land management in the tropical savannas and an approach to the range of different perceptions and values of savanna users. The first print run of 300 was not sufficient to meet demand, and a second print run was planned. A plain English version for land managers and the broader community is due out in late 2001, and will be distributed with the Centre's newsletter.

Vegetation map

The development of the first seamless vegetation map of northern Australia at a scale of 1:2,000,000 provided a broad overview of the floristic, structural and landscape diversity of the savannas, and permitted localised projects, management practices or planning problems to be seen in context by planners and researchers. A draft digital version of the map at the scale of 1:1,000,000 was used in 2000 by CALM Fire (Perth) for fire planning in the Kimberley region. The National Vegetation Information System (NVIS) used the digital map data in April–May 2001 to fill information gaps in the northern Australian vegetation database. The map provides a context for two TS-CRC Projects 2.1.1 Vertebrate biogeography and 2.2.2–3 Grassland patterning and habitat suitability for granivorous birds and *Decline of crimson and star finches in Queensland*.



A TS-CRC project has developed the first seamless vegetation map at a scale of 1:1,000,000. The map provides a broad overview of the diversity of savanna landscapes, and will enable more localised research and management practices to be seen in context

Projects with the NLWRA

The Centre successfully tendered for the Audit Rangeland Implementation Project (formerly Project 3.1.2) with the National Land and Water Resources Audit. This project will allow planners access to a better picture of rangeland health. The project is conducted over four biogeographical regions in northern Australia. Information products at a range of scales were developed to meet the needs of land managers in the respective regions. An innovative multimedia visualisation describing the objectives of the project was produced which aimed at informing decision-makers and the public of this research.

The Centre also produced a report for the Audit: *Developing an Analytical Framework for Monitoring Biodiversity in Australia's Rangelands*. This will allow various land-management agencies to better plan strategies for monitoring the status of biodiversity in the rangelands.

Land Administration Forum publication

Land Administration and Land Management in the Tropical Savannas: A better way, the proceedings of a workshop held in early 2000, was released in early 2001. It deals with the important and sensitive issues of land tenure, regional planning and administration and was ordered by, and distributed to, numerous representatives of the land-planning agencies of the Northern Territory, Queensland and Western Australia.

Pastoral land condition assessment

Output from Project 3.1.1 *Indicators of landscape health* was provided to both WA and NT Pastoral Land Boards, with results regularly incorporated in the NT Pastoral Land Board Annual report on the condition of pastoral leases. The formation of the Terrestrial Monitoring Section in the Resource Management Branch of NTDLPE is evidence that the project influenced decision-makers within government. Involvement with a pastoral company using information from the project to plan future development is further evidence of the application of results.

Water managers

The Western Australian Water and Rivers Commission continued work on ecological water requirements and a water allocation plan for the lower Ord. Drs Start and Wyrwoll from Project 2.3.1 *Integrated overview of the Ord River's riparian zone*, continued to advise the WA Water and Rivers Commission through membership of a scientific advisory panel. The Ord Land and Water project (a community driven project for management of the Ord) called for advice from the project on a range of issues.

Data from Project 1.2.1, *Carbon and carbon exchange of savannas* is to be integrated into groundwater modelling efforts of NTDLPE's Natural Resource Management section. Data describing seasonal patterns of tree water use, evapotranspiration, soil water dynamics and deep drainage are parameters that will assist in the calibration of soil and groundwater models. Such models are to be developed for the Howard East and Gunn Point areas near Darwin where the project's data collection has been focused since 1994. It is hoped that such modelling will assist in setting sustainable extraction rates of the region's groundwater.

Students

The Centre's Higher Education and Extension projects used 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 2.2.2-3 *Declining granivorous birds* and Project 2.4.1 *Fire and savanna landscapes*.

As described in the Education section, the number of students enrolled in the Centre-supported MTEM and GDTEM courses increased over the last few years. These students are often drawn from and feed back into research and user organisations.

Vegetation map

The vegetation map of the tropical savannas produced by Project 1.1.2 is now being used by students. A field trip in July 2001 for the JCU savannas' course 'Structure and Dynamics of Tropical Savannas', led by A/Prof. Betsy Jackes and Tony Roberts, used the map and draft report. The JCU subject 'Evolution of the Australian Flora and Fauna', coordinated by Mr Gary Werren, will use parts of the map and draft report.

Pastoral Land Managers

Application of the Centre's research by the pastoral industry were partly 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 2000–01, the VRD Management Study produced the report *Managing healthy country in the VRD*, which was aimed at pastoral land managers and agency staff. The book brought together research into fire and 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 report went to a second print run of 300 and was distributed to many land managers and agency staff.

The Management studies' various workshops and other meetings resulted in the Centre's research on land monitoring and fire management being adopted by Heyetsbury Pastoral Co.'s stations in the regions.

Burdekin Management Study

This year saw the 'Green Book' mostly completed. This publication 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. An initial workshop with partner agencies 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

The GIS first developed through the TS–CRC was updated further this year. PhD student Alex Kutt, based at JCU, has almost completed the first comprehensive fauna survey of the region. These data will be used the draft Desert Uplands Conservation Strategy undertaken by the EPA. Plans to create an atlas of vertebrate fauna for the Desert Uplands are being considered as is a simple field guide to the fauna, their habitats and management in the region.

Pastoralists' learning

In 2000–01, the booklet *More than can be said: a study of pastoralists' learning* was released, based on research by Project 5.2.3. This publication was aimed at pastoral land-management agencies and extension services to allow them to better influence and work with pastoralists,

and help them achieve sustainable land management. A small print run of 200 was planned, but this was soon exhausted. A second print run was subsequently produced.

Using biodiversity research to plan sustainable grazing

A major highlight of the progress in Project 2.1.1 *Vertebrate biogeography*, over the last year was the willingness of stakeholders to consider the approaches and results of its work. Many pastoral stakeholder groups are now seeking out project staff for advice on biodiversity, and are working cooperatively with the Centre to research and manage biodiversity and enterprise options. Work by researchers associated with this project provided important information and tools for land-use decision-making, in the Daly Basin, Desert Uplands and Tiwi-Cobourg bioregions.

Fire Managers

Fire-management projects

The NHT-funded fire management studies set up by Project 2.4.1 *Fire and savanna landscapes* are focused on developing fire-management techniques that can be used by land managers, and this has started to occur in each of these studies.

Fire-management publications

One of the main ways fire managers in north Australia will be able to use fire-management research is through the publication of *Savanna Burning: understanding and using fire in northern Australia*. This major publication describes the effects of fire on these vast ecosystems, and was largely completed in 2000–01. It will be published by the TS–CRC with additional funding support from BFCNT, the MLA and Environment Australia (Bushcare). The contents include:

- The savanna landscapes;
- Fire regimes;
- The ecological effects of fire;
- The traditional use of fire;
- Detection and monitoring of fires;
- Wildfires and their control;
- The use of fire in land management;
- Future trends.

A readable and well-illustrated book, it will provide the latest information on fire to managers of pastoral, Aboriginal and conservation lands, to ecologists and to the general public. It is due for release in late 2001.

Fire-monitoring technology

R&D for satellite-based fire monitoring and associated information-dissemination systems clearly have longer-term community benefit. Already, such information is widely used by land managers and agencies across northern Australia. Given the demonstrated utility of the fire maps produced by these techniques and associated data for northern Australian land managers, Project 4.4.1 plans to: (a) develop more reliable, automated systems for the processing of raw satellite imagery; and (b) develop more user-friendly, readily accessed, web-based products for disseminating this information. From discussions with colleagues working in savanna environments elsewhere, such approaches have considerable international practical and commercial applications. As well, such mapping systems will clearly have considerable benefits in the estimation of greenhouse emissions, biomass burning, and carbon storage.

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 on the next page.

Weeds book

The publication, *Not from here: Plant invasions in Aboriginal lands of the Top End*, produced by Project 4.3.2 (3) was released this year. It provided 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. The first print run of 200 copies has now almost been exhausted.

The results of this project will be used as the basis for the development of a weed strategy for Aboriginal lands of the Top End and as background information for the more detailed research for which the report calls.

Kimberley land and sea management

The report produced by project 4.3.2 (2) *Kimberley land and sea management*, is seen as an invaluable resource by the Balangarra and Wunambal-Gaambera 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 information relating to land and sea management priorities of the Balangarra and Wunambal-Gaambera people. 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.

Through the project, the Aboriginal Traditional Owners of Ngauwudu (Mitchell Plateau) also produced their own land-management plan in November 2000, with the assistance of the Kimberley Land Council. The Plan, *Land of Wandjina and Wunggurr-Ngauwudu (Mitchell Plateau) Management Plan*, addressed sustainable savanna management by starting with the immediate issues of visitor impacts and protection of sacred sites.

Cape York collaborative planning

After the research conducted by Project 4.3.2(4) was completed, feedback from the Wik and Kugu communities on the central west coast of Cape York indicated that the exercise had been one of their most fruitful and satisfactory interactions with western scientists. Consequently, an ethno-ecology project that will help the Wik and Kugu people conserve their knowledge of plants and animals, and improve their capacity to use the resources of western science, will begin soon under the Tropical Savannas Management CRC. This represents a major practical development in an area where collaboration has been problematic in the past.

Tourist Industry

Information on the tropical savannas

The Savannah Guides are one of the major tour-guide organisations in the tropical savannas. Their website has extensive links to the TS-CRC site which it uses as an information resource. The Savanna Guides and other tourist groups also make extensive use of the Centre's newsletter, *Savanna Links*—particularly the recent lift-out supplements on tropical savannas' natural history. These supplements were dry tropics editions of the EPA-produced *Tropical Topics*, an interpretive newsletter for tour operators in north Queensland.



Kathryn Thorburn

The first school of the NT branch of the Institute of Australian Tourist Guides held in March 2001. Partially funded by the TS-CRC, the school drew around 50 people. Presentations included rainforest biodiversity, accreditation in the NT, talks on spiders and snakes, identifying birds by their calls and developing effective communication and interpretation skills

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 2000–2001, but on a broader basis. This year seminars were given on a range of savanna ecological and cultural issues. The Centre also supported a guide's school held at Noonamah, south of Darwin, in which tour guides from across the Top End heard talks on natural history, accreditation, cultural and other issues.

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 *Invertebrate indicators of biodiversity and ecological change*, are continuing to work 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 2.2.2–3 researchers on granivorous birds in Queensland (EPA) and the NT (PWCNT) collaborate.
- 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

During 2000–01, the TS–CRC took an innovative step in promoting the uptake of conservation research across northern Australia by employing an experienced writer and journalist to help communicate the Centre's conservation research to various audiences. This person was based at the CSIRO Sustainable Ecosystems in Darwin and distributed accounts of the conservation research findings of the Centre—mostly from Project 2.1.1 *Vertebrate biogeography*, based at PWCNT—to various outlets such as newspapers and community newsletters. They also attended and produced displays on the Centre's conservation research at schools and pastoral industry open days.

Mining Industry

The Centre has helped the mining industry gain better access to the research expertise of different agencies.

Measuring landscape condition and managing fire

Dr Williams, Project 1.1.1 *Savanna form and function*, collaborated with Ms Annie Lane NTDPIE, on the potential of native grasses in mine site rehabilitation. Wet season burning techniques, encouraged by Project 2.4.1 *Fire and savanna landscapes*, and are used to control fuel loads on the mine lease at Ranger Mine, NT.

Consultancies using invertebrate indicators

Researchers from Project 3.2.1 *Invertebrate indicators of biodiversity and ecological change*, assessed mine-site restoration with the German Creek and Callide Creek mines in Queensland.

Australian Defence Forces

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

Bradshaw Field Training Area

Biodiversity research by Project 2.1.1 *Vertebrate biogeography*, on the ADF's Bradshaw Field Training Area in the VRD is being incorporated into the Environmental Management Plan for that area.

Methods for defining landscape health condition as a function of fire regimes and the vital attributes of species (especially plants at this stage) were used to assess landscapes in the Bradshaw Field Training Area by Project 2.4.1 *Fire and savanna landscapes*.

TABLE 5 CONSULTANCIES

	Sector	Consultant	Project	Consultancy	Funding Source	Amount	Period
1	Government	J. Childs, CRC	2.1.1	Development of an Analytical Framework for Monitoring Biodiversity	NLWRA	\$40,000	2001
1	Government	J. Woinarski, NTPWC	2.1.1	Vertebrate Monitoring and Re-Sampling in Kakadu National Park	Director of National Parks	\$66 000	2001
1	Government	J. Russell-Smith, BFCNT	2.4.1	Developing a sustainable satellite fire monitoring program for rural northern Australia	RIRDC	\$6000	2001
1	Government	J. Russell-Smith, BFCNT	2.4.1	Assessing fire patterns and their environmental impacts for national State of the Environment reporting	EA	\$62,700	2001
1	Government	J. Russell-Smith, BFCNT	2.4.1	VRD and Sturt Plateau project coordinator	NHT	\$71,000	2000-2001
2	Government	J. Russell-Smith, BFCNT	2.4.1	Fire Education and Communication for the Northern Australian Savanna Community	NHT	\$150 000	2000-2002
1	Government	R. Applegate, NTLPE	3.1.1	Interpreting landscape change using Landsat satellite data over four biogeographic regions in northern Australia's tropical savannas	NLWRA	\$55,000	2001
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	M. Quirk DPI (Qld) R. Fell CRC	4.3.5	Grazing Land Management Education Programme	MLA	\$25 664	2001

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

TABLE 6 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 P/L				✓				
Energy Resources of Australia			✓					
Earth, Water, Life Sciences Pty Ltd	✓			✓				
Aboriginal Community Groups								
Balkanu Cape York Dev. Corp.			✓	✓				
Bawinaga Association, Arnhem Land			✓	✓				

TABLE 6 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 cont.								
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 P/L			✓	✓				
Australian Tourism Council (NT)	✓		✓	✓		✓		
Institute of Australian Tour Guides				✓		✓		
Savannah Guides Ltd			✓	✓		✓		
GLADA				✓		✓		
Queensland Tourist Commission			✓	✓				
Undara Experience				✓		✓		
Sanctuary Park Endangered Wildlife Foundation				✓				
Funding Agencies								
ACIAR			✓	✓			✓	
LWA	✓			✓			✓	
Environment Australia (Biodiversity Group)	✓	✓		✓	✓		✓	
Department of Environment Sport and Territories				✓			✓	
Meat Research Corporation, NAP				✓				
Rural Industries Research Development Corporation				✓			✓	
Bureau Resource Sciences				✓				

TABLE 6 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								
AUSLIG				✓			✓	
Australian Defence Force	✓		✓	✓				
Bureau of Meteorology			✓	✓				
Great Barrier Reef Marine Park Authority				✓				
Agriculture Western Australia		✓		✓				
WA DOLA Department of Land Administration			✓	✓		✓		
Bushfires Board of Western Australia			✓	✓		✓		
WA CALM	✓	✓						
Kakadu, Nitmiluk Litchfield, National Parks			✓	✓				
NT Power and Water Authority		✓						
NT Bushfires Council			✓	✓		✓		
NT Department Primary Industry and Fisheries		✓		✓				
NT Parks & Wildlife Commission		✓		✓				
CYP2010			✓	✓				
ERIN				✓				
NRIC				✓				
CSIRO Sustainable Ecosystems	✓	✓	✓	✓		✓		
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				✓				

TABLE 6 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
Cooperative Research Centres								
CRC for the Conservation & 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				✓				
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			✓	✓				
Dalrymple BeefPlan Producer Group			✓					
Seventy Mile Range Catchment 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				✓				

TABLE 6 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
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				✓				
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			✓					

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 one staff member: the Publications & Web Manager.

The Centre also has the following specified personnel.

TABLE 7 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	83	Coordinator, Vocational Education & Extension
Dr Peter Whitehead	Northern Territory University	28	Leader Theme 1
Dr John Ludwig	CSIRO, Wildlife & Ecology	90	Leader Theme 2
Dr Paul Novelly	Agriculture Western Australia	40	Leader Theme 3
Prof. Greg Hill	Northern Territory University	45	Leader Theme 4

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Williams, R.J. 2000, 'Fire impacts on vegetation', presented to the Kaplaga Fire Symposium, Darwin, Sept.

Williams, R.J. 2001, 'Towards a carbon account for frequently burnt savannas', presented at the GEOTROP 2001 Conference, Townsville, May.

*Where there is more than one author for a reference, an underlined name indicates that this author is from the TS-CRC.
An * denotes an invited presentation.*

Zhang, Y. 2000, 'An operational approach for mapping bushfire history in the tropical savannas of northern Australia', presented to the 21st Asian Conference on Remote Sensing, Taipei, Taiwan, 9 Dec,

POSTER PRESENTATIONS

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Craig, A.B., Hadden, D.J., Baird, P.R. & McCartney, R.F. 2000, 'Using fire plots to study the effects of fire on Kimberley pastoral lands', Northern Grassy Landscapes Conference, Katherine, NT, 30–31 Aug.

Finlayson, M., van Dam, R., Walden, D., & Storrs, M. 2001, 'Risk assessment for managing the tropical weed *Mimosa pigra*', in *Assessment and management of alien species that threaten ecosystems, habitats and species: Abstracts of keynote addresses and posters presented at the sixth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, Montreal, Canada, 12–16 March 2001*, CBD Technical Paper 1, Secretariat of the Convention on Biological Diversity, Montreal, Canada.

Forner, J., Whitehead, P.J. & Devonport, C., 2000, 'Sustainable harvesting of eucalypts for didjeridu production: The use of remote sensing and GIS to manage a natural, cultural and economic resource', Northern Grassy Landscapes Conference, Katherine, NT, 30–31 Aug.

Fox, I., 2000, 'A vegetation map for northern Australia', Northern Grassy Landscapes Conference, Katherine, NT, 30–31 Aug.

Neldner, J. 2000, Poster presentation to the Northern Grassy Landscapes Conference, Katherine, Aug.

Neldner, J. 2000, Poster presentation to the Ecological Society of Australia Conference, Melbourne, Oct.

Richardson, K.M. & Karfs, R. 2000, 'Satellite based rangeland monitoring in northern Australia, north eastern QLD—Dalrymple shire', Northern Grassy Landscapes Conference, Katherine, NT, 30–31 Aug.

Tran, T., Nguyen, L.T., Storrs, M.J. & Le, C.K. 2001, 'The value of awareness and early intervention in the management of alien invasive species: A case study on the eradication of *Mimosa pigra* at Tram Chim National Park and U Minh Thuong Nature Reserve, Vietnam,' in *Assessment and management of alien species that threaten ecosystems, habitats and species: Abstracts of keynote addresses and posters presented at the sixth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, Montreal, Canada, 12–16 March 2001*, CBD Technical Paper 1, Secretariat of the Convention on Biological Diversity, Montreal, Canada, pp. 37–39.

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Where there is more than one author for a reference, an underlined name indicates that this author is from the TS–CRC.

*An * denotes an invited presentation.*

Grants and Awards

TABLE 8 GRANTS

Researcher	Research Project	Title of Grant	Funding Source	Amount	Period of Award
1. J Childs, CRC	Various Projects	Northern Grassy Landscapes	EA–Bushcare Conference	\$5,000	2000–01
1. T Start CALM WA	2.3.1	WA Water & Rivers Contribution	Water and River	\$25,000 Commission	2001
2. M Quirk QDPI	4.3.5	Practical Grazing Management Guidelines for Dalrymple Shire	NHT	\$18,800	2000–01

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

Awards

Dr Alan Andersen, leader of TS–CRC research project, Invertebrates and Change, was awarded the Asian Innovation Award 2000 presented by the Far Eastern Economic Review for his research into the use of invertebrates as bio-indicators in ecosystem management.

Dr John Woinarski, leader of TS–CRC research project, Biogeographic Biodiversity, was awarded the 2001 Royal Botanic Gardens Sydney Eureka Award for Biodiversity Research.

Dr John Woinarski was also awarded the Serventy Medal, by Birds Australia, in recognition of his lifetime contribution to Australian ornithology.

Mr Yue Zhang, TS–CRC PhD student, was awarded the Best Paper, (Best Speaker), for ‘An operational approach for mapping bushfire history in the tropical savannas of northern Australia’ at the 21st Asian Conference on Remote Sensing 9 December 2000 in Taipei, Taiwan.

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 developing the successful re-bid for a CRC for Tropical Savannas Management.
 - New stakeholder groups representing Indigenous land managers (NAILSMA) and pastoral land managers (MLA) will be partners in the new CRC for Tropical Savannas Management.
 - 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, training and communication needs and strategic direction, including the re-bid for a CRC for Tropical Savannas Management, 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 and the Management Group to new projects.
 - The Consultative Committee met three times during the year, both in Townsville and Darwin.
 - The Management Group met seven times throughout 2000–01.
 - All partner agencies participated in organising and attending the Northern Grassy Landscapes Conference in August 2000. The conference was sponsored by partner agencies Environment Australia, NTDPIF, PWCNT, QPWS, AGWEST, NTDPLE and CALM WA.
 - A communication officer working principally with PWCNT TS–CRC projects was housed by CSIRO
 - Several workshops involving partner agency staff were held to determine future directions pursued in various projects, and the research themes—particularly the directions that would be pursued in the new CRC for Tropical Savannas Management.
-

Extent of interaction with other research funding bodies

- Meetings held with LWA, MLA, Optus C&W, NABRC, NLWRA, RIRDC, Environment Australia, and ACIAR.
- Working with MLA on a Grazing Land Management course.
- Compiling major reports for NLWRA
- 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.
- Project 1.1.1 and the Landscape Processes theme continued to have strong links with the IGBP. Dr Williams collaborated with Dr Joe Craine, University of California at Berkeley, on native grass morphological and physiological traits. Drs Ahmad and Menges collaborated with Dr Jacob van Zyl from NASA on applications of radar as a remote-sensing tool.
- Dr Lindsay Hutley, Project 1.2.1, was involved in formalising teaching and research links via the development of a Memorandum of Understanding between the University of Botswana and NTU/TS–CRC. The project also began cooperative work with researchers from Monash University to examine the role of fire and burn scars in modifying surface heat and moisture fluxes to the atmosphere.
- The Centre was contracted to write two major reports for the NLWRA on monitoring landscape condition and biodiversity in Australia's rangelands.
- The Centre is a major participant in the Ord Bonaparte Project.
- Project 2.4.1 is involved in the ongoing development of a collaborative fire-management and training program in eastern Indonesia, funded primarily through ACIAR. A five-year program is due to commence in 2002.
- Project 2.4.1 was also engaged in collaborative research with the Japanese Space Development Agency (NASDA), and the University of California at Irvine, concerning their interests in biomass burning in the SE Asia region.
- Important overseas links were strengthened with the Indonesian Government, the university of Stockholm, NASA and the European Space Agency
- Project 3.2.1 made strong collaborative linkages with invertebrate taxonomic staff at the Australian National Insect Collection, and other Australian, American and European museums.
- Collaborative work in Project 4.3.4, Modelling Landscape Change, continued with Dr Mike Cougenhouer, University of Colorado, Dr. Bob Scholes CSIR, and other international modellers.
- Project 5.1.1 strengthened links with JCU, the KCTWM and Batchelor Institute of Tertiary Education.

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. 89–95) and Grants and Awards (p. 109) for more details. The substantial decline in grants not administered by the CRC reflected the wind-down of many of the CRC's projects and transition to the renewed CRC.
- Two major reports on the status of Australia's rangelands were undertaken and completed for the NLWRA.
- Collaborative research undertaken with Cattlemen's Association of the NT, NT Pastoral Land Board, Meat and Livestock Australia, NABRC, WWF,VRD Conservation Association, Energy Resources of Australia, Balkanu Cape York Dev. Corp., Bawinaga Association, Cape York Land Council, Kimberley Land Council, Northern Land Council, National Centre for Studies in Travel and Tourism, Australian Tourism Council (NT), Savannah Guides, Queensland Tourist Commission, ACIAR, Australian Defence Force, Bushfires Board of WA, Kakadu, Nitmiluk and Litchfield National Parks, Bushfires Council of the NT, CYP2010, DUBDSC, Mary River Land Care Group, Mary River Technical Working Group, Balfes Creek Catchment Landcare Group, Sturt Plateau Best Practice Group, landowners in central Qld,VRD, Seventy Mile Range Catchment Group, Dalrymple BeefPlan Producer Group, Daly River Landcare Trust, Sustainable Beef Group Torrens Creek.

RESEARCH AND RESEARCHERS

Indicator

Extent to which program objectives and milestones have been achieved

Assessment

- This year saw the mature projects of the Centre produce major outputs. These outputs were coordinated and integrated by the research Themes and were used by the Education, training and communication programs of the Centre.
- The research program continues to strengthen links with research users in 2000–2001, particularly through the Management studies, workshops and industry meetings and the Northern Grassy Landscapes Conference. See Utilisation and Application section.
- The research program continues to strengthen links with national and international researchers. Major reports were produced for 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. A particular feature was the number of practical publications aimed at research users produced.

FIGURE 2 NUMBER OF PUBLICATIONS THAT ACKNOWLEDGE THE CRC

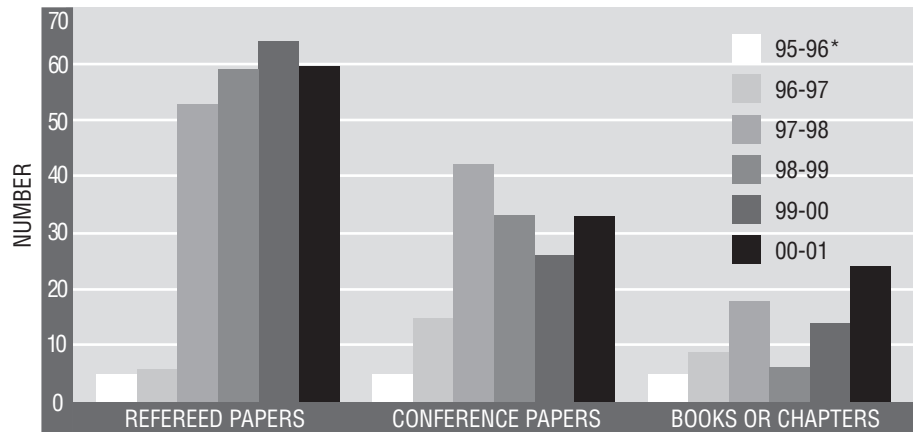


FIGURE 3 NUMBER AND VALUE OF GRANTS AND CONSULTANCIES NOT ADMINISTERED BY THE CRC

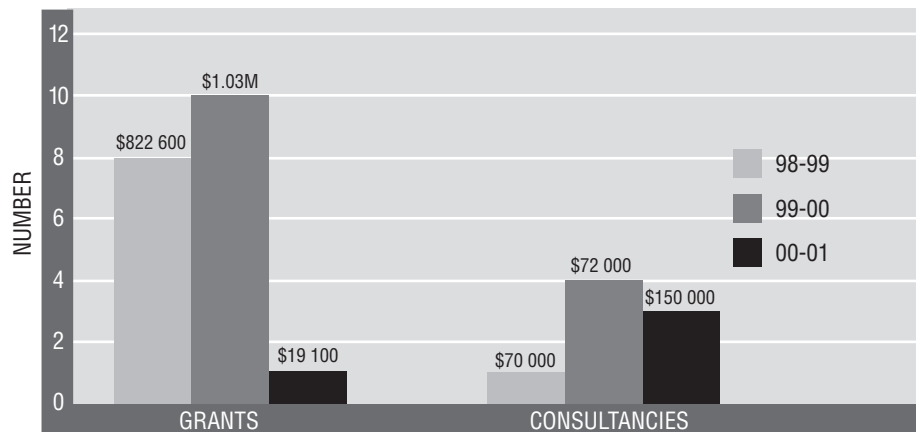


FIGURE 4 NUMBER AND VALUE OF GRANTS AND CONSULTANCIES ADMINISTERED BY THE CRC

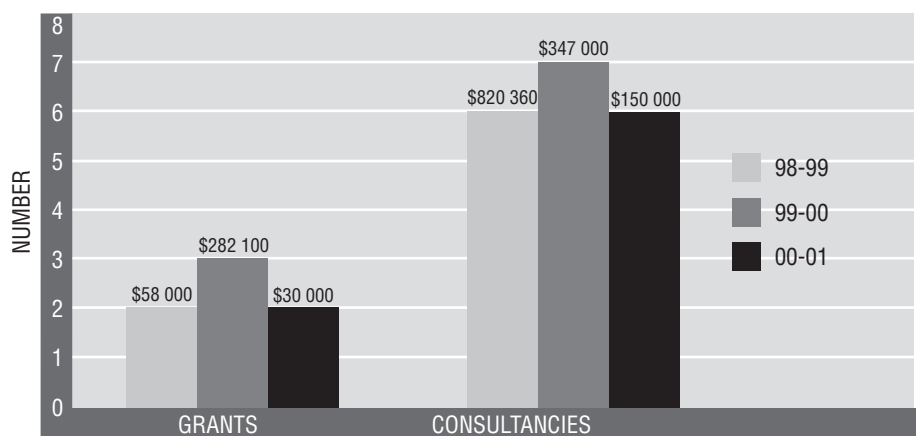
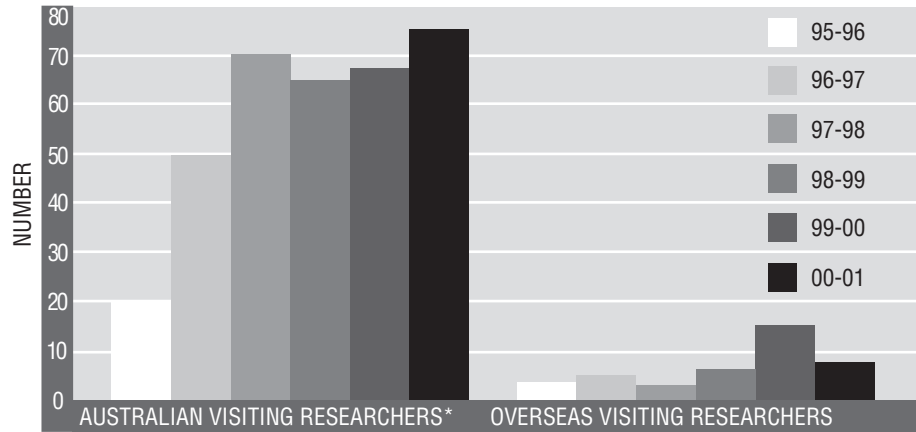


FIGURE 5 EXTENT TO WHICH RESEARCHERS ARE ATTRACTED TO VISIT THE CENTRE



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

FIGURE 6A EXTENT OF NATIONAL AND INTERNATIONAL RECOGNITION OF THE CENTRE

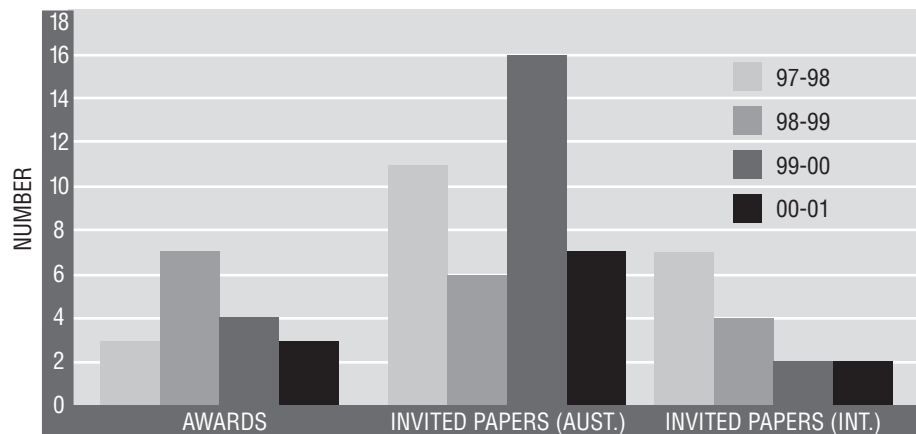
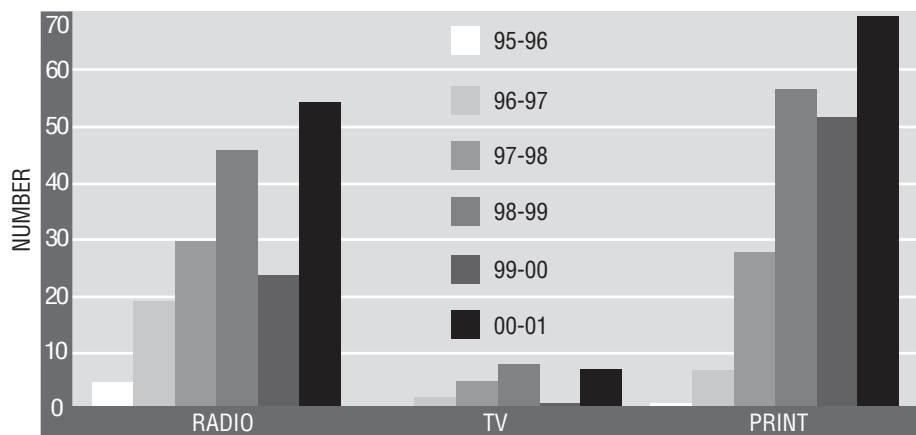


FIGURE 6B EXTENT OF NATIONAL AND INTERNATIONAL RECOGNITION OF THE CENTRE



EDUCATION AND TRAINING

Indicator

Extent and nature of graduate training programs developed by the Centre

Assessment

- 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 had 36 students in the past year.
 - All six core units in the Masters and Grad Dip are available for remote users, most via online or CD-ROM technologies. The University of Georgia, USA, carried out formal evaluation of one unit.
 - A unit evaluation instrument was developed at NTU and applied to MTEM units at NTU and JCU. Preliminary results indicated high satisfaction with the quality, relevance and currency of the units.
 - A further module on Environmental Policy will be offered at JCU in 2002.
 - Research outcomes of several TS-CRC projects are contributing to the MTEM and GDTEM courses.
 - Several TS-CRC students were funded to take an intensive scientific writing workshop from 2-6 October, 2000.
-

Number of postgraduate students in the Centre and their ability to find employment after graduation

- 17 PhD, 1 Masters, two Honours.
 - PhDs were conferred on five students: All of these candidates are employed in a variety of research areas at agencies and universities including CSIRO, Northern Territory University and Australian National University.
 - Enrolments continued to increase with a record number of 36 enrolments in postgraduate coursework.
 - Of the 18 known MTEM/GDTEM graduate destinations, 14 are with land or wildlife management bodies, four are in continuing studies or research and two in teaching positions.
 - Three MTEM students graduated with a Masters in 2000-2001. All are now employed with land or wildlife management bodies.
-

Extent to which non-university staff involved in the supervision of postgraduate students and the distribution of students amongst partner agencies

- Eight non-university and collaborative staff were involved in supervising students.
- Students at NTU, JCU, ANU, CSIRO W&E, CSIRO TAG, PWCNT, BFCNT, QDPI, UO.

EDUCATION AND TRAINING

Indicator

Extent to which the extension and vocational education services of the Centre are successful in modifying management practices within tropical savannas

Assessment

- Fire-management strategies were 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, developed by the TS-CRC, influence land management.
- Modules on weed management were 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 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.

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

- MLA, NLC, land-management agencies and other user groups 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 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 of Australia involved in initiating and developing tour guide seminars.

FIGURE 7 NUMBER OF POSTGRADUATES

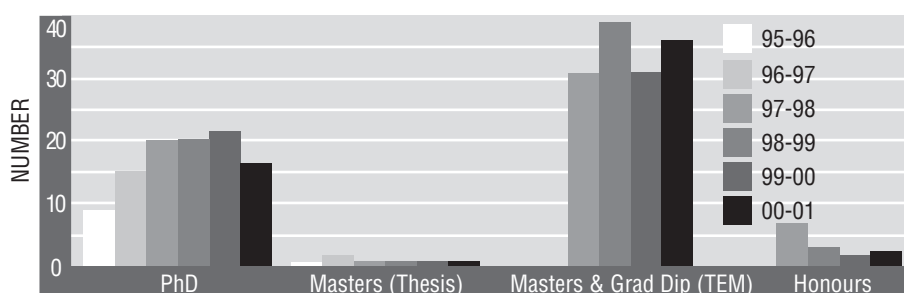
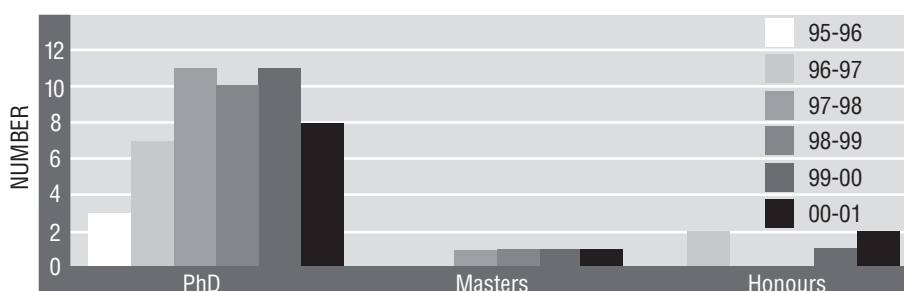


FIGURE 8 NUMBER OF NON-UNIVERSITY OR COLLABORATIVE STAFF INVOLVED AS SUPERVISORS



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 used by land managers involved in three NHT-funded projects in Western Arnhem Land,VRD–Sturt Plateau and the Kimberley
- Fire–management research used by the mining sector (eg ERA) and the ADF (Bradshaw station).
- Satellite based fire–mapping technology developed with WA DOLA used by fire managers in NT,WA and Qld.
- The Centre’s web–based Clearinghouse of research information received 20–40,000 hits per month. Preferred website on savannas for two major US educational networks.
- Most of the stakeholder–targeted research publications produced have not been able to keep up with demand. This includes publications on land management in the VRD and weed management on Aboriginal land.
- Aboriginal groups in the Kimberley and Cape York Peninsula used centre research findings in developing management plans.
- Heytesbury Pastoral Co. is used 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

- Two major reports on developing frameworks for rangelands land condition and biodiversity monitoring were completed for the NLWRA in 2000–2001
- A publication on important land administration and management policy issues distributed to relevant authorities.
- The Centre is to coordinate a major component of the Ord–Bonaparte Program.
- The vertebrate biodiversity research of the Centre 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.
- 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.
- The Centre’s newsletter *Savanna Links* goes to 2800 stakeholders from all sectors
- The Centre’s Northern Grassy Landscapes conference in August 2000, aimed at stakeholders, drew 240 attendees from across the north.
- Centre researchers advised 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.

APPLICATION OF RESEARCH

Indicator

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

Assessment

- Resource economic consultants URS were engaged to assess these economic benefits and will produce a report in late 2001.
- Strategies for sustainable management were developed with Desert Uplands landholders.
- Assessment of benefits of conservation planning 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 were asked for regular updates on achievements that can be publicised internally and externally.
- Communication coordinator is on the 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

- 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 were able to use the North Australia Fire Management Workshop to shape the Centre's fire-management research.
- Stakeholders are involved in developing important land-management and policy tools such as the definitions of healthy landscapes
- Stakeholders and research users were integrally involved in developing the proposal for the new Tropical Savannas CRC in a series of workshops and meetings in 2000–2001.

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 involved the CEOs of the rural fire agencies from Qld, NT and WA.
- Aboriginal land-management studies integrated western science and Aboriginal culture.
- Project 2.4.1 involved personnel representing the pastoral, Aboriginal, defence and conservation sectors.
- VRD Management Study involved people from the pastoral, Aboriginal, and conservation sectors, through the VRD Conservation Association.
- The Desert Uplands Management Study involved people from the pastoral and conservation sectors together with socio-economic researchers.
- The Burdekin Management Study involved the pastoral, conservation and defence sectors
- The Northern Grassy Landscapes Conference 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 met required timeframes.
- A project management system incorporates internal review of technical and financial performance.

Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ACF	Australian Conservation Foundation
ADF	Australian Defence Force
AGSO	Australian Geological Survey Organisation
AGWEST	Department of Agriculture Western Australia
AHC	Australian Heritage Commission
AirSAR	Airborne Synthetic Aperture Radar
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
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 SE	Commonwealth Scientific Industrial Research Organisation, Sustainable Ecosystems
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
CYP2010	Cape York Peninsula 2010
DCC	Darwin City Council
DoD	Department of Defence
DOLA WA	Department of Land Administration Western Australia

DPI (Qld)	Queensland Department of Primary Industries
DU	Desert Uplands
DUBDSC	Desert Uplands Build-Up and Development Strategy Committee Inc.
DXF	Drawing Interchange Format
EA	Environment Australia
EPA	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
LWA	Land & Water Australia
LWRRDC	Land and Water Resource Research and Development Corporation (now LWA)
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

NAILSMA	North Australian Indigenous Land & Sea Management Alliance
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
PAN	Parks Australia North
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
QEPA	Queensland Environment Protection Agency
QFD	Quality Functions Deployment
QFRA	Queensland Fire and Rescue Authority
QNRM	Queensland Department of Natural Resources & Mines
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



TROPICAL SAVANNAS CRC
Cooperative Research Centre for Tropical Savannas Management

Annual Report

2000 ~ 2001

Part I

MISSION

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

RESEARCH THEMES



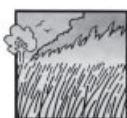
North Australia Landscape

This theme provides the research needed for a comprehensive atlas of northern Australia. It provides descriptions and definitions of minerals, native plants and animals, soils and crops. It looks at the status of waterways, soils, pastures and biodiversity.



Landscape Processes

This theme investigates how the landscapes of the tropical savannas work. It looks at how water from rainfall and nutrients such as phosphorous and nitrogen are cycled through the atmosphere, the soils, and the plants and animals of the tropical savannas.



Ecosystem Management

This theme investigates the effects that activities such as grazing and disturbances such as wildfire and weed invasion have on the landscape.



Human Capability Development

This theme is about enhancing the knowledge and skills of people who are stakeholders in the tropical savannas.

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