Session 9: Natural resource management

Speaker abstracts:

9.1. Martu Living Deserts Project – partnering for conservation led by Indigenous people

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While most of Australia’s aridlands have suffered either total loss or serious declines of native fauna, the Martu lands in WA’s Western Desert in the eastern Pilbara provide one of the last wild havens for some of Australia’s iconic but highly threatened desert species.

With support from the Australian Government, an innovative partnership between The Nature Conservancy (TNC), BHP Billiton Iron Ore (BHPBIO) and the Martu people (represented by Kanyirninpa Jukurrpa – KJ) is achieving exciting social, cultural, economic and environmental outcomes. TNC has been able to bring its strategic conservation planning experience in landscape scale projects to assist the Martu people build capacity and fulfil their desire to preserve their culture while actively managing their 13.6 million hectare native title determination area.

Through KJ as the local delivery partner, Martu people are returning to work on country to:

- clean and protect water holes;
- improve fire management;
- manage feral herbivores and predators;
- manage cultural heritage;
- protect priority threatened species (such as the Bilby); and
- translocate rock-wallabies (and potentially other species) into their former habitats.

The project provides significant employment opportunities for Martu men and women in ranger teams working throughout the native title area. It is also generating measurable social, cultural and economic benefits for Martu people and environmental benefits for part of the most intact arid ecosystem anywhere on Earth.

Keywords: Martu, conservation, partnership, country, culture, threatened
9.2 (Student). New cross cultural monitoring for effective management of indigenous lands: a case study from western Arnhem land

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The rapid growth of Indigenous owned and managed conservation areas in Australia and internationally represents a new paradigm in land management. Known in Australia as Indigenous Protected Areas (IPAs), they have expanded from a single 55,000 ha region in 1998, to 65 IPAs in 2014, totalling over 50 million ha, now constituting around 40% of Australia's National Reserve System. Covering vast swaths of rangeland these IPAs include some of Australia's most biodiverse and intact landscapes. Although predominately under sole indigenous management, IPAs require multiple external partnerships for effective land management. Therefore it is necessary to move beyond the dominant indigenous/government 'joint management' model.

Environmental monitoring is essential for effective management of protected areas. Recent critiques of environmental monitoring however have been highly critical of its value; consequently new monitoring frameworks are emerging. These models however are designed for a scientific and bureaucratic context and are not well suited to the unique cultural, geographic and economic circumstances of IPAs. Their application on indigenous lands results in esoteric monitoring programmes which, without community support, are unsustainable. This research created a new cross cultural monitoring framework, integrated with indigenous land management whilst also satisfying the requirements of funding bodies and other partners. Cross cultural monitoring requires a shift from the dominance of compliance monitoring and externally driven research, to a monitoring programme where indigenous understanding of country directs all facets of the monitoring cycle; from inventory, to research, to assessing management outcomes, whilst simultaneously communicating with multiple audiences.

The endemic, fire sensitive Allosyncarpia ternata dominated forests of the Arnhem Plateau provided a case study within the Warddeken IPA to demonstrate the cross cultural monitoring process. In doing so it produced more functional datasets, customised tools, key ecological research findings and importantly increased indigenous re-engagement with these ecologically and culturally significant forests.

Keywords: indigenous land management, cross cultural monitoring
9.3. Traditional hunting of feral cats to help protect key threatened species at Kiwirrkurra

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Kiwirrkurra country, in the remote Gibson Desert, hosts important populations of two key threatened species: bilby and great desert skink. These species are sparsely distributed throughout the western desert regions, and are declared as Vulnerable under the EPBC Act. Predation by feral cats and unsuitable fire regimes are two key threatening processes for both species.

Like many other desert Aboriginal groups, Kiwirrkurra people regularly patch burn their land whilst hunting. Kiwirrkurra people also have a long tradition of hunting feral cats for food, and importantly still undertake this activity today.

Recognising the significance of this unique skill, a program was set up in mid-2014 to maintain and expand traditional cat hunting in key bilby and great desert skink habitats. The program encourages the retention and passing on of this skill through:

- Reimbursement of costs for successful cat hunts, through direct payment to the hunter,
- Data collection on who hunts, and when and where cats are caught,
- Analysis of stomach contents by a wildlife ecologist (guts are kept and frozen for later analysis), and
- Two-way knowledge sharing on the value of cat hunting for biodiversity and culture.

The cat hunting program is complemented by regular patch burning in the same areas, both as part of Kiwirrkurra people’s daily life and through paid land management work.

Regular (bi-annual) monitoring of the distribution and abundance of both threatened species and feral predators is being undertaken to assess the impact of this program on both populations. A key indicator will be the persistence (or otherwise) of known bilby and great desert skink populations.

Keywords: feral cat, bilby, great desert skink, hunting, biodiversity protection, Kiwirrkurra
9.4. Manta Palyakutu: Ngurra kantilya kanyini! Land use and management led by Anangu on Anangu land near Indulkana, APY Lands of South Australia

Willy Wara Edwards and Wangka Wangka, Indulkana Community, APY Lands, South Australia

The eastern APY Lands were the home of the Yankuntjatjarra people living traditionally until European pioneering development led to many Anangu providing labour to the pastoral industry and permanent settlements arose. Pastoralists generally developed and used the land as they saw fit and many sacred sites were damaged or destroyed in building pastoral infrastructure.

When the APY Lands came into being, many eastern areas continued to be grazed by cattle, but mainly on agistment by commercial pastoralists from as far away as western Queensland. Without owning it, pastoralists cared for land under agistment less than they did for their profits. The land suffered and so the Anangu suffered. Grazing management no better (perhaps worse) than before.

We explain how we are changing this using the EMU™ Process with support from APY Anthropology. We plan what can happen and where on our land, protect sacred places and special ecosystems and start planning our own businesses that “fit” our land-culture. This programme we call Manta Palyakutu (really healthy/good land): Ngurra kantilya kanyini (looking after our places really strongly). This is the story of our progress so far. We are grateful for support from the APY Executive, Commonwealth Government and AWNRM Board.
9.5. MTP Contracting: Running a remote NRM business on the Barkly Tablelands

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MTP Contracting is an Indigenous business operating out of Corella Creek Community in the Barkly Tablelands, NT. Established originally as a contract mustering business, MTP has expanded into NRM as a weed spraying business providing a targeted, on-ground effort in the battle to manage Parkinsonia and other woody weeds on the Barkly, and was also recently involved in a drought refuge survey of ephemeral waterholes in the area. This presentation will provide an overview of why MTP Contracting was established by founders and directors Joy and Maxie Priest and talk about the challenges faced in developing livelihoods in NRM on this remote community, the projects completed and the hopes for the future. The business model builds on strong relationships with regional stakeholders, knowledge of country, and an unwavering commitment to reside on the Barkly alongside the 5% of the population who call the Australian outback home. The business is now in its 4th year and has employed over 20 staff during that time providing formal and informal training to ensure skills are maintained and enhanced. As a result, MTP has established strong relationships with the pastoral industry, in particular Australian Agricultural Company, Barkly Landcare and Territory Natural Resource Management, and has become an influential organisation in the Barkly and beyond.

Keywords: indigenous, Barkly, NRM, weeds, fee-for-service, innovation
9.6. Challenging the concept of Aboriginal mosaic fire practices in the Lake Eyre Basin, with particular focus on the Cooper Creek country and adjoining Simpson Desert, 1845-2015.

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In the many discussions about the significance of Australia-wide Aboriginal fire practices since Rhys Jones’ seminal “Fire-stick farming” paper 40 years ago, one aspect that has become a constant is that of the importance of patchy or “mosaic burning”. This, it is believed, still is, or once was, done in a substantially controlled manner for a variety of reasons, and often actually or implicitly indicates idealistic traditional knowledge about landscapes, seasons, animals and plants, as well as an ability to control fire. Bill Gammage (2013), the latest advocate of such perfect Australia-wide fire management, has restricted his research to the time of the permanent arrival of Europeans. My starting point in this study (with my emphasis), referring to the period 1876-1951 (and implicitly as far back as 1845) is:

“There were reports of bushfires burning along the New South Wales and Queensland borders - a new phenomenon in the Cooper country ---” (Tolcher 1999:144).

Evidence will be presented from 1845 to 2014 both for and against this statement, indicating that the terrain, changing nature of vegetation, seasonal conditions (including times of lightning strikes), the presence or not of Aborigines, the stocking of the pastoral country and spread of feral animals, government policies about fire and desert reserves, and Aboriginal Land and Native Title Rights, all have some relevance.

In that the use of fire by rangers and others to recreate a vegetation mosaic is often being practiced in “remote Australia”, and being advocated by many Australia-wide, is there a need to pause? In particular, what are the ramifications for the future management of the desert areas under consideration?
Understanding climate science supports adaptation in indigenous rangeland management

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Indigenous land managers are contributing to global knowledge of climate change through their observations but often have little understanding of climate science. Limited climate science understanding means that Indigenous land managers, like other people, can find it difficult to assess the relevance or trustworthiness of information they hear about climate change and determine how best to respond. The psychosocial impacts of this ‘knowledge uncertainty’, which range from apathy to elevated stress, can inhibit effective planning and reduce adaptive capacity.

We have been learning collaboratively about climate science in the context of the Ltyentye Apurte Rangers’ work program. We used gully erosion as a focus because the rangers are working to restore the land and are worried about gullies. We demonstrated why climate change, including increased rainfall intensity, is likely to exacerbate gullies. We explored past weather and climate variability from people’s recollections, old photographs and weather records. Science explanations for causes of climate change added to the rangers’ knowledge and motivation to explain climate change to others in their community. Developing a power-point presentation consolidated the rangers’ understanding. Following the presentation to three community groups, discussions identified likely climate change impacts, feasible adaptations, and limits on the community’s capacity to adapt without complementary action by others. Seeing the results from Bob Purvis’ four decades of gully restoration on Woodgreen Station led the rangers to a new understanding of the length of time and commitment required and raised their motivation and confidence for action on their own country. Addressing knowledge uncertainty through these experiential methods has developed the rangers’ climate literacy, including perception of risk from climate change and interest in adapting, which are important to people’s capacity to adapt to climate change.

Keywords: climate adaptation, Aboriginal land management, climate literacy, land restoration, Aboriginal community rangers
9.8. The use of camera traps to investigate wildlife usage of remote waterholes in central Australia

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Central Australian waterbodies can be biological hotspots and areas of high endemism for aquatic species, and most have great cultural significance to local Aboriginal people. Until recently little work has been done to quantify their importance to terrestrial wildlife, or investigate if the presence of large feral herbivores, such as camels, impacted on native wildlife usage. Since 2007 we have worked closely with Traditional Owners and Indigenous ranger groups to deploy camera traps at over 20 sites across central Australia, from the Simpson Desert to the east, the Tanami Desert to the north, and the Petermann Ranges to the southwest. Over 1.5 million images have been obtained to date from a combination of camel-accessible and non-accessible sites. We used co-occurrence occupancy and niche overlap models to investigate if camels competitively excluded native species and to what extent exclusion occurred. We constructed activity budgets for a sub-set of species, and investigated how these budgets changed due to camel presence and other covariates. Not surprisingly waterholes were heavily used during times of extreme drought, but overall usage remained high even during wetter periods. The presence of camels at a waterhole significantly reduced the probability of native wildlife using the waterhole at the same time, and in some cases triggered a “competitive cascade” whereby native species were displaced by apex predators that had been displaced by camels. Our data suggest that central Australian waterholes are an important resource for a variety of native wildlife species, even those thought to rarely need water.

Keywords: central Australia, waterholes, camera traps, competitive cascades, feral camels
Large feral herbivores such as camels and horses are one of the major threatening processes for biodiversity in arid Australia. To address this issue, the Australian Feral Camel Management Project (AFCMP) started in 2009 and was an ambitious 4.5 year national project spanning the Rangelands in Western Australia, Northern Territory (NT), South Australia and Queensland. The overall aim of the project was to reduce camel densities to 0.2 camels/km² at 18 key sites of significance. Sites were selected due to environmental, social and cultural significance. Over the life of the project 160,000 camels were removed and density targets were achieved at all 18 sites. Of the camels removed, about half were removed from the Northern Territory. Project success in the NT was attributed to six key elements: priorities, partnerships, policy, procurement, people and processes. In addition, several critical turning points were identified during the project and together with the six key elements, led to project success. The critical turning points and key elements were not explicitly defined at the start of the project, but rather were identified and defined during and after project implementation. Now that these elements and turning points have been recognized, their inclusion in on-going large feral animal removals should enhance future project outcomes.

**Keywords:** landscape scale, feral herbivore, natural resource management, partnerships
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Poster abstracts:

P9.1. Is more or less fire needed in northern savannas? Fire history (and optimal management) varies with land use and land type

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Fire management recommended for biodiversity conservation and reducing greenhouse gas emissions (reduce late dry season fire) contrasts to that for managing woody plant thickening on pastoral lands (increase late dry season fire). To investigate whether contrasting fire managements are justified, NAFI fire history derived from AVHRR imagery was used to analyse fire frequency between 1997 and 2010 in the Victoria River District of the Northern Territory. Fire frequency for all fires (January to December), and late dry season fires (August to December) were derived for different land uses (defence, national park, indigenous, indigenous pastoral and pastoral) and broad land types. Average fire frequency was lowest on pastoral land (19%), and highest on park (31%) and defence land (39%). Indigenous and Indigenous pastoral land burned 26% of years. However, on pastoral land the frequency of fire varied across land types. The most productive pastoral land types burned the least, averaging just 11% of years, while the least productive land types burnt in 25% of years. Trends were similar for late fire frequency on pastoral land, which was lowest on high productivity land (7%) and highest on low productivity land (19%). Areas that are not grazed experience high average fire frequency and will benefit from fire reduction strategies. Conversely, the very low fire frequency on the most productive pastoral land types is likely to have contributed to observed woody thickening in the region. In these important pastoral land types increasing fire frequency may assist to manage woody cover and improve or maintain productivity. In contrast, where there is a high fire frequency on low productivity pastoral lands (which are often not grazed), there may be opportunities for participation in Carbon Farming Initiative savanna burning projects to reduce fire frequency and greenhouse gas emissions.

Keywords: fire frequency, fire management, savanna burning
P9.2. Approaches to validating satellite imagery products of woody vegetation thickening using aerial photograph interpretation: methods and preliminary results

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The increase in woody plant density in grasslands and the conversion of open woodlands into shrublands (i.e. woody thickening) is a phenomenon that has been increasingly reported in the past decade and is particularly common across arid and semi-arid regions of Australia. While woody thickening may reduce biomass available for domestic livestock grazing, there are some significant benefits for carbon sequestration and biodiversity (e.g. increased diversity and abundance of in some regions for some taxa). The goal of this project was to investigate the trends (increasing or decreasing) in woody vegetation cover across western NSW to inform assessments of carbon potential, landscape productivity and habitat change. Landsat imagery from 1987 to present was used to develop models of linear trends in persistent green cover over time ('trend product'). Trends in persistent green cover are expected to represent the woody, rather than herbaceous, component of vegetation change. Aerial photograph interpretation (API) was used to validate the use of persistent green index as an accurate measure of woody cover change by determining whether a change detected in the trend product appeared as a change (positive or negative) in the aerial photographs, and vice versa. Further investigations aim to determine whether the nature of the relationship between the API results and the trend product change according to land system/landscape position, or any other discernable factors. The methodology presents an advanced and novel development in the use of remote sensing for natural resource management.

**Keywords:** Landsat, aerial photograph interpretation (API), woody thickening, western NSW
The Western CMA catchment is large, covering 40% of NSW, with a range of Landsystems and vegetation community types. Under future climate change scenarios, western NSW is more likely to experience longer periods of hot, dry weather. This may pose problems for terrestrial biota that are not well adapted to warmer conditions. There is a paucity of on-ground studies in western NSW that have assessed sites for their potential as suitable refuge areas during periods of hot, dry weather.

Recent studies suggest that convergent environments, such as deep valleys and gorges, are potential refuge sites because their local climate is decoupled from the regional climate, making them environmentally stable. These environments may be characterised by higher soil moisture with denser, more persistent vegetation than the surrounding region on a similar land system. This is due to them being in water run-on areas where moisture and nutrients accumulate, and in areas of cold-air drainage, with lower daily insolation, and sheltered from hot, dry wind.

Due to the large size and inaccessible nature of Western NSW, an innovative remote sensing based approach to identifying potential refuge sites has been proposed. Several remotely-sensed datasets have been used within a decision-support tool environment, combining local, expert knowledge, with a regional view provided by the data to identify the potential location of refugia in western NSW.

Landscape position indices derived from the SRTM DEM along with Landsat time-series derived datasets including water occurrence and persistent green vegetation have been combined in a GIS environment to create rule-sets for identifying refugia specific to each landscape type, as it is unlikely that a single rule-set will be applicable across the entire catchment. The results of the project to map refugia locations in western NSW are presented here.

**Keywords:** refugia, landscape, climate, remote sensing, time-series, Landsat
P9.4. Ngadju fire and conservation land management

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In 2014 Ngadju were granted Native Title over some 10 million hectares of southern Western Australia, including exclusive possession over 5 million hectares of unallocated crown land in the Great Western Woodlands.

The determination recognised Ngadju’s uninterrupted connection to country and the desire of many Ngadju to maintain their strong cultural links into the future. Ngadju Conservation was established in 2012 to coordinate and manage conservation land management programs on behalf of the broader Ngadju native title claim group. The core objective was to link the many components of land management into future employment and economic opportunities that created jobs on country. This is being achieved through the establishment of a ranger program focusing on fire training for wildfire suppression and mitigation, the development of a conservation action plan to identify a land management strategy plus surveying and mapping of invasive weeds and malleefowl.

Through a partnership with Gondwana Link, Rangeland NRM, Shire of Dundas and Department of Fire and Emergency Services we are in the final stages of developing the Conservation Action Plan and have established the Dundas Rural Bushfire Brigade. We engaged in a cultural and land management exchange with Martu rangers operating within the Birriliburu Indigenous Protected Area and our current program includes assisting in the development of regional 10 year fire strategy with Department of Fire and Emergency Services and Dundas Shire and training in Indigenous Land Management Certification 111.
This presenter is a passionate believer in the commercial model for land and environmental management. This presentation will outline the history and ethos of the Natural Area business that he commenced in 2001 after a long involvement in the volunteer environment sector.

The business employs 55 full time staff across 3 offices in WA and has developed to be become the pre eminent business of its type in the State. The business is active in supporting industry bodies and community groups allied to environmental policy and process.

The presenter has lived and worked throughout Australia for over 50 years in a wide range of business, including banking and finance, wholesale, retail and service sectors. This has included a long presence in the Pilbara with extensive exposure to South Australia and the Northern Territory.

The Natural Area model is vertically integrated and its operations encompass the provision of environmental contracting, consulting and product supply to a wide range of clients and projects. This presentation will detail the types of services that can be drawn together to create a viable business and protect against vagaries of the market. The opportunities for cross marketing and staff development will be explored.

This presentation will outline the importance of developing viable and competitive private sector businesses in the environment space and advocate for the acceptance of private environment businesses as part of the commercial mainstream. The presenters motivation to provide permanent employment and career development for young Australians will be outlined.

The underlying intention of this presentation is to demonstrate what is possible and sow positive and uplifting concepts to the attendees, sure to engender healthy debate.
Across Australia a series of projects have been running to gather climate change information and make it relevant and useful for NRM groups to assist in their regional planning processes. The aim is to enable the NRM groups to plan for climate change impacts as part of the NRM plan for their region.

The Rangelands Cluster Project worked across seven NRM regions in the rangelands: Rangelands WA, Territory NRM, Alinytjara Wilurara NRM, SA Arid Lands NRM, Desert Channels Qld, South West NRM Qld and Western Local Lands Services. Researchers from CSIRO and the University of Canberra prepared information and tools to inform and support climate change planning in the rangelands.

This paper provides examples from two of those regions and presents how they took the information that was delivered by the Cluster Project, the National Projections Project and other climate change research, and used it to inform their NRM planning processes.

**Keywords**: climate change, NRM planning, research, adaptation, rangelands, climate change impacts

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Territory Natural Resource Management (TNRM) is a non-for-project community organisation which partners with a range of stakeholders to sustainably manage natural resources in the Northern Territory. TNRM introduced the Territory Conservation Agreement (TCA) program in 2011 to encourage landholders to protect areas on their property with high conservation significance. The TCA program aims to raise awareness among landholders of the benefits of integrated conservation management. It establishes a precedent for conservation on high value sites, and strengthens the off-reserve conservation network. Priority is given to sites located within poorly represented bioregions that provide habitat to rare or threatened species, or that contain important ecological communities. TCAs seek to demonstrate the benefits of integrated approaches to conservation, including multiple land uses. Currently 24 TCAs have been established. These are located across nine bioregions with six of the nine covering underrepresented bioregions in the National Reserve System. Feedback from the landholders involved in the program for more than one year has been positive, with reports including good business outcomes as well as increased protection to assets such as water quality and native species on their property. The findings so far illustrate that by involving the landowner in the process of developing the management actions appropriate for the site the outcomes are more likely to include both conservation and productivity benefits. This is more likely to encourage landholders who may not otherwise have considered participating in a program which was viewed as being only conservation based.

Keywords: natural resource management, conservation, pastoral, partnership, off-reserve, production
The paper describes trends associated with the human ecology of the rangelands using scenarios of experience, evidence and prediction. Our concern is with trends influencing the human ecology in the rangelands of Remote Australia. We juxtapose and reconsider some key themes emerging from trends identified in recent research in remote and very remote Australia.

Rangelands are complex and biodiverse ecological regions that require land management to remain healthy. Human ecology places people into landscapes as managers whose advocacy informs impacts within and beyond the rangelands, and will continue to have impact in the future.

In many rangeland regions technology, economics, resources, policy, land tenure and labor force mobility provide indicators and evidence of trends. Human ecology offers the concept of people and landscapes as indivisible and we use this to refocus our observation and analysis of how trends affect the agency of rangelands human ecological land management.

A rangelands lens can inform local, regional or wider perspectives, and in turn ascertain how the local regional and national variables impact on the agency and equity afforded across rangelands regions. The health of the landscape is well interpreted and understood by some constituents, and its agency underpins a wider cohort, including those reliant on or deriving livelihood from human ecology of the rangelands. Currently the equity afforded across rangelands is diverse and subject to change and uncertainty. Some themes that affect or will affect the human ecology of the rangelands include changes apparent as climate, population and livability trends; and changes predicted in labor markets, social determinants, population mobility and demographic trends. We discuss the implications of these trends within and beyond the rangelands through the lens of human ecology.

**Keywords**: trends, technology, economics, resources, human ecology, land management
P9.9 (Student). Grazing for biodiversity conservation and landscape function in NSW semi-arid rangelands

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Domestic livestock are often seen as a threat to biodiversity conservation. However, there is evidence to suggest that appropriately managed livestock grazing is compatible with maintaining conservation objectives and can play an important role in enhancing the biodiversity value of agricultural landscapes. Little research has been undertaken in the semi-arid rangelands of western New South Wales to understand this role.

My research explores the implications of commercial grazing management practices for achieving biodiversity conservation and landscape function objectives, and aims to determine the potential to integrate livestock production and conservation in NSW semi-arid rangelands. The project will also highlight trade-offs between conservation and production outcomes in a complex, rapidly changing, social-ecological environment.

Specific objectives of the project include to: (1) examine the impacts of innovative grazing management strategies on biodiversity and landscape function in comparison with traditional production and conservation areas; (2) determine if grazing management can be used to improve the conservation value of land and as a method of off-reserve conservation in the semi-arid rangelands of NSW; (3) investigate how these effects change over different spatial scales, land systems and seasonal conditions, and (4) identify relationships between biodiversity and landscape function in different semi-arid range types.

Floristic surveys, experiments, and landscape function analysis are being used across paired sites on properties throughout north-west NSW employing innovative grazing management, traditional production methods, and areas managed for conservation with little or no domestic livestock. The results of the project should assist natural resource management organisations, landholders and conservation groups with management tactics and strategies to achieve conservation and grazing outcomes in western NSW. In this presentation, preliminary results from initial floristic surveys will be presented, and future experiments will be discussed.

\textit{Keywords:} conservation, biodiversity, grazing management, landscape function
P9.10. Land system characterisation: towards mapping the distribution of sequestered carbon in the Western Australian rangelands

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Rangelands NRM (WA) vision is for the rangelands to nurture financially viable and ecologically sustainable enterprises and activities, including better management of areas of significant environmental values. Underpinning this vision is the belief that managing for carbon within an integrated land use system, is, in effect, managing for ecological health. Our Carbon Awareness Project supports this vision through the provision of Australian government CFI and ERF information; raising awareness of opportunities, benefits and risks of carbon offset projects; and the generation and provision of scientifically-sound information on sequestered carbon. It is the last activity that this paper describes.

Our work involves extensive field sampling and measurement aimed at understanding the distribution of sequestered organic carbon in the soils and vegetation of particular land systems in the Western Australian rangelands. In this context, distribution encompasses intrinsic characteristics such as the proportion of carbon occurring in the above-ground (biomass) and below-ground (soil) stocks, the concentration (average, range) of carbon, and its spatial variability (heterogeneity). This is land system characterisation. Such studies have been undertaken by the Carbon Capture Project (2009-10), and at Yalleen (2011), Muggon (2012), Meka (2013), Yoweragabbie (2013) and DeGrey (2014) stations on 25 land systems. Using one study as an example, sample design, field techniques, analytes, data analysis methods and findings are described.

The large body of directly measured fundamental data acquired is being synthesised to allow further necessary work including calibrating remotely-sensed biomass estimates, informing enterprise planning and financial decision tools, and numerical modelling of carbon sequestration. Because of the very high cost of field measurement, it is imperative that low cost remotely-sensed techniques are developed to help make sequestered carbon credit projects financially viable in the rangelands. Our robust, simple plant allometrics should lend themselves to biomass and carbon measurement by high-resolution remote-sensing techniques.

**Keywords**: sequestered carbon, above-ground biomass, below-ground carbon, field sampling, allometrics
P9.11. Habitat distribution modeling of *Halocnemum strobilaceum* and *Artemisia sieberi* species using Maximum Entropy Method (Maxent) in QUM Province rangelands

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Predictive modeling of species geographic distributions and habitats identification in different plant species has an important role in the conservation and rehabilitation of rangelands. The Objective of this study was to estimate geographical distribution of *Halocnemum strobilaceum* and *Artemisia sieberi* species, Finding the most important variables in the distribution of these species, as well as Understanding tolerance range of these species to environmental factors in Qom province rangelands. Maps of the environmental variables were constructed using GIS and Geostatistics. Then predictive maps of species distribution using maximum entropy method (Maxent) and presence data species were made. The correspondence of predictive with real maps was evaluated using Kappa coefficient were assessed. Also Accuracy of the predictive models was evaluated using the area under the curve (AUC). According to the results, gravel factor in the first and second of soil depth, The electrical conductivity of first depth and sand content in second depths have the greatest impact on distribution of *Halocnemum strobilaceum* species Whereas lime amount in first depth, Amount of Silt in the first and second depth and acidity of the first soil depth have the greatest role in distribution of *Artemisia sieberi* species. Compliance of the actual and predicted maps for both species was very satisfactory level (Kappa coefficient was .74 and .70 for *Halocnemum strobilaceum* and *Artemisia sieberi* species respectively).

**Keywords**: Maxent, geostatistics, potential habitat, *Halocnemum strobilaceum*, *Artemisia sieberi*, AUC, Kappa coefficient
P9.12. Land Management in the APY Lands

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The Anangu Pitjantjatjara Yankunytjatjara (APY) lands are located in the far north-west corner of South Australia covering approximately 10 million hectares. Approximately 70% of this area is managed by the APY Land Management team under 3 major funded programs: Indigenous Protected Areas; Women’s Land Management; and Black-Flanked Rock Wallabies. The three key natural resource management issues common to all programs are threatened fauna, fire management and Buffel Grass control.

There are three APY threatened fauna flagship species: Nga’namara or Malleefowl (Leipoa ocellata); Warru or Black-Flanked Rock Wallaby (Petrogale lateralis); and the Tjakura or Great Desert Skink (Egernia kintorei). Each of these species historically had wider distributions and higher abundance throughout the APY lands however all have contracted due to feral predation and changed land management practices. APY Land Management has programs in place to monitor and manage the known remnant populations.

Traditional landscape patch burning practices have declined since traditional owners have become more centralised into township living. As a result fuel loads have increased and wildfires have caused significant landscape changes across the APY lands. APY Land Management is working with government, ecological consultants and Traditional Owners to better understand the fire regimes across the landscape and combine the traditional and modern fire management techniques to make the landscape more resilient.

Buffel Grass has dramatically changed the landscape across the northern APY Lands where it was introduced to stabilise soils around communities in the 1980’s. Buffel Grass has become a virtual monoculture in those areas where it was initially established and is aggressively invading plains, ranges and sand dune country. The APY Land Management Team is working with the SA Buffel Grass Taskforce and AWNRM trialling chemical control options, mapping distribution and abundance and developing management plans to slow the spread of into new areas and reduce the impact at culturally significant sites.

Keywords: APY, threatened species, fire, buffel grass, South Australia, IPA
P9.13. Teaching the word (waterponding and waterspreading) Aus Aid style

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A joint three year Aus Aid African training partnership between University of New England Armidale and Central West Catchment Management Authority Nyngan saw 79 Aus Aid African trainees from 29 African countries trained in the waterponding and waterspreading rangeland rehabilitation technique.

Method

This paper will highlight the training methods used in the intense hands on teaching / training, so the Aus Aid African trainees could return to Africa and be able to develop / carryout the survey and construction methods of both waterponding and waterspreading rangeland rehabilitation techniques in their own country.

Discussion

The theory can be taught in the class room but to put it straight into practise and to come out and have the skills required at the end of the training to implement the rehabilitation methods back in their own country is a challenge in its self.

References


Keywords: waterponding, Aus Aid, African trainees, training, teaching, rehabilitation
The rock-hole complexes throughout the Gawler Ranges of South Australia are of cultural significance to the native title holders. They are associated with traditional mythology and law, and store rainfall which historically afforded subsistence groups to migrate over vast landscapes in search of resources. The rock-holes and associated granite landscapes are also of ecological significance, comprising of isolated patches of mature vegetation with a high level of plant and habitat diversity, and providing the only source of natural surface water in an area of extreme aridity.

On Thurlga Station in the central Gawler Ranges, the project *Caring for Country and Culture* is jointly applying cultural and western knowledge to restore and protect rock-holes through an integrated natural resource management approach. Feral goats (*Capra hircus*) are the greatest threat to maintaining ecological health of the rock-hole complexes, so in an attempt to restore the Traditional Owner role as custodians of the rock-holes, the native title holders have partnered with the pastoral lessee to install three permanent water-point trap-yards to remove goats from the landscape. This innovative approach to feral goat management is generated from valuable observations of the animal’s migratory behaviour and temperament, and understanding of the conditions which result in good capture rates.

The trap-yards are strategically positioned and operate in the height of summer when the yearly drying occurs and desperation entices the goats to feed themselves through the infrastructure to access water. The trap-yards are left open while they become attuned and more are persuaded from the surrounding hills where prime habitat and protection hinder other methods of feral goat management. At a point the exit gate is shut, and the goats are trucked off for slaughter. In January 2013, 1820 goats were trapped.

This project is a great illustration of cultural and pastoral interests working in partnership to achieve cultural, ecological and economic outcomes for all.
P9.15. Interactive effects of burn intensity and mast seeding years on post-fire regeneration of mulga (*Acacia aptaneura*)

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Members of the arid Australian mulga (*Acacia aneura*) complex are fire-sensitive shrubs that produce mast seed crops after exceptionally high rainfall years. Such years also drive widespread wildfires in inland Australia, as high rainfall causes grassy fuels to accumulate, enabling fuel contiguity to occur. Despite seedling regeneration playing an important role in mulga post-fire recovery, a dearth of information exists on the dynamics of its seed banks. Moreover, no previous studies have investigated the impacts of mulga mast seeding events on seed banks, or how such events may influence seedling recruitment responses after fire. In this presentation, results are presented from a study on the temporal and spatial dynamics of seed banks of a mulga population after a region-wide masting event at Laycock's Sandplain, central Australia. Additionally, preliminary results from a mensurative field experiment are presented, which examined the effects of fire intensity and mast seeding on mulga regeneration after fire. Results from the seed bank study indicated that mast seed falls had a profound effect on seed banks, with the 2010 Laycock’s Sandplain mast event producing massive but short-lived pulses of seed in upper soil layers. After seed fall, seed banks declined rapidly, and within 18 months had been reduced by predator depredations to low pre-mast levels. Results from the mensurative field study indicated that both fire intensity and the ‘strength’ of a pre-fire mast event were important drivers of post-fire seedling regeneration, and it was shown that high intensity fires after large pre-fire seed falls resulted in increased levels of post-fire recruitment. Our findings indicate that mulga masting should enhance resilience to burning by providing transient seed pulses during periods of high flammability (i.e. after heavy rainfalls). The results also indicate that burn intensity influences post-fire regeneration by interacting with seed germination biology and post-mast seed bank dynamics. There are numerous possible evolutionary drivers behind mulga seeding periodicity, and we hypothesize that rain-driven masting in mulga is a fire-related form of environmentally predictive masting.

**Keywords:** mast seeding, mulga, *Acacia aneura*, fire ecology, seed banks, seed predation