

Savanna Futures Forum

28th February 2008

Mal Nairn Auditorium, Charles Darwin University

The Tropical Savannas Cooperative Research Centre (CRC) is now in its thirteenth year. During that time it has made a significant contribution to our understanding and practical management of northern Australia, and while we have learned much we have also generated many new questions. This forum will review the lessons learned, but equally importantly, will assess how this knowledge can be applied in the years ahead. What is the future for Australia's tropical savannas?

8.00 Registration

8.30 Welcome

David Garnett

Session 1 – Overview / Landscape ecology and health

Chair: David Garnett

8.50 Achieving a sustainable future for Australia's savannas: lessons from a decade of cooperative research.

John Ludwig

9.10 Savanna carbon dynamics

Dick Williams

9.30 Closing the gate after the grass has bolted: research to improve future weed management and policy

Michael Douglas / Samantha Setterfield

9.50 Drivers of landscape change

Aaron Petty*

10.10 Panel discussion

10.40 *Morning tea*

Session 2 – Industry and community NRM

Chair: Paul Novelty

11.00 Is Heffernan right? What is the real potential for pastoral and agricultural development in North Australia?

Neil MacDonald

11.20 Fire management – recent initiatives, future prospects

Jeremy Russell-Smith

11.40 Managing and monitoring the biodiversity of the tropical savannas

Alaric Fisher

12.00 Talking turkey about future conservation directions: how to cater for dispersive species in a dynamic landscape.

Mark Ziembicki*

12.20 Panel discussion

12.50 *Lunch and book launch: 'Future options for north Australia' by Stephen Garnett, John Woinarski, Rolf Gerritsen and Gordon Duff (See more details overleaf)*

Session 3 – Regional planning and management

Chair: Peter Whitehead

13.50 Outback livelihoods: continuing conundrums

Rolf Gerritsen

14.10 Lessons from Ngukurr, the wrong side of the Roper

Eva McRae-Williams*

14.30 What does savanna regional natural resource management deliver?

Cathy Robinson

14.50 Enhancing community benefits from regional development: it's not just what you do but how you do it.

Natalie Stoeckl

15.10 Panel discussion

15.40 *Afternoon tea*

Session 4 – Human capability development

Chair: Stephen Garnett

16.00 Job Done? Is Indigenous capacity done?

Joe Morrison

16.20 Indigenous management of turtles and dugongs in northern Australia

Rod Kennett

16.40 Talk about a walkabout: pathways and potholes for savanna knowledge in schools.

Julie Crough

17.00 There's more where that came from: future directions for NRM Information Tools in northern Australia.

Peter Jacklyn

17.20 Panel discussion and summary

17.50 onwards – Drinks, barbecue and further in-depth discussion.

[* Current or past student supported by the CRC]

LUNCH TIME BOOK LAUNCH

Future options for north Australia by *Stephen Garnett, John Woinarski, Rolf Gerritsen and Gordon Duff*

Anticipating the future is uniquely human. We strive constantly to anticipate trends and great events, to seek opportunity and avoid disaster. So what will drive the future of tropical Australia? The four authors of this book, all of whom have a close association with the Tropical Savannas CRC, identify ten major drivers that will shape the north: population, social function, property rights, Commonwealth policy, the global economy, resource use, oil futures, climate change, invasive organisms and technological innovation. For each they identify the risks, uncertainties and the extent to which they can be controlled by the people of the north. Then they describe seven possible futures: chronic underdevelopment, degeneration, a northern ricebowl, an industrial powerhouse, environment first, an Indigenous community Utopia and dynamic urbanization. These are not predictions. They are scenarios to make readers think and realize that the decisions being made today will have a profound influence in the future. Whereas for the rest of the world, the future has largely been set by unplanned development and the irrevocable contingencies of history, northern Australia can be moulded by deliberate and considered choices. Our generation has the opportunity and frightening responsibility to make those choices.

Stephen Garnett has had experience in many different sectors – Indigenous, pastoral, government and academic – in his 30 years in tropical Australia. John Woinarski is the doyen of environmental scientists in the north with a deep understanding of the evolutionary processes that have shaped, and will shape, our region. Rolf Gerritsen is an economist with an independent view of trends in tropical economies and Gordon Duff, who once headed the Tropical Savannas CRC, has had decades of experience bringing diverse groups together in a common purpose to take the north forward towards a more harmonious future.

Achieving a sustainable future for Australia's savannas: lessons from a decade of cooperative research

G. Duff¹, D. Garnett¹, P. Jacklyn¹, J. Landsberg², J. Ludwig³, J. Morrison⁴, P. Novelly⁵, D. Walker⁶, P. Whitehead¹ (Authorship in alphabetical order)

¹ Tropical Savannas CRC and

² Queensland Department of Primary Industries & Fisheries, Cairns (deceased)

³ CSIRO Sustainable Ecosystems, Atherton

⁴ North Australia Indigenous Land & Sea Management Alliance, Darwin

⁵ Western Australia Department of Agriculture & Food, Kununurra

⁶ CSIRO, Canberra

Correspondence, email: john.ludwig@csiro.au

Introduction

Achieving the sustainable use of landscapes requires a robust design to plan and manage natural and cultural resources. An important component of this design is collaboration where research providers and users cooperate to learn how to utilize resources in a landscape while sustaining its long-term health. For the landscapes of north Australia, a Tropical Savannas Cooperative Research Centre (TS-CRC) was established in 1995 to foster collaborative research. The TS-CRC is a joint venture of major organizations involved in research and land management.

This paper is an overview of some key lessons learned over the last twelve or more years about how to effectively foster cooperation and integration to achieve practices leading towards the sustainable management of savanna landscapes in northern Australia. These lessons are based on the combined experiences of TS-CRC Chief Executive Officers (Duff, Garnett), a Communication Coordinator (Jacklyn) and Research Theme Leaders (Landsberg, Ludwig, Morrison, Novelly, Whitehead).

Lesson One

We learned that collaboration (working in combination), not necessarily integration (combining parts into a whole), must be the main goal. While integration might seem a worthy ideal, diverse stakeholder values and aspirations seldom lend themselves to integrated solutions. Integration across culturally diverse perspectives can devalue the position of the less empowered participants. In contrast, we found that positive outcomes were achieved by embracing and respecting differences within a cooperative framework, where different stakeholders work together to gather new information (via collaborative research projects) and develop new tools (information and mapping websites) to achieve land management goals, such as how to effectively use and control fire across vast savanna regions (Fig. 1).

Lesson Two

A lesson learned was that trust and respect amongst the participants was critical. A collaborative research organization must value the trust of its stakeholders above all else.



Figure 1. Andrew Edwards, Dean Yibarbuk and Otto Campion use maps printed from a TS-CRC website to plan strategic burns in Arnhem Land, northern Australia.

Lesson Three

A cooperative venture must be able to act as an honest broker by resisting advocacy of one view over another.

Table 1. A few key publications by the Tropical Savannas Cooperative Research Centre. A complete list is provided in Tools and Information for Savanna Country: Product Guide 2006, available on the TS-CRC website www.savanna.cdu.edu.au.

Publication title	Year
Defining and measuring the health of savanna landscapes	2000
Savanna burning	2001
Slower than the eye can see	2002
Healthy rangelands	2004

Lesson Four

A cooperative venture must invest in communication and networking so that people can learn from one another's experiences, understand each other's challenges, and respect each other's choices. To foster networking and information exchanges, the TS-CRC actively publishes its research (Table 1) and produces a full-colour, widely distributed newsletter (*Savanna Links*) twice a year. It also maintains an award winning website, www.savanna.cdu.edu.au, with links to other websites on natural resource management.

References

- Dyer, R; Jacklyn, P; Partridge, I; Russell-Smith, J. and Williams, D. (Eds) (2001) *Savanna burning: understanding and using fire in northern Australia*. Tropical Savannas CRC, Darwin, Australia
- Lewis, D. (2002) *Slower than the eye can see: environmental change in northern Australia's cattle lands – a study from the Victoria River District, Northern Territory*. Tropical Savannas CRC, Darwin, Australia.
- McCullough, M. & Musso, B. (Eds) (2004) *Healthy rangelands: principles for sustainable systems. Focus on Australia's Burdekin rangelands*. Tropical Savannas CRC, Darwin, Australia
- Whitehead, P; Woinarski, J; Jacklyn, P; Fell, D. and Williams, D. (Eds) (2000) *Defining and measuring the health of savanna landscapes: a north Australian perspective*. Tropical Savannas CRC, Darwin, Australia

Savanna carbon dynamics

Dick Williams^{1*}, Chris Stokes², David Rose, Adam Liedloff¹, Lindsay Hutley³, Robert Eager¹, Garry Cook¹.

Tropical Savannas CRC and

¹CSIRO Sustainable Ecosystems, TERC, Darwin

²CSIRO Sustainable Ecosystems, Davies Lab, Townsville

³Charles Darwin University, Darwin

Correspondence, email: dick.williams@csiro.au

Savanna carbon

Savannas constitute approximately 30% of Australia's carbon stocks, and make a substantial contribution to national Greenhouse gas (GHG) emissions. GHG emissions from Australian rangelands derive from three main sources: land-use change, livestock production and savanna burning. Between 1991 and 2005, the range of emissions has been, respectively, *ca.* 50-130 Mt CO₂-e y⁻¹ (deforestation) ; 60-66 Mt CO₂-e y⁻¹ (livestock) ; and 5-15 Mt CO₂-e y⁻¹ (fire). Understanding the stocks, flows, responses of savannas to elevated CO₂, savanna sequestration capacity and the markets for savanna carbon have been the foci of this project.

Carbon stocks, flows and sequestration capacity

We have estimated carbon stocks from several sites using direct harvest and allometry in the Darwin, Katherine, Kidman Springs regions of the NT. Above ground and root biomass depends on tree density and diameter; soil organic carbon is the main component of savanna carbon, but does not appear to vary with tree population structure. We are examining the application of the National Carbon Accounting System (NCAS) and remote sensing techniques such as RADAR and LIDAR for estimating stocks and changes to stocks at medium-large spatial scales.

We have estimated the bio-sequestration potential of the mesic savannas of the Northern Territory, using several different methods (empirical inventory, remote sensing, eddy covariance) and under different fire regimes. These analyses have indicated that the savannas are a weak sink, even when burnt almost annually. Net Biome Productivity (NBP), a production index that accounts for carbon fixation, and losses to both respiration and disturbance, is of the order of -1 t C ha⁻¹ y⁻¹. Reducing annual area burnt and the incidence of more intense late dry season fires is likely to increase the sink size. Temporal and spatial uncertainties surround these estimates of sequestration strength at landscape scales, and better estimates are needed of area burnt, burning efficiencies, poorly documented fuel types such as coarse woody debris, and the duration of the sink strength, and the sensitivity of sequestration strength to other land uses such as pastoralism.

FAC Experiment

A Free-Air Carbon Dioxide Enrichment (FACE) experiment using three levels of CO₂ - 370 ppm (current ambient); 460 ppm and 550 ppm - was established at Townsville. Transplanted seedlings of both eucalypts and acacias show evidence of enhanced growth under elevated CO₂, with a stronger response in the acacia (nitrogen-fixer) than the eucalypt. There are indications of rising soil moisture levels under elevated CO₂, which might be due to increased water use efficiency of vegetation.

Likely carbon markets

Global carbon markets traded more than 800 million t CO₂e worth \$13 billion in 2005. These markets are expanding, primarily from the entry into force of the Kyoto Protocol in 2005. While carbon

markets are still disparate and emerging, businesses are voluntarily paying \$1-30 per tonne of CO₂e and investing in a wide range of emission reduction projects, pointing to the increasing economic potential of actions that aim to reduce global emissions of GHGs.

Carbon and Natural Resource Management

Worldwide, the storage of carbon on land as a greenhouse gas abatement strategy is controversial because of (1) difficulty in measurement and verification, (2) the high risk of their transfer to the atmosphere, (3) the potential for diversion from the main goal of reduction in fossil fuel emissions and (4) difficulty in partitioning fortuitous from deliberate carbon sequestration. There is a risk of perverse outcomes in some savannas if they are managed primarily carbon sinks as an end in itself, at the expense of other natural resource management objectives. Where carbon sequestration would have unintended negative consequences for broader land management goals, these trade-offs need to be acknowledged and balanced in land management decisions. Where synergies exist between carbon sequestration and other land management objectives, it would be desirable to promote these combined benefits through existing natural resource management initiatives.

Closing the gate after the grass has bolted: research to improve future weed management and policy.

Michael Douglas¹ and Samantha Setterfield²

Tropical Savannas CRC and

¹Centre for Tropical Rivers and Coastal Knowledge, Charles Darwin University, Darwin

²School of Environmental and Life Sciences, Charles Darwin University, Darwin

Correspondence, email: Samantha.Setterfield@cdu.edu.au

There are approximately 160 species of naturalised grasses in northern Australia. Several species have been identified as serious weeds and are emerging as a significant threat to tropical savannas for conservation, Aboriginal, pastoral, mining, and defence land users. Although concerns about the environmental impacts of exotic grasses have been raised since the early 1990's, progress on this issue was hampered by an active campaign of denial and misinformation about their impacts and by a lack of published scientific information evaluating environmental effects. Research supported by the Savannas CRC addressed this knowledge gap and demonstrated that species such as Gamba grass and Mission grass can have major effects of savanna plants, animals and important ecosystem processes including nutrient and water cycling and fire regimes.

The negative impacts documented through this research are likely to become even worse in the future. The current effects may become more widespread as many species occupy only a tiny proportion of their potential range and have the potential to become established across the entire tropical savanna region. The situation is also likely to worsen in currently invaded sites as longer-term effects become apparent. For example, species that increase fuel loads and fire temperatures have the potential to initiate a self-perpetuating cycle of tree loss and habitat degradation. We are only just beginning to see such effects and have only begun to appreciate the consequences for greenhouse gas emissions. In short, without major change in policy and management action, the long-term future looks bleak.

Fortunately, there are signs that a shift in policy are occurring, due in part to growing awareness of the CRC research findings and the projects that have followed from this. Although the research began among a climate of debate and denial re the need to act, in the face of growing research evidence, attitudes have slowly but markedly changed with most people now accepting that exotic grasses can pose a serious environmental and economic problem for a range of stakeholders. The research has been picked up by weed management agencies across Australia and is being used to lobby for action.

The research has grown considerably from the CRC project, but it has retained many of the key features that were fostered by the CRC – a focus on research aimed at influencing policy and on ground action, strong partnership between researchers and managers and collaboration across the region. Building on the foundation of the CRC project, the current program consists of four interconnected projects involving more than 40 people from across Australia and supported by \$2 million of external funding. These projects will address weed management on four fronts: developing a weed risk management system for the NT based on the Australian National Weed Risk Management Protocols, developing a set of best practice guidelines for the use of exotic grasses, undertaking research on the cost-effectiveness of alternative management approaches, and improved co-ordination and efficiency of weed control methods across northern Australia. This research should ensure better management of the grasses currently in the region and a greatly reduced risk of the widespread use of species that are likely to become serious weeds.

Drivers of landscape change

Aaron Petty

Tropical Savannas CRC and Centre for Tropical Rivers and Coastal Knowledge, Charles Darwin University, Darwin
Correspondence, email: Aaron.Petty@cdu.edu.au

Tropical savannas extend across nearly one third of the Earth's – and Australia's – surface. Although the biome is principally defined by a climate condition – highly seasonal but regular rainfall patterns – the name “savanna” is also given to the dominant feature of tropical savannas – open woodlands characterised by the coexistence of grasses and trees. Under classical successional theory this is a paradox: either conditions do not support trees, or trees eventually supplant grasses. There has been much debate over the factors that lead to grass-tree coexistence in savannas, but a consensus is forming that disturbance, particularly from grazing and fire, is the key structuring factor. Because tropical savannas are disturbance dependent systems, they can be particularly impacted by seemingly subtle changes in disturbance regime.

Tropical savannas communities exhibit great diversity in both composition and disturbance regime, and it is helpful to think of savanna ecosystems in terms of resistance and resilience. “Resistance” refers to the capacity of a system to resist change in the face of disturbance, while “resilience” is the capacity of a system to return to its former state after a disturbance. For example, woodlands are a highly resistant ecosystem that can withstand repeated disturbance, particularly very frequent fire regimes, but under particularly severe disturbance can irreversibly shift to an alternate state. Floodplains are resilient on an annual scale, as they change in composition between wet and dry seasons, but also appear to change rapidly in response to shifts in grazing or fire regime and to have some capacity to revert if the prior regime is restored.

The contrast between resistant and resilient ecosystems is highlighted by the ecological legacy of feral water buffalo in Kakadu National Park. Buffalo reached carrying capacity in Kakadu by the 1960s and the impact of buffalo on floodplain hydrology and vegetation was immediately apparent. By the 1970s many floodplain vegetation communities had all but disappeared and saltwater channels had expanded markedly throughout the Alligator Rivers/Mary River region. Although there were some permanent shifts, the freshwater ecosystems largely returned to their original state soon after the removal of buffalo from Kakadu in the 1970s and 1980s.

The impact of buffalo on woodlands was less apparent during the buffalo era, and only now are we beginning to understand the legacy that some two decades of high density grazing pressure has had on the structure and function of woodland ecosystems. Buffalo had a substantial negative impact on understory vegetation in woodlands, and the rapid removal of buffalo released annual grasses, particularly annual sorghum (*Sorghum intrans*). The increase in sorghum abundance was likely enhanced by frequent fires, locking some portions of the Kakadu savanna into an alternate ‘grass-fire’ state where an understory dominated by sorghum promotes frequent fires that decrease competition between sorghum and perennial vegetation, and has led to the long term decline in woodland cover in some areas. Moreover, an overall increase in fire frequency has been linked to the decline of small mammals across Kakadu.

In the past fifty years, there has been a consistent expansion of closed forest vegetation across Kakadu. This seems somewhat counterintuitive given that closed forest vegetation is particularly susceptible to damage from both fire and buffalo (i.e. it is both less resistant and resilient than floodplains and

woodlands). Increasing rainfall, particularly within the past decade, has likely contributed to this expansion. Also, buffalo grazing may have reduced fire frequency at closed forest margins. Finally, the removal of buffalo coincided with an increasingly vigorous fire management program within Kakadu that focused both on early dry season, high frequency but low intensity burning of woodlands, and the protection of closed forest vegetation margins.

The introduction of feral animals and changes in fire regime in Kakadu National Park illustrate the sorts of management changes that can have long term consequences for ecosystem structure and function within tropical savannas. Grazing and fire are the key disturbances in savanna systems and decisions about fire management, the introduction of large grazing animals, and the introduction of exotic grasses all have the capacity to profoundly change savanna ecosystems. The sustainable management of tropical savannas relies upon knowing the limits of resistance and resilience within ecological communities. It would appear that the chief danger lies in underestimating the capacity of highly resistant, but low resilience ecosystems such as woodlands to withstand changes in disturbance regime. The impact of change may not be immediately apparent, but the legacy of change may last many decades.

Is Heffernan right? What is the real potential for pastoral and agricultural development in North Australia?

Neil MacDonald¹, Robyn Cowley¹ and Steve Petty²

¹Tropical Savannas CRC and NT Department of Primary Industry, Fisheries and Mining, Katherine

²Northern Development Pty Ltd

Correspondence, email: Neil.MacDonald@nt.gov.au

With extended droughts in the south and projections for worse to come under climate change, the focus of Australian agriculture has clearly turned to the tropical north. The practical implications of this are already being seen, with a major increase in the value of farms and pastoral properties over the last few years and in the number of development applications submitted.

This paper sets out to look critically at the real potential for northern development, particularly in the pastoral area. This assessment will be based on the findings of the TSCRC project “Developing Grazing Management Tools to Improve Savanna Condition”, which set out to extend our capability to objectively estimate safe carrying capacity, and also on the Pigeonhole Project which looked at alternative models of intensification.

Pasture growth models are based on historical rainfall effects, and that poses a dilemma because rainfall in some of the main pastoral zones of the NT has increased markedly over the last 50 years especially over the last 15 years. There is also the question of climate change. Companies moving north and west often quote climate change as one of their main reasons for doing so, and the paper will discuss whether that is justified.

Over the last few years the value of NT land has been rising faster than any other part of Australia, to the extent where there is concern that current prices may be unsustainable. From 1999-2007 the index for NT agricultural land has risen by 14% pa and the index for NT grazing properties by 27% pa. However this is from a low base. A recent North Australian land value survey still quotes NT pastoral land as the best value in the north, on a price-productivity basis. Implications for pastoral production and land use are discussed.

Although the talk and the CRC project are based on the pastoral sector, reference is also made to alternative land uses such as agriculture, irrigation and forestry.

It is argued that there is a role for a future CRC or alternative body in providing sound scientific land use assessment so the community can make an informed choice about suitable levels of development across the North Australian savannas.

Fire management research in the savannas—recent initiatives, future prospects

Jeremy Russell-Smith

Tropical Savannas CRC and Bushfires NT, Darwin
Correspondence, email: Jeremy.Russell-Smith@nt.gov.au

Before considering future challenges facing fire management and associated applied research issues across the tropical savannas, it is useful to consider the achievements of the Tropical Savannas CRC and its partners over the past decade or so. These have been substantial. An early challenge was to develop a coordinated approach to fire management research across the north that was inclusive of and relevant to all major extensive landholders, the rural fire agencies and fire researchers. Tangible outcomes of that initiative have been, notably:

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

An allied key task simmering in the background has been to address the fundamental problem of how to develop economically sustainable fire management solutions for savanna landscape managers. While such issues are most glaringly conspicuous in the instance of indigenous lands and communities, they apply more-or-less equally to fire-prone lands under all tenure arrangements. The development and implementation of the Western Arnhem Land Fire Abatement (WALFA) project has been singularly important in this regard. Not only has that project succeeded in offering economic sustainability as a commercial greenhouse gas offset program, it has demonstrated that effective partnerships can be forged between, and which pay mutual respect to, the knowledge traditions of indigenous land managers, scientists and, often forgotten, supportive policy makers. In all these respects WALFA provides a landmark for the future. I would also submit that WALFA would not have been made possible without the commitment and support of the Tropical Savannas CRC.

As to the future, a number of challenges spring to mind; unfortunately not all of which are likely to be as positively exciting as WALFA and its successors. On the very positive side, over the next few years commercial opportunities surrounding the development of new savanna burning and greenhouse gas abatement projects will continue; in fact, discussions are well advanced concerning the establishment of projects in fire-prone central Arnhem Land, the Gulf country between Borroloola to Burketown, the north Kimberley, and, further down the track, western Cape York and south of the Daly River in the NT. While each of these projects has substantial technological and capacity building issues to meet, the ongoing development of appropriate and supportive policy and governance frameworks poses perhaps even greater challenges. Of these, a key issue is to sort out legal issues surrounding entitlements and rights to offsets in multi-tenure settings. Another is to develop effective multi-party business models and arrangements.

Other fire and land management-related opportunities are also on the horizon: accounting for an increased set of greenhouse gases other than emissions of the two gases (N₂O, CH₄) currently allowed for; the potential for carbon sequestration in above- and below-ground stores; and associated potential

for developing 'avoided deforestation' and 'biodiversity credit' instruments and markets. Each of the above issues provides substantial and significant research and policy development challenges. Equally, there is clearly an opening for indigenous organisations themselves to develop a coordinated approach, indeed a commercial partnership, to progress development of these opportunities for the benefit of their stakeholders. The North Australia Indigenous Land & Sea Management Alliance (NAILSMA) will likely play a major coordinating role in this regard.

The above initiatives are reliant on ongoing support for developing technological infrastructure (e.g. fire mapping; fuel curing maps) and information delivery systems (e.g. websites such as NAFI). The Tropical Savannas CRC has played a pivotal role in such developments to date, and it is evident that a substantial challenge lies ahead in securing ongoing funding support from new sources for these critical tools. In short, a national program (outside of the ad hoc CRC program) is required, as recommended by the COAG *National Bushfires Inquiry*.

A final and imposing challenge for land and fire managers across the north which needs to be addressed here concerns dealing with the ever-growing threat from introduced pasture grasses. Various of these species develop very substantial and highly flammable fuel loads (e.g. Mission grass, Gamba grass). Much attention has been given in the past to the biodiversity impacts and invasibility of such species. Today, it is increasingly clear that in unmanaged situations the uncontrolled spread of such species poses a very considerable threat to human life (including those of professional and volunteer fire-fighters) and property, and far greater recognition needs to be given to life and property issues than hitherto. Management solutions will be difficult and require a concerted applied research effort backed by informed community and government support.

Managing and monitoring the biodiversity of the tropical savannas.

John Woinarski¹, Alaric Fisher¹ & Alex Kutt²

Tropical Savannas CRC and

¹ Biodiversity Conservation Division, NT Department of Natural Resources, Environment and the Arts, Darwin

² Sustainable Ecosystems, CSIRO, Townsville, Queensland

Correspondence, email: John.Woinarski@nt.gov.au

There has been a substantial “savanna biodiversity” program, in various guises, for the lifetime of two iterations of the Tropical Savannas CRC. The general objectives of this program have been to increase our basic knowledge of the distribution and conservation status of savanna biota; to investigate the impacts of a range of land management regimes on biodiversity; to better incorporate consideration of biodiversity conservation into land management planning and decision-making; to develop robust techniques for assessing and monitoring biodiversity ‘health’; and to provide information about biodiversity in useful forms to a wide array of land managers and other stakeholders.

Over the past decade-and-a-half these objectives have largely been achieved, resulting in a great increase in understanding and appreciation of the biodiversity of the tropical savannas, on lands of all tenures and across a wide range of stakeholder groups. We have compiled near-comprehensive databases of the known locations for vertebrate and plant species across the tropical savannas. A large number of systematic biodiversity surveys have addressed substantial gaps in this baseline information or, where they have resampled areas where historical data exists, been very important in highlighting changes in biota, particularly declines in the small mammal and bird fauna. Research projects have clarified the impacts on biodiversity of grazing pressure from cattle; of clearing and fragmentation, and thickening or thinning, of vegetation cover; of the spread of introduced pasture grasses; and of changes in fire regimes. Robust biodiversity monitoring programs have been implemented in some areas, and we have a much greater understanding of the value, and inadequacies, of various surrogates and indices for biodiversity condition. We have developed robust principles or guidelines for biodiversity-friendly land-management practices, and had substantial input to jurisdictional conservation planning and regional natural resource management plans.

Our projects have generally been collaborative efforts with Indigenous ranger groups, local landcare organisation, conservation agencies, non-government conservation organisations, natural resource management regional bodies, and individual land managers. We have also attracted considerable complementary funding from many sources, including Land & Water Australia, Meat and Livestock Australia and the Natural Heritage Trust, and several ongoing projects will continue to address the objectives of the TS-CRC after its demise.

The wealth of information about biodiversity and the effects of land management compiled during this program is now widely available to land managers and the general public via the user-friendly Land Manager and Biodiversity Info-Net websites. Additionally, this program has been associated with over 200 scientific papers, reports and books relating to savanna biodiversity and sustainable land management, which have extended to a national and international audience.

These achievements, and much other fine work by those both within and outside the CRC umbrella, have not secured the future for Australia’s tropical savanna biodiversity (although it has assisted in clarifying the opportunities and risks). Rather, we feel that we are now close to a critical juncture for

this future. There is a narrow and diminishing path between hope and despair for the environmental future of northern Australia. As development and degradation continue and accelerate, we may slide further down the familiar path of biodiversity decline followed over the past two centuries in our southern landscapes. Alternatively, we may recognise and embrace the opportunity to maintain and nurture our largely intact savanna landscapes and to better value and safeguard their magnificent biota.

We attempt here to prescribe some key requirements in order to realise this latter future. These are far broader than a strict research agenda, but this reflects the essential need for a general attitudinal change to how the savannas, and their biodiversity, are perceived, and to the national priorities for natural resource management.

Correction of the distortion in the national environmental perspective and resourcing for environmental management

The tropical savannas are alien to most Australians, inadequate attention is paid to their future by southern decision-makers, and resourcing for environmental management is miniscule in relation to their size and significance for biodiversity. While low population density and limited capacity may be impediments to natural resources management, greater investment in maintaining relatively healthy systems will ultimately be far more cost-effective than attempting to restore decimated landscapes and rescue species on the cusp of extinction.

Systematic long-term land use planning that recognises and retains conservation values as the foundation of a sustainable future

The integrity of the tropical savannas and the underlying ecological processes should be recognised as an essential component of the future of this region. Development should proceed only where it does not diminish this essence, and land use planning should be built around maintaining the connectivity and functioning of savanna landscapes.

Broad-scale programs to staunch ongoing, pervasive decline in biodiversity

While a number of factors have been implicated in the insidious decline of some components of the savanna biota, a sustained research program is required to better elucidate the causes of decline, linked to carefully targeted management and a program of monitoring biodiversity and its responses to management intervention.

Implementation of robust, landscape-scale biodiversity monitoring programs, linked to adaptive land management regimes

There needs to be recognition that biodiversity monitoring should be a foundation for measuring environmental sustainability and a key component of adaptive land management, with adequate, long-term resourcing. The efficacy of land management interventions needs to be assessed by such monitoring programs across all land tenures.

Mitigation of the impacts on biodiversity of pastoral land use

As the dominant land use in the tropical savannas and with virtually complete hegemony over many savanna ecosystems, impacts from pastoralism will continue to be critical to the long-term fate of savanna biodiversity - more so with continuing pressures to intensify pastoral production across this region. These impacts must be mitigated through improved representation of productive landscapes in the protected area system; a combination of appropriate incentives and legislative requirements for the retention of biodiversity on pastoral lands; and tight regulation of land clearing and use of introduced pastures.

Secure long-term resourcing for conservation land management by indigenous people

Indigenous people manage large areas of the tropical savannas, including many of the areas of outstanding conservation significance. Much of this management responsibility has been formalised through the recent development of indigenous land management organisations and indigenous protected areas, as well as joint management arrangements of conservation reserves, but the impediments of limited capacity, inadequate resourcing and insecure or short-term funding must be addressed. As in other tenures, it is important to link funding for environmental management to explicit outcomes and assess the efficacy of management through adequate monitoring.

Implementation of a carbon-trading scheme that rewards the retention of native vegetation and the application of benign fire management

Active management of land to maintain or improve biodiversity values is most likely to occur if landholders receive a tangible benefit from doing so. One promising mechanism by which this could occur is through carbon offset schemes, which may apply both to the retention of native vegetation (which may otherwise be cleared for pastoral or agricultural development), and landscape-scale programs for the reduction in the frequency and severity of fires.

A strategy to safeguard the biota most susceptible to impacts of climate global change

We have done little to address this threatening process during the savanna biodiversity project. While the direct effects of climate change may not be ameliorated, it is essential we understand the risks that it poses to savanna biodiversity, develop strategies to protect the most susceptible elements, and retain intact ecosystems over broad scales in order to maximise options for species' adaptation to these changes.

Development of a research and management program for understanding and maintaining tropical savanna dynamics

The dynamic nature of tropical savannas, both spatially and temporarily, is very important for many components of biodiversity. While we have been very good at studying pattern, we are less advanced in understanding these processes, and this needs to be addressed through "big picture", long term research programs.

Elaboration of international linkages to other tropical savannas

There is a substantial opportunity to increase our understanding of tropical savannas through better communication and collaboration with researchers and land managers internationally, and we can also better contribute to better management of tropical savannas globally.

Acknowledgements

We gratefully acknowledge the participation of many staff, students, collaborators and volunteers in the savanna biodiversity projects over the lifetime of the CRC. The Tropical Savannas CRC has played a crucial role in advancing the conservation of tropical savannas biodiversity, both through financial support and by facilitating communication and partnerships between a diverse array of agencies, organisations, researchers and land owners and managers.

Talking turkey about future conservation directions: how to cater for dispersive species in dynamic landscapes?

Mark Ziembicki

Tropical Savannas CRC and Biodiversity Conservation Division, NT Department of Natural Resources, Environment and the Arts, Darwin

Correspondence, email: Mark.Ziembicki@nt.gov.au

Many birds of Australia's arid and monsoonal regions are characterised by dispersive or nomadic movements and large population fluctuations in response to variable climatic conditions. These characteristics, compounded by our generally limited knowledge of bird movements and population dynamics, complicate population monitoring and conservation for such species. Indeed, the protection of dispersive fauna in general is regarded as one of the greatest challenges for conservation biology because conventional conservation practices and representative reservation cannot adequately cater for such species.

This presentation discusses these issues in light of a study that used the Australian Bustard as a 'model' for developing techniques to monitor and predict population fluctuations and dispersive movement patterns over broad spatial and temporal scales. If the locations and preferred habitats of dispersive species such as the bustard are known or can be predicted at particular times, then such sites can be prioritised for protection at critical times. Such knowledge would effectively facilitate predictive or pre-emptive conservation planning (e.g., by developing mobile or shifting conservation zones in time and space), thereby overcoming the limitations of current static reserve design and conservation strategies. For example, refugia required during drought, or breeding habitats and lekking areas used by bustards, could be protected at key times by controlling introduced predators, managing for appropriate fire regimes, minimising stocking rates for livestock, or implementing moratoria on hunting.

Continental-scale analyses of distributional data of bustards, and satellite tracking of individuals, suggest that their movement patterns vary widely across the country. The seasonality of bustard occurrence is generally more pronounced in regions characterised by predictable seasonal conditions. Seasonal patterns are also evident in more climatically unpredictable regions, although here they may be increasingly overlaid by more idiosyncratic movements as a result of longer term variation in rainfall and associated patterns of vegetation greenness. Limited evidence was found that bustards respond to inter-regional irregularities in rainfall events, suggesting that nomadic movements are generally not continental but rather intra-regional. However, longer term data sets that cover several more, or more extreme, climatic fluctuations than that considered here, are needed to assess these relationships adequately.

Complementing this broad-scale approach was a detailed study of the ecology of the bustard at two representative sites in northern Australia. This study also demonstrated the variability of the bustard's ecology. The species' widespread distribution and variable biology and threats mean that there are no simple, homogenous prescriptions for its protection - illustrating the challenge and need for lateral and creative approaches for the protection of the bustard and other similarly dispersive species over continental scales.

Outback Livelihoods: continuing conundrums

Rolf Gerritsen,

Tropical Savannas CRC and Charles Darwin University, Alice Springs
Correspondence, email: Rolf.Gerritsen@cdu.edu.au

Introduction: The Outback Livelihoods Project

This project was to be a precursor to more sustained socio-economic research contingent upon the Tropical Savannas CRC being refunded for a further five years. It was a cobbled together exercise involving four separate sub-projects:

1. A CSIRO-led exercise looking at constructing and applying Bayesian belief systems in regional economic development;
2. A PhD student investigating the conflict of ideas behind western and Aboriginal notions of “work” and the paradoxes that entails (this is presented at this Forum by Eva McRae-Williams);
3. A study of economic multipliers, an exercise of direct and important relevance to regional economic development (represented in this Forum by Natalie Stoekle and Owen Stanley); and
4. An investigation of the possibility of establishing an Aboriginal natural resource management enterprise, using the market based instrument of carbon credit trading (by myself).

This talk is about the fourth sub-project. It describes the sub-project and then goes on to outline conundrums created by the “institutional” implications for the future of remote Aboriginal communities in northern (and central) Australia that arose out of the project and the resulting requirements for further research.

Establishing a southeast Arnhemland carbon credits enterprise

This exercise was initiated in 2005 (while I was still a bureaucrat in the NT Government) and designed over a period of two years (2006/2007) dry season fieldwork. I have had an intermittent association with the Ngukurr community for nearly 30 years and am on close terms with some of the most senior males in the community. So the fieldwork was not constrained by a lack of trust but focused upon educating people on the possibilities of a carbon trading business.

The data upon which the SE Arnhemland carbon credit enterprise was predicated was supplied by Felicity Watt, of the NT Bushfires Council, and used the same satellite monitoring system pioneered by the West Arnhemland Fire Abatement Project. The WALFA project is essentially a regulatory grant program. What I wanted to design was a market based instrument approach, which is less dependent upon governmental regulatory interventions and relies upon the incentive structure of the market.

Data for fire patterns in SE Arnhemland was collected for five years. Vegetation patterns were incorporated into the data to provide a bank of potential carbon savings (by increasing early dry season fires and decreasing late dry season fires). The difference in fire intensity between early and late fires, creates this potential carbon saving and hence the tradeable credit. Depending upon the price obtained for each tonne of verifiable carbon saved, there is a potential annual income stream of between \$400,000 and about \$1 million available to this “business”.

Therefore a southeast Arnhemland carbon credit trading corporation is sustainable and economically viable, in the strict capitalist sense. But it is unlikely to happen, at least soon.

I now seek to explain why a sustainable, equitable and participatory carbon credits enterprise is not viable under contemporary institutional frameworks and hence why dramatic reforms in the institutional framework enveloping remote Aboriginal communities is required.

Firstly, the difficulty of implementing this carbon trading scheme is not because of Aboriginal incapacity. The Aboriginal people of SE Arnhemland know how to burn the country correctly. Incipient conflicts between various groups and the potential for overlapping claims to country (caused in part by intermarriage between groups and the increase in accessing rights to country through matrilineal descent lines) can be resolved with patient consultation over an extended period. Also there are plenty of people in the community who could oversight the “business” elements of the enterprise. The problems with implementing the change in living arrangements involved in this proposal reside mainly with the structures and operation of government (and arguably these effects are worse than they were 20 years ago).

So I would claim that the difficulties with implementing this proposal lies squarely with the methods and processes of governments.

The governmental factors inhibiting Aboriginal people living on country

There are basically two sets of issues here:

A centralising spatial bias:

Essentially this is about systems of incentives that have evolved over the past 20 years and which discourage Aboriginal people from living in small family or clan groups on country and force/encourage them to live on large multi-group communities.

For example:

- The centralization of (very inadequate) education opportunities that discourages families with children from living on outstations/homelands; and
- The central bias of many programs and infrastructure (eg sporting and other facilities)

Even progressive governmental programs - in particular those associated with NRM or Aboriginal Land Management - ignore or devalue Aboriginal cultural interests in country and so are of limited social sustainability. That is they assist Aboriginal people to look after country but not necessarily to live on that country. So the Aboriginal people remain dependent upon government for the funding to carry out their conservation and land management activities. That dependence is a fragile framework for the future.

The incapacity of government

This is an equally serious charge against governments of all persuasions. It has several interconnected elements which I will outline but do not have the time to elaborate upon:

- The New Public Management (NPM) and the incentive structures created by programme budgeting versus effective fused service delivery (imposed “coordination”, via a central or lead agency, will not solve this).
- Related to the effects of NPM, the absence of long term and programmatically consistent funding (programs come and go with bewildering rapidity and inevitable ineffectiveness).

- Credentialism vs para-professionalism which limits service delivery options (this particularly affects medical services) and means inadequate levels of services are inevitable (eg the shortage of doctors in remote Aboriginal Australia).
- The change in whitefella socio-economic expectations This creates high staff turnover, which is inimical both to Aboriginal modes of operating with whitefellas and means that government service agencies have little historical memory or policy continuity. It means high transaction costs for whitefella staff.
- Inadequate resources; a particular NT problem though endemic even in Commonwealth programs (eg Wadeye COAG trial). Programs such as Land and Sea Rangers, IPA conservation programs, etc. – to say nothing of education and health (eg the inadequate medicare based funding in the NT) are all under-funded relative to need.

Arising out of the research I conducted in this Outback Livelihoods sub-project I have now begun an investigation of the means to rectify the systems of perverse incentives created by the relationship between government and remote Aboriginal communities: in effect, to try and provide an answer to the paradoxes that bedevil these “continuing conundrums”. The solutions I will propose will have to await another forum.

Lessons from Ngukurr, the wrong side of the Roper

Eva McRae-Williams

Tropical Savannas CRC and Charles Darwin University, Darwin
Correspondence, email: Eva.McRae-Williams@cdu.edu.au

This presentation will provide an overview of my PhD thesis presently entitled *Understandings and Values of Work in Ngukurr*. It will concentrate on my analysis of the ethnographic data collected during periods of fieldwork. I began this research project in July 2005 and hope to submit my final draft in the middle of this year.

The concept of work is complex, its purpose, structure and value has changed over time and its meaning can be interpreted from many historical, social and cultural perspectives. My thesis draws upon the work ideologies inherent in Western culture and those which have developed within an Australian Aboriginal community. It describes the issues and differences within and between these ideologies and how they have influenced Aboriginal perspectives and experiences of work within a specific Aboriginal community; Ngukurr in South East Arnhem Land in the Northern Territory of Australia.

My thesis stems from a need to better understand the perceived “problem” of Aboriginal employment or more precisely unemployment in remote communities. It questions common assumptions associated with the purpose, meaning and value of work through analysing historical, cultural and social components that have influenced the development and construction of work ideology in the study setting. In this presentation I will discuss the nature of Aboriginal work ideology in Ngukurr and through this process question the usefulness of employment statistics in the measurement of life quality in this remote Aboriginal community.

What does regional natural resource management in Australia's savannas deliver?

Cathy Robinson

Tropical Savannas CRC and CSIRO Sustainable Ecosystems, St Lucia, Brisbane, Queensland
Correspondence, email: catherine.robinson@csiro.au

Regional natural resource management (NRM) is now widely advocated across Australia as part of growing policy commitment towards integrated approach to environmental management. The ability to demonstrate the effectiveness of selected regional NRM programs are critical questions now being asked by government program and regional community investors. Yet as the findings of this research highlight, collaborative efforts to evaluate outcomes generated from NRM delivery in Northern Australia is a challenge. The emphasis collaborators place on natural, social, cultural and economic *substantive outcomes* delivered in savanna regions might not necessarily be shared. Priorities and resources dedicated to deliver *enabling outcomes* – such as improving capacity building or developing socially robust approaches to developing new knowledge systems – might also not be agreed. The protracted effort required to negotiate plans and set regional targets suggest that there are significant costs to establish and maintain partnerships between scattered and diverse local communities who often have different interests in shared natural resources. Government funding offers critical drivers behind action-outcome relationships that have been facilitated through regional planning arrangements yet government agencies struggle to commit to regulatory and institutional actions needed to ensure delivery of outcomes in such remote settings. A comparison of outcomes reported within Northern Australian regions compared with the outcomes sought and captured by the NHT2 / NAP program can be used to inform improvements in current efforts to evaluate the effectiveness of regional NRM in Australia's savannas:

- Expect resource condition target setting to rely on testing links between actions and outcomes adaptively. This will need to recognise that the achievement of specific actions will need to be accepted as surrogate measure for achieving outcomes in many instances.
- Successful integration of natural resource use, planning and management through the coordination of government, community and industry perspectives and effort are just as critical to achieve outcomes as on-ground actions.
- Existing monitoring and evaluation frameworks make it difficult for government and other investors to access the full (environmental, social, cultural, and institutional) impact of regional NRM. Support for a refined assessment of outcomes delivered from integration fit for the purpose of savanna environmental management needs is required.

Enhancing community benefits from regional development: it's not just what you do but how you do it

Natalie Stoeckl and Owen Stanley

Tropical Savannas CRC and James Cook University, Townsville, Queensland
Correspondence, email: natalie.stoeckl@jcu.edu.au

The presentation is based on the publication entitled *Regional Economic Multipliers in Australia's Tropical Savannas* which was one of the outputs from the Outback Livelihoods Project.

Some important questions which motivated the research were:

1. Which industries create the most regional economic benefit in terms of direct and downstream (multiplier) effects?
2. How can policy be changed so as to increase the size of regional benefits?
3. How does the total regional economic benefit of an industry compare with its environmental and/or social cost?

The answer to any of these questions is assisted by knowledge of regional multipliers – hence the CRC's interest in the multiplier case-study; although the study only focused on (1) and (2), leaving much scope for further research on (3).

Traditional methods of estimating multipliers (such as Input-Output analysis and Computable General Equilibrium Models) are costly to develop and are not generally suitable for small-region analysis. So the study used an established 'short-cut' to produce small area (post-code) multiplier estimates for 17 different industries across the tropical savanna.

Estimates were produced using expenditure data from a survey of 963 organisations. As expected, most respondent organisations were relatively small – the median number of employees was generally fewer than 10, and those employees often worked part-time and/or were members of the family that owned the organisation. The largest organisations were in mining and government. Despite the fact that Aboriginal and Torres Strait Islander (ATSI) people comprise more than 25% of the population in the savannas, they were underrepresented in the sample: fewer than 6% of respondent organisations were owned or operated by ATSI people and only 14% of employees were ATSI.

After accounting for imports, the household sector was found to receive the largest share of revenues when expressed as a percentage of total organisational revenues. The retail sector was the next largest recipient. Financial flows to other local businesses were generally quite small.

Organisations within the government and health sectors spent the highest proportion of their revenues locally. Consequently, the largest business-level multipliers were found to be associated with those organizations. This means that an expansion of the Health or Government sector could do more to promote regional development than an equal expansion of other sectors.

The survey also presented evidence that suggests much expenditure within the savanna is 'supply constrained'. Consequently, it may be possible to increase the size of local multipliers by encouraging the development of 'support' / 'supply' industries.

In other words, those interested in enhancing the community benefits from regional development should not just look at the demand side of the equation (i.e. at what is spent or 'delivered' to a region – such as health or education), but they should also look at the supply side, ensuring that the local community participates in the delivery and production of goods and services.

With the above in mind, policies that can assist local development include those that encourage existing organisations to 'buy local' and/or those which enhance community capacity to supply. Strategies for doing so are discussed in the presentation, and directions for future research are highlighted.

Job Done? Is Indigenous capacity done?

Joe Morrison

Tropical Savannas CRC and the North Australian Indigenous Land and Sea Management Alliance,
Darwin

Correspondence, email: Joe.Morrison@cdu.edu.au

For many years, Indigenous representative and development agencies have agitated for increased engagement with the research community to support them in strengthening their ability to manage and/or develop their ancestral estates. Importantly, Indigenous people still maintain that they are not just another sector or stakeholder in the region, but with customary obligations and deep unmatched connections that extend thousands of years in the past. The Tropical Savannas CRC (TS-CRC) offered an opportunity to do just this, but with historical neglect and a focus on land rights, citizenship and equality the road to Indigenous engagement was going to be a hard one. The northern alliance that was formed to examine native title, presented as the means by which land and sea management could be maximised and provided a unified point of contact for engagement with groups such as the TS-CRC. After a long gestation this led to the eventual birth of the North Australian Indigenous Land and Sea Management Alliance (NAILSMA).

So has NAILSMA achieved what it set out to with the TS-CRC? This paper presents the results in a broad range of key areas such as:

- Indigenous input into the governance arrangements,
- decision making,
- engagement with the immediate research community,
- links to the broader research and development community,
- ground up methodology for action research and implementation and
- advocating the rights, interests and requirements for remote Indigenous lands across the wet/dry tropics of the north.

What of the future? One measure of the success of NAILSMA is that it is now sufficiently robust and well-supported to continue in its own right beyond the life of the TS-CRC. It has achieved critical mass and has built a level of credibility which will serve it well in the immediate future. There is clearly strong support for NAILSMA at local, regional, national and international levels and the challenge is now to deliver meaningful outcomes to its stakeholders at these different levels.

Indigenous management of dugongs and marine turtles in Northern Australia

Rod Kennett

North Australian Indigenous Land and Sea Management Alliance, Darwin
Correspondence, email: Rod.Kennett@cdu.edu.au

Northern Australia is one of the last great strongholds for marine turtles and dugongs on the planet. With home ranges that cross borders and seas, these migratory species face a diverse range of threats and impacts that, collectively, have decimated populations elsewhere around the world. Maintaining Australia's great herds of dugong and marine turtle requires effective partnerships, networks and collaborations that span northern Australia and indeed the SE Asian region.

Northern Australia is also home to some of the longest running, intact land and sea management regimes in the world. Indigenous communities of northern Australia maintain long-held rights and responsibilities for land and sea management and continue to enjoy dugong and marine turtles as a significant natural and cultural resource. There are numerous examples demonstrating the skill of Indigenous Australians in combining traditional and contemporary skills, knowledge and expertise for better resource management, and for north Australia Indigenous land and sea managers are the only management presence.

The NAILSMA Dugong and Marine Turtle Project (DMTP) is about Indigenous communities across northern Australia working together to protect threatened sea turtles and dugongs and their coastal habitats. Indigenous rangers and community members from the Kimberley, Northern Territory, Gulf of Carpentaria, Cape York and Torres Strait are working with government organisations, scientists, industry and other stakeholders to map and protect sea grass beds; clean beaches and rescue stranded wildlife, tag turtles and monitor turtle nests; record and share traditional knowledge about turtles and dugongs; and educate and raise awareness about the need to look after turtles and dugongs. Building local capacity and sustainable partnerships to support ongoing community activities are essential to the NAILSMA DMTP.

The NAILSMA DMTP represents a recognition by government that effective and sustainable management of dugong and marine turtle requires a community-based approach that builds on the strengths, skills and expertise of Indigenous people and is driven by the concerns and issues identified by Indigenous people. The collective expertise of the Indigenous participants in the project coupled with the networks facilitated through NAILSMA and the partnerships being forged with government and other stakeholders, is making significant contribution to the sustainable management of dugong and marine turtle.

Talk about a walkabout: pathways and potholes for tropical savannas knowledge in schools

Julie Crough

Tropical Savannas CRC, Darwin
Correspondence, email: Julie.Crough@cdu.edu.au

Savanna Walkabout is the first learning module to be completed for the Tropical Savannas Knowledge in Schools project. The *EnviroNorth* website which provides the framework and support resources for teachers and students for *Savanna Walkabout* and subsequent modules, was launched in February 2007. A CD-ROM of *Savanna Walkabout* was disseminated to all schools in the Northern Territory with a letter of support by the NT Department of Employment, Education and Training's CEO in April 2007. Both resources have been disseminated and promoted in educational professional circles throughout Australia and overseas.

However, one of the largest obstacles with the adoption of *EnviroNorth* and *Savanna Walkabout* is the time and resources required to engage teachers with the module given the remoteness of most schools in northern Australia. Experience since the 2007 launch has demonstrated that it is not until you physically expose teachers to *Savanna Walkabout* and encourage them to engage with it, that its real potential is realised. Presentations, teacher workshops, and face-to-face meetings have reinforced this issue. This has enormous implications for the implementation of the project and resources. The project has taken many pathways with the inevitable potholes along the way. There are bound to be more pathways (and unforeseen potholes) as we map and implements the project's future directions.

Pathways and Potholes

- Promoted and very positive feedback through professional networks and conferences at regional, state, national and international levels including: National (and International) Science Teachers Association; Explore NT (NT DEET); the Australian Sustainable Schools Initiative (DEWHA) and is included in the Australian School Science Education National Action Plan (2008-2012).
- Direct link from NT schools portal to *EnviroNorth* website as well as NT DEET website.
- Professional links in both Queensland and Western Australia have been developed with *Savanna Walkabout* (& *Burning Issues*) being used at science teachers' workshop in Broome in April.
- Article for national education publication that is distributed (and published by Curriculum Corporation) throughout all State and Territory education departments.
- Linked and incorporated *EnviroNorth*, *Savanna Walkabout* and also *TRARC* into teacher workshops.
- Resources are being incorporated into project – Mainstreaming sustainability into pre-service teacher education across Australia (NT and QLD are pilot projects).
- Funding grant has been granted (led by Dr Linda Ford) for "*Engaging Indigenous students in science using Savanna Walkabout in language*".
- *Burning Issues*, the second module in the series, is in the final production stages and has received 50% of its funding from Bushfires NT. It will be officially launched in April 2008. Plans underway to pilot *Burning Issues* in Term 3, 2008.
- *Cattle Country*, the next module, will recommence development in April 2008.
- Further funding and consultation will be required for the fourth module, *Caring for Country*.

- Working towards developing Professional Learning for teachers in schools that is an accredited online module that embeds all the *EnviroNorth* resources.

There's more where that came from: future directions in NRM information tools for the tropical savannas

Peter Jacklyn

Tropical Savannas CRC, Darwin

Correspondence, email: Peter.Jacklyn@cdu.edu.au

Over the last thirteen years the Tropical Savannas CRC (TS-CRC) has developed a range of Natural Resource Management (NRM) Information resources that are now valued tools used across northern Australia, including the *NAFI* website and the *Savanna Links* newsletter. This talk will outline the plans we have to continue maintaining and developing these resources after the TS-CRC winds up later this year.

After the Tropical Savannas CRC?

Our information tools have characteristics that came directly from the TS-CRC environment and that have often contributed to their success: they arose from projects in which end users decided what information tools to develop; they can be used right across northern Australia by a range of land managers and planners so they add value to what our partners do; and the tools are responsive to user feedback once they are in use. What will happen to these NRM Information tools and the knowledge base behind them once the Tropical Savannas CRC winds up? Strategies for maintaining these processes and the knowledge base and supporting resources they sustain will be outlined. Proposed institutional arrangements and networks with research users and researchers will also be discussed.

New web tools

Another priority is to continue to develop our existing NRM information tools to meet emerging NRM needs. For example we are looking at new features on the *NAFI* website: an improved map viewer; quicker fire scar mapping; new satellite sources to improve fire detection in cloudy conditions; new ways of visualizing fire spread; maps that display carbon emissions and other greenhouse-related data.

We have also developed another site for NT NRM Board that builds on the *NAFI* experience: a mapping website that provides planning resources for NT land managers. This site meets an important emerging need as many people, from pastoralists who have to develop property management plans, to Indigenous Ranger groups who have to monitor progress on their projects, will need to have easier access to information that profiles the natural and cultural assets on their lands, along with the threats and shows how these may be changing. This information might maps of natural resources or fire history or lists of threatened species, weeds and feral animals likely to be found on their land together with information on how to manage these species. The *InfoNet* project is putting the finishing touches to a web application that provides these resources and allows people to walk away with useful printed maps and species identification booklets. The site relies on an extension of the *NAFI* web-mapping technology as well as the database of information on our Land Manager website, but more importantly it relies on the same emphasis on end user input from a range of sectors and disciplines used by CRC sites. While the site is focused on the NT, we have been talking with various NRM groups about applications of this technology in Queensland.

If we are successful in securing funding for the NAFI site and the other NRM websites we should be able to continue operating the *Savanna Explorer* website, the TS-CRC legacy website as well as selling and distributing the TS-CRC's remaining publications and producing *Savanna Links*.

Our future role

The NRM websites and many of our publications play a similar role: they are practical NRM tools that draw on data largely from Government agencies or research institutions, and make this data useful for practical tasks to a range of end-users associated with north Australian NRM. The websites do this via easy-to-use interfaces, the design of which is open to input from the end-users. State and Territory Governments in particular have a key role as custodians of much of the NRM data but the development and maintenance of our website interfaces is well suited to a user-driven body with good networks and a strong knowledge base that is perceived to be independent.