ABSTRACT BOOK

Australian Rangeland Society

22nd Biennial Australian Rangeland Society Conference

18-22 September 2023 – Broome, Western Australia

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Preparing for drought: What farmers say

J. Laffan

Tocal Agricultural College, Paterson, New South Wales, Australia

Abstract:

Preparation for dry times and survival through them has not been well documented. There are many useful publications about *managing for drought* and *recovering from drought* but once the drought breaks there is a tendency to move on and not record successful measures that people put in place before the drought. This study is about *preparing for drought*.

Many consider that drought is expected as one of the of risks to agricultural production. Although such conditions are never welcome, it makes good business sense to prepare for this calculated risk.

Forty producers from widely distributed areas throughout New South Wales and into Central Western Queensland were interviewed about their drought management strategies. The concept of drought is not the same to everyone: it can differ according to severity; frequency; days or years of dry time; industry; growing season; ambient temperature. Production in the study included the following enterprises: grazing; cropping; viticulture; dairy.

Although individual circumstances and locations differ, there are common themes that evolve:

- livestock selection and management;
- soil moisture content assessment;
- ground cover as a priority;
- need for climate forecasting;
- water storage;
- goal setting;
- financial opportunities and management;
- mental and physical health of all involved; benefit of community involvement.

In addition, it was often common to realise the need to make tough decisions such as breaking away from traditional family or location management practices or selling seed stock. However, it can be difficult to be objective when formulating the plan.

Preparation for drought is best undertaken in normal times. Act now!

Two complementary methods measure recovery of a degraded landscape in central Australia

G.N. Bastin*, M.H. Friedel, C. Materne*****

*Alice Springs, Australia
**Research Institute for Environment and Livelihoods, Charles Darwin University, Alice Springs, Australia
***Department of Industry, Tourism and Trade, Alice Springs, Australia

Abstract:

Most of Old Man Plains Research Station, south-west of Alice Springs, was formerly one large paddock (~470 km^2) within the Owen Springs pastoral lease. When the research station was established in 2002 the land had been severely degraded.

Two methods that largely remove the effects of rainfall variation on vegetation dynamics show that land condition, based on remotely-sensed groundcover, has improved since 2002.

The Dynamic Reference Cover Method (DRCM) (Bastin *et al.* 2012) examines the persistence of groundcover in the driest of years. Spatially averaged deficits improved from -43 in 1991 to -24 in 2019.

Grazing gradient methods (GGMs) examine groundcover response in the wettest years. The 'cover production loss' (%CPL) index (Bastin *et al.* 1993) decreased from 19.7 in 2000 to 6.3 in 2011, after two very wet years, and 11.2 in 2022, following increased cattle numbers in some paddocks and extensive death of perennial grasses in preceding dry years.

DRCM analysis is largely automated and readily accommodates altered grazing infrastructure when updated in the GIS database. Repeat analyses by GGMs requires that distance from water is updated. Moreover persistent degradation surrounding long-established waterpoints may confound %CPL values where grazing infrastructure changes.

Despite the limitations of GGM analysis, both methods can assist in objectively judging the long-term sustainability of grazing practices because they can be used in contrasting seasonal conditions.

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Grazing decision support tool uses satellite-derived vegetation production data and user-defined animal behavior variables

T. Hudson*, M. Rahr, M. Reeves***, S. Hall****, G. Yorgey******

*Washington State University Extension, Ellensburg, Washington, U.S.
**University of Arizona College of Agriculture & Life Sciences Communications and Cyber Technologies, Tucson, Arizona, U.S.
***USDA Forest Service Rocky Mountain Research Station, Missoula, Montana, U.S.
****Washington State University Center for Sustaining Agriculture & Natural Resources, Wenatchee, Washington, U.S.

Abstract:

Grazed grassland, shrubland, and savanna ecosystems worldwide are critical for human flourishing and are vulnerable to degradation and undesirable ecological state changes when socioeconomic conditions incentivize unsustainable forage harvest patterns or amounts (Sala *et al.* 2017). On large grazing areas, whether private property or common pool resources, the ability of plant communities to retain rangeland health attributes of soil stability, hydrologic function, and biotic integrity depends on stocking rate and control of grazing timing, duration, severity, and frequency (Dyer *et al.* 2021). Sustainable stocking rates depend on judicious use of available forage. Balancing forage supply with animal demand remains a critical step even under the most innovative grazing management approaches. Most stocking rate tools assume land managers have spatially accurate information on forage quantity and that a static sustainable stocking rate can be developed in highly dynamic ecosystems. But in arid and semi-arid ecosystems defined by resource scarcity and prone to threshold events driven by abiotic variables, the inherent interannual variability of precipitation and net primary herbaceous biomass is especially fraught with peril for pastoralists (Moritz *et al.* 2014). This environmental variability and social vulnerability also highlight the importance of animal distribution effort, and distribution is usually driven by grazing infrastructure such as watering sites and fence. Washington State University Extension, in partnership with the University of Arizona and the United States Department of Agriculture Forest Service, offers a grazing decision support tool that incorporates historical forage production and variability with user-defined animal behavior prediction to permit spatially-explicit dynamic stocking calculations and grazing planning (Hudson *et al.* 2021). It also allows scenario testing infrastructure investments by predicting increase in forage availability. These analyses are critical for preventing degradation of grazed semi-arid ecosystems, as these transitions are difficult to interrupt or reverse (Bestelmeyer *et al.* 2017, 2013).

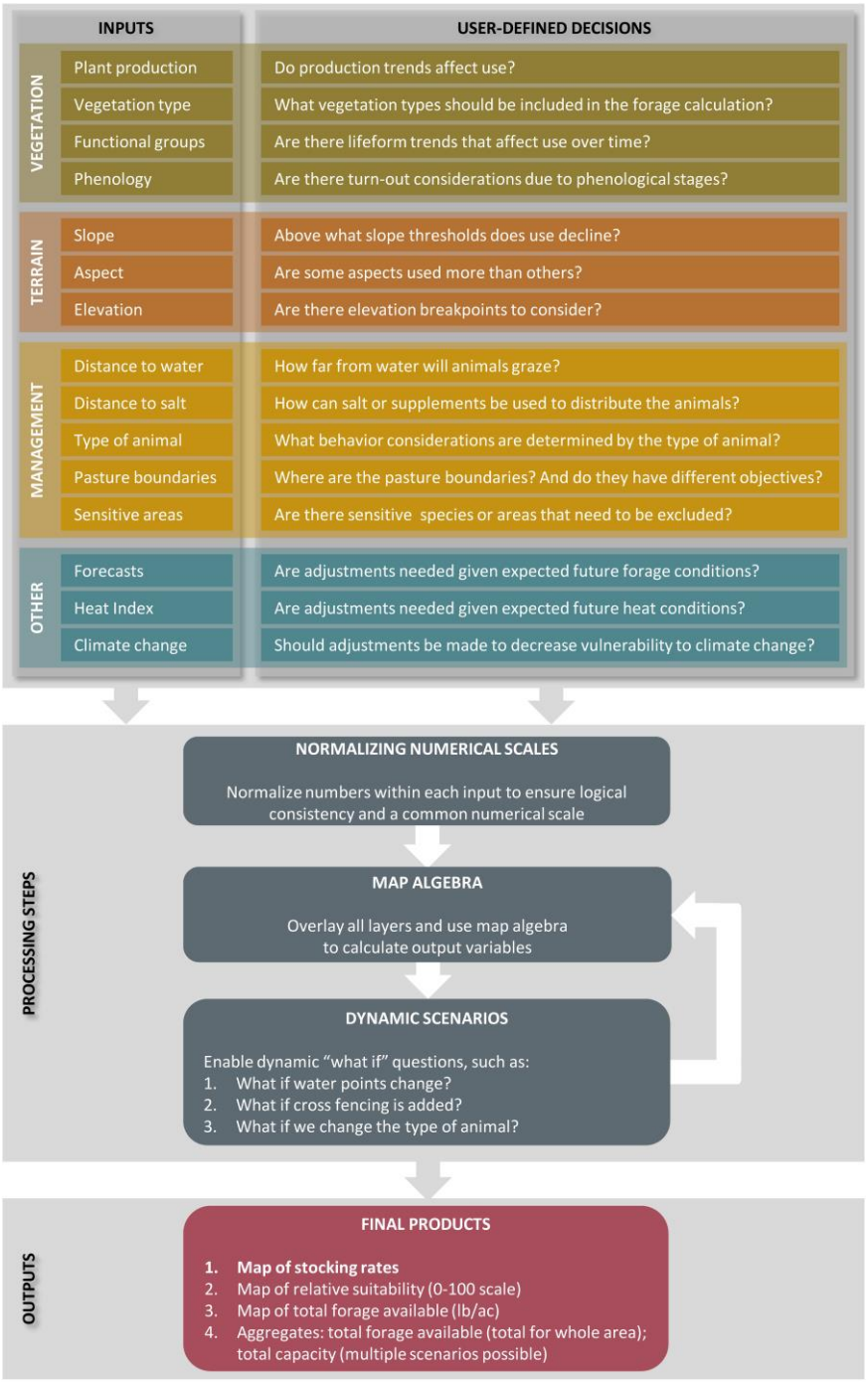

Figure 1.1 Decision Support Tool flowchart.

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Resilient plants - yam daisies appear again on Hay plains

Sally Ware

Riverina Local Land Services, Hay, Australia

Abstract:

Some arid area plants spring up during prolonged wet periods and then disappear, until the appropriate seasons return again, often many years later. Such is the case for a yam daisy species that bloomed in the Spring of 2022 during the La Nina event, in isolated populations on the Hay plains. The discovery was made in September 2022 on the Travelling Stock Reserve north of Hay in western NSW by Booligal Primary School Principal Lindy Stewart, who is an avid naturalist and photographer. Since the find, a plant and seed were mailed to the Royal Botanic Gardens in Victoria, where identification confirmed the specimen to be potentially *Microseris walteri* the more common of the three taxa identified in the Murnong paper published by Neville Walsh in 2016. Further examination may yet show this form to warrant formal taxonomic recognition (N. Walsh, pers. comm.). Seed was also collected by staff from Riverina Local Land Services, ecologist Martin Driver and Murray Local Land Services Seed Services, to be placed in the Seed Services seed bank. Photographs and drone footage were captured by professional photographer Brett Naseby and a press release was issued by Riverina Local Land Services in addition to social media posts in October 2022. Following this publicity and a Riverina ABC interview with Hay based Senior Land Services Officer Sally Ware, many local landholders reported seeing the yam daisies on their properties and images and information were shared.

An important food source for the local Aboriginal population, anecdotal records from the 19th century suggest that there were once large stretches of the daisies before historic stock movements, combined with significant dry periods, contributed to their rapid decline. The collected seed will be used to grow plants in the Hay Plains Landcare new greenhouse nursery with the plants distributed to the community to build knowledge of this rare plant.

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Building Rangeland Careers

V. Anderson

Regional Landcare Coordinator, Schools – Western Landcare NSW, Australia

Abstract:

Western Landcare NSW Inc. (WLNSW) has been shocked by the number of primary school (aged) children who do not know the difference between native and introduced flora and fauna.

How can the next generation care for our environment when they don't have the basic knowledge of what should and should not be in a natural ecosystem and how the biodiversity within that environment functions?

Children need to know what lives in their local environment, why it lives there, what it needs to survive and what are the introduced threats in that habitat. They also need to know how and why that ecosystem works so they can monitor and contribute to the balance. We have developed some activities that are interactive, fun and educational to help children understand the impact introduced species have on their local environment, how ecosystems work and why soil is important.

Visits to schools, speaking with students and teachers, helped develop the concept of the 'Eco quilt'. The quilt depicts a riparian ecosystem where laminated creatures are stuck onto the quilt by each student using Velcro. Discussions take place around each creature in turn. Conversations include where they live, why they live there, are they native or introduced. The age and capabilities of students is dependent on language used, time and involvement of conversation around the ecosystem.

'Soil ya Undies' an activity developed by Dr. Oliver Knox (Winner of the General Jeffery Soil Health Award 2022) was adapted for primary school children in soil health and structure. 'Good Fish, Bad Fish' along with 'Who am I' are fun games that we have developed to help educate the next generation.

These activities have been hugely successful in the Western region of NSW. We hope to continue travelling and visiting as many isolated schools as we can.

Hot And Cold Cattle: Developing Cattle-Specific Thermal Stress Forecast Products

T. Cowan*,, M.C. Wheeler**, D. Cobon*, J.B. Gaughan*****

*Centre for Applied Climate Science, University of Southern Queensland, Toowoomba, Australia
**Bureau of Meteorology, Melbourne, Australia
***The University of Queensland, Gatton, Queensland, Australia

Abstract:

Weather extremes, such as winter chill events, heavy rainfall, flooding, and protracted heat can cause discomfort and harm in grazing cattle and livestock in exposed pastures. If the conditions are severe enough, as was the case during the Gulf floods of February 2019, animals can die from hypo- or hyper-thermia. Currently, the Bureau of Meteorology generates a national sheep graziers alert if there is the potential for chill and exposure, however there is no national warning system or forecast product for heat or cold stress in cattle.

In this presentation, I will discuss the current research that is being conducted, as part of the Northern Australia Climate Program (NACP), on developing forecast products that have been specifically designed for predicting cattle comfort during both hot and cold weather conditions. I will first discuss three different cattle heat stress indices, using past historical heat events to show the types of weather conditions that animals are most susceptible to (for example, humid and sunny).

I will then present a new seven-day cattle heat stress forecast product that is under development; these forecasts display the hourly evolution of accumulated heat load potential in cattle for different breed-specific heat-tolerance thresholds. Future work aims to extend cattle heat stress forecasts out to 2–3 weeks using the Bureau's sub-seasonal forecast model, ACCESS-S2. Finally, I will present the latest NACP research on constructing new cold thresholds for cattle in northern Australia, based on a comparison of the livestock chill index and the cattle comfort index, utilising historic chill events for ground-truthing.

The Bureau of Meteorology's Newest Multi-Week To Seasonal Forecast Products Targeted To Agriculture

T. Cowan*,, D. Hudson**, M.C. Wheeler**, D. Cobon***

*Centre for Applied Climate Science, University of Southern Queensland, Toowoomba, Australia
**Bureau of Meteorology, Melbourne, Australia

Abstract:

In response to the need for information on the likelihood of upcoming extreme weather (week to multi-week) and climate (seasonal) events, the Bureau of Meteorology released a suite of new forecast tools in June 2022. The tools were developed as part of the five-year Forewarned is Forearmed project, managed by Meat & Livestock Australia, but with partners and input across agriculture industries including grains, cotton, sugar, livestock and dairy. These tools are aimed at improving the resilience and profitability of farmers and producers across Australia by informing their short-term management decisions.

One of the probabilistic tools describes the chance that temperatures and rainfall, in the upcoming weeks, will be above or below what is normally expected for that time of year, but also, the likelihood that the conditions might be extreme. A new feature also allows a user to get an idea of the upcoming fortnightly to seasonal climate conditions at the grid-point scale over Australia. Other tools include the chance of at least a set amount of rain (min. 1 mm, max. 700 mm) falling over a particular location in the forecast period, and the chance that three-day rainfall totals could exceed certain thresholds. This information is important for farmers and producers managing the planting or harvesting of crops or moving livestock. In this presentation, I will give a broad overview of these tools, how to use them, where to find these features on the Bureau's webpage, and how to make sense of the forecast accuracy.

Impact of Flash Drought on Vegetation in Australian Rangelands

H. Nguyen*, M.C. Wheeler*, D. Cobon**

*Bureau of Meteorology, Melbourne, Australia
**Centre for Applied Climate Science, University of Southern Queensland, Toowoomba, Australia

Abstract:

Flash drought describes a fast intensification or rapid development of drought conditions with potential severe impacts on agriculture and ecosystems. In the Australian rangelands, flash droughts tend to occur during the summer in the north, and during winter in the south. On average, they are more intense and more frequent north of about 20°S, and last one to four months.

The typical evolution of flash drought occurrence is associated with a simultaneous precipitation decrease and solar radiation increase about five to six weeks prior to flash drought declaration, leading to soil moisture desiccation. Similarly, flash drought recovery is associated with a precipitation increase and solar radiation decrease about four weeks prior to flash drought end.

We show that regions dominated by grasslands are markedly affected by flash drought. In particular we estimate a decrease in vegetation health and a 20% loss of pasture growth up to three months after flash drought occurrence in the main agricultural and grazing areas.

These results offer avenues for real-time flash drought monitoring to forewarn of impacts on vegetation health and pasture growth on the subseasonal timescale. For example, knowing its typical evolution means that once a flash drought is declared in real-time, grazing industries can then implement strategies to better prepare for the vegetation changes in the upcoming few weeks to months.

Aminocyclopyrachlor - a new herbicide for woody weed control

J. Kaapro

Envu, Western Sydney, New South Wales, Australia

Abstract:

Aminocyclopyrachlor is a new generation herbicide which has been used in North America for woody weed control for several years.

Several years of research trials in Australia have led to registration and availability of this herbicide.

Details of the features and benefits of the herbicide, including mode of action, application, spectrum of activity, will be presented along with results from a range of weed trials conducted in Australia.

Drier and Wetter Times: Rainfall is Episodic

G.C. Curran

Animal and Climate Investigations, Broken Hill, Australia

Abstract:

Records show rainfall to be episodic, distinctly drier or wetter, ending and beginning with breakpoint transitions. Exact durations and rainfall for each episode allow characterisation of rainfall for any location and viewing of trends in time. Rainfall data from Wilcannia in western New South Wales for 1879 to 2022 is used as an example of an Australia-wide phenomenon.

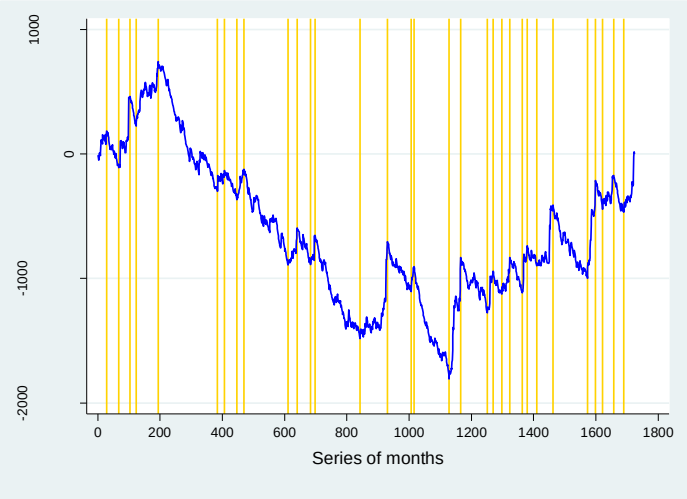

Figure 1.1 Change plot of monthly rain with breakpoints for Wilcannia 1879 to 2022.

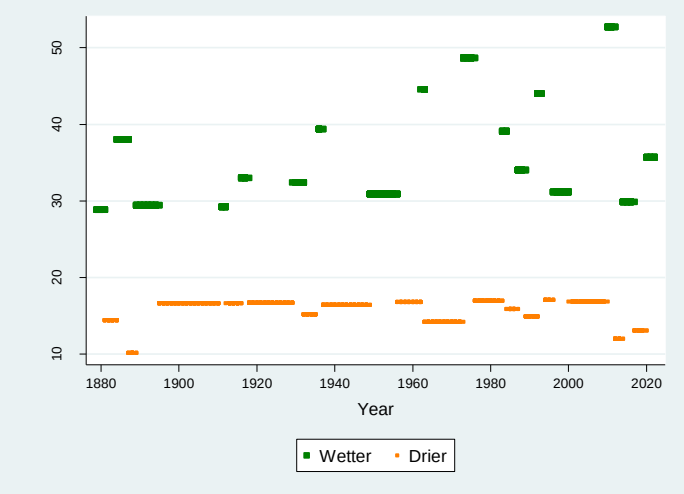

Figure 1.2 Average monthly rain in each episode for Wilcannia 1879 to 2022.

The simple process of analysing rainfall to see a location's change plot and rainfall episodes is explained (Foley 1957).

Change plots and episodic rainfall for north-west NSW and Longreach regions from the 1880s illustrate the method can be generalised.

Rainfall is not random (not '*it rains when it rains*') nor cyclical with gradual change. Rainfall is an episodic system, with breakpoint transitions.

The relationship between rainfall episodes, oceanic indices and continental temperatures is discussed.

Knowing how dry and how wet your land has been over time is essential to managing rangelands; each property and each region of Australia needs to determine what rainfall to expect in its drier and wetter episodes, and their durations.

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Grazing to Increase Resilience

James Gordon

Mt Pleasant, Burdekin Catchment, Queensland, Australia

Abstract:

I am a 3rd generation producer and 1st generation land manager on the Bogie River in the south-east corner of the Burdekin Rangelands.

When buying the family farm in 1995, I was acutely aware of the changes that had occurred across the landscape since my childhood. This strongly motivated me to identify the drivers of land condition change bought about by grazing the landscape since the introduction of livestock. My fundamental aim to this day is to continue learning to understand and manage the influence of grazing livestock so that livestock can actually be used to complement and improve landscape health, all the while operating a profitable beef production business.

As a result of buying the family farm in 1995 and being very aware of the changes that had occurred across our landscape since my childhood, I embarked on a course of study into the drivers of land condition change with the immediate and continued aim of learning to understand and manage those factors contributing to the decline of function across our country. All the while operating a beef production business of also ever-improving health.

Of the various combinations of grazing practices available to us as commercial operators, we have experimented with and trialled many, retaining some and discarding others, but learning all the while.

The presentation will discuss the history of grazing and management as it has impacted the landscape of Mt Pleasant since colonisation, and the findings we've observed and documented as we've changed management practices since 1995.

I will present elements of the following across a timeline:

- What were the changes over time and when did they occur.
- How and why did the changes occur.
- When practice changes occurred.
- The effects observed and recorded.
- The landscape condition at present.

Birds, buffel, brigalow and bovines; integrating conservation with production in Queensland rangelands.

B. Crouch*, H. McMillan, J. Peart**, B. Witt*, M. Maron***

* The University of Queensland, St Lucia, Australia
**Department of Agriculture and Fisheries, Dutton Park, Australia

Abstract:

How can we stimulate widespread ecosystem restoration on privately-owned grazing lands without compromising the productivity and profitability of the businesses that operate on them?

One possibility is to investigate management interventions that deliver mutual benefit for both agricultural production and biodiversity. Linear strips of native vegetation are common features throughout parts of Australia's rangelands. Strips are often voluntarily retained on properties for the benefits they can provide to the production system. These strips can also provide important habitat resources for a variety of taxa. Substantial scope remains to increase the number and extent of these strips, yet their uptake as an on-farm conservation measure is restricted by uncertainty surrounding both their impacts on production, and also their habitat value to taxa of conservation concern.

We asked whether a declining woodland bird community would use strips of native vegetation retained in the highly-modified brigalow *Acacia harpophylla* landscapes of Central Queensland, Australia. We also quantified the impact that strips have on adjacent pasture production. We surveyed the bird communities of 47 sites within retained strips ranging from 30–388 m in width, and sampled pasture basal area along transects perpendicular to the strip edge.

We found that brigalow-dominated strips support many species of woodland birds in a grazing landscape, including species of conservation concern. Relatively thin strips (<50 m wide) were occupied by a similarly rich assemblage of woodland birds as wider strips, although abundance was lower. A distinct zone of increased pasture basal area adjacent to strips was detected at five of eight pasture survey sites, which may help offset pasture productivity losses beneath the strip's canopy. These results suggest that the retention of brigalow-dominated vegetation in the form of strips could be an effective vegetation management strategy that delivers improved outcomes for woodland birds whilst minimising pasture productivity losses.

Passing the baton: Engaging the next generation in rabbit management

Peter Day

Foundation for Rabbit-Free Australia Inc., Adelaide, South Australia

Abstract:

How do you engage a new generation in managing a problem that is largely unseen and underrated; and where success only comes from the skilled application of established techniques tailored to local situations?

The answer to the oft-asked question of 'hasn't calici cleaned up the rabbit problem?' is both 'yes' and 'no'. Yes, a combination of bio-controls have very effectively reduced rabbit numbers, often to levels where they no longer pose a major threat to production. No, they haven't reduced rabbit numbers to levels where they don't shape the entire structure of a vegetation community, sustain feral predators, and persist in numbers that threaten to rebound should the effectiveness of bio-controls wane as immunity grows or virulence fades.

Foundation for Rabbit-Free Australia and its partners are initiating a 'national conversation' about rabbits, aiming to engage the next generation of managers (who often have little appreciation of pre-calici landscapes and the devastation possible from rabbits), and link them with technical experts and the latest science.

A mixture of online technologies and traditional means of communication are being tested and refined as they grapple with the task of creating meaningful links across the nation. Meeting with stakeholders and adopting their processes (like national conferences) is one element of the strategy—seeking opportunities to share information and, most importantly, test ideas and gather suggestions for how to do better.

Our presentation will outline the current and planned elements of the 'national conversation' and invite input to shape its evolution and application in Australia's rangelands.

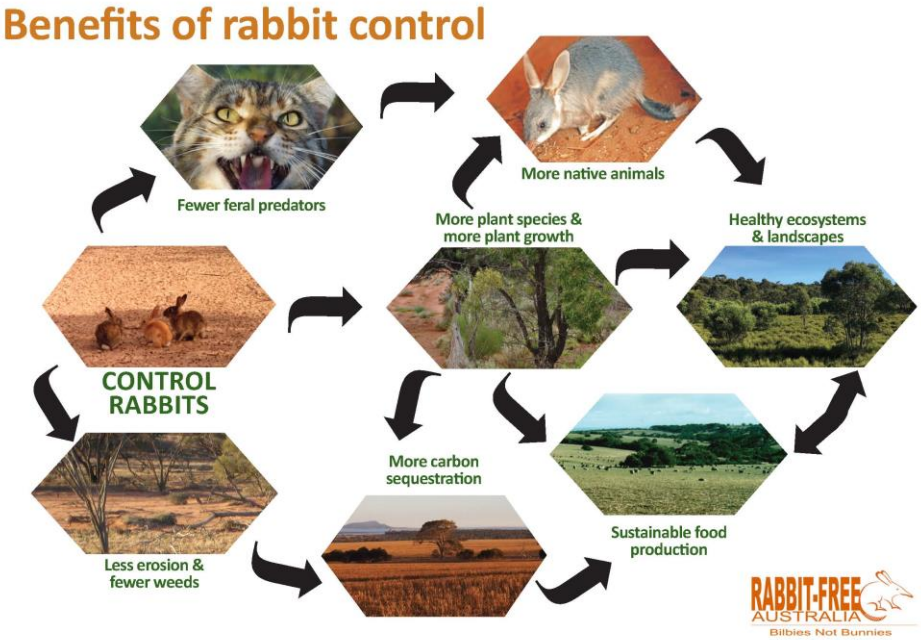

Figure 1.1 The benefits of rabbit control.

Achieving productivity and environmental outcomes through collaborative research

A.W. Whyte*, S. McDonald**

*Pastoralist, Western New South Wales, Australia
**Rangeland Scientist, Trangie, New South Wales, Australia

Abstract:

Producers in western New South Wales have been striving to improve financial, production and environmental outcomes across their businesses by changing their management and trialling alternate approaches to regenerate land. The Rangeland Living Skin Project (RLS) was developed in close collaboration with producers, research scientists, extension officers and commercial partners to understand and quantify the changes observed by the producers, and how management can further enhance these changes. The seed to the project was a four-hour car trip with producers, researchers and extension staff travelling together, sharing observations and perspectives. There is no greater example of understanding landscape response, triggers, interactions and feedback loops than people who observe and listen to their landscape. Producers are masters of observation and experimentation, and so successful research will include producers, their ideas and their feedback. Within the RLS project, producers provide a key role in describing past innovations trialled, identifying new innovative and practical strategies to trial and monitor, alongside contributing to the design of methodology, collection of scientific data and guiding the communication of outputs to ensure these are relevant and accessible to other producers within the region. It is anticipated that working together will facilitate a greater opportunity for all partners to learn from each other and better identify solutions that address producer needs.

Action: A key outcome of the RLS project is demonstrating how scientific research and farmers can work together to identify practical, cost-effective practices that regenerate the rangelands to support production into the future. This means more reliability from year to year, improved soil and pasture health (natural capital) with increased business and landscape resilience. The science gets informed by best practice farming and the farmers build relationships with researchers and continue learning and improving their skills. These types of partnerships are essential to build respect and trust between the many facets of land management.

Managing a large carbon project using time-controlled grazing and long rest management techniques.

Mr James Kerr

James Kerr

Paroo Pastoral Company, Lightforce Group, Buckleboo Station, Kimba, South Australia

Abstract:

In 2020, after three years of severe drought and a heavily-impacted productivity at Buckleboo Station, we commissioned the design of a detailed five-year Ecologically Sustainable Rangelands Management (ESRM) Environment Plan.

Paroo Pastoral has fast-tracked the ESRM Plan and the added benefits of: Producing more lamb in a shorter time-frame, championing innovative and industry-leading regenerative grazing processes. The station has changed from set stocking to time-controlled grazing. The dorper ewes are now running in one mob. The station is sub-divided into six grazing areas of approximately 40,000 acres, each area being grazed for three months followed by 15 months complete rest. Every watering point has a trap yard around it. More watering points are being prepared to ensure even grazing of each area.

Badly-degraded scalded country has been treated with a crocodile seeder to divot the surface with the aim to slow down the flow of water and re-hydrate the soil. These areas will be closely monitored to determine if the native grasses return.

New technology has been adopted for key project outcomes: Ceres satellite tags for livestock movement monitoring, NDVI satellite monitoring, satellite monitoring of water storage tanks and soil probes to measure moisture available to plants in a range of different soil types. Twelve monitoring sites are being constructed across the station to monitor the changes in vegetation.

In October 2021, the Emissions Reduction Fund (ERF) approved a large carbon project (over a million tonnes of carbon sequestered) for Buckleboo Station. This project is managed by Australian Integrated Carbon. More fencing will be constructed in the future to control the grazing of livestock. Our key ACTION is managing the carbon project with time-controlled grazing and not destocking the carbon project areas.

Management of pasture dieback, rundown and Indian couch invasion in buffel pastures of central Queensland

Paul Jones*, Stuart Buck, Kendrick Cox***, Kylie Hopkins**, Polani Shadur****

*Department of Agriculture and Fisheries, Emerald, Queensland, Australia
**Department of Agriculture and Fisheries, Rockhampton, Queensland, Australia
***Department of Agriculture and Fisheries, Mareeba, Queensland, Australia

Abstract:

The Brigalow belt bioregion within central Queensland is a critically important area for the beef industry with a gross value of production from grazing at $2.3b. Sown pastures on relatively fertile soils drives high beef productivity. A significant challenge to the industry includes threats to production from a decline in available soil nitrogen (pasture rundown) and pasture dieback in buffel grass, both of which facilitate the ingress of the low-yielding Indian couch.

Legumes have the potential to double gross margins on greater than 80% of the Brigalow belt through improvements in pasture growth and liveweight gain. Additionally, legumes are not affected by pasture dieback and can potentially mitigate current losses of $15–$41m annually.

Four trials have been established on existing buffel grass pastures affected by pasture dieback, rundown and Indian couch. They examine the role of perennial legumes, sown grasses, fertiliser, fallowing and seedbed preparation for improving pasture production. The trials also include ‘break’ crops with forage; and insecticide and fungicide treatments for addressing pasture dieback.

Pasture dieback did not reduce pasture growth for any of the sown grasses during the two years of the trials. Below-average rainfall suppressed the growth of all species during the first year of the trials. Three of the four sites had above-average rainfall in the second year and, together with fertilising, resulted in high pasture yields for sabi, signal, finger, Gayndah buffel and Epica rhodes grass. High grass yields consistently resulted in very low yields of Indian couch. One site had moderate yields of grass as well as the legumes Caatinga and Seca stylos.

The preliminary results show the potential to significantly reduce Indian couch and establish legumes following reliable sown pasture establishment. This includes fallowing to store moisture, seedbed preparation and rolling in good quality seed.

The Question of Camels - Weapons against weeds or liability for landholders

Natalie Pearce*, Simon Wiggins*, R. Blackley**

*Desert Channels, Longreach, Queensland, Australia
**Desert Channels, Toowoomba, Queensland, Australia

Abstract:

The presentation will outline the challenges and successes of a project run by Desert Channels Queensland and funded by the Desert Channels Foundation which has focused on the role of camels in controlling Prickly acacia (*Vachellia nilotica*), a weed of national significance, while also helping to recover degraded areas of the Mitchell Grass Bioregion. Grazing patterns have been monitored using electronic tags, while pasture species diversity was monitored to determine changes in species, density and ground cover.

While camels are much maligned as a pest, the project has started to identify clear trends which offer opportunities to landholders tackling a weed covering 21 million hectares, but also points to critical management learnings, particularly as preferential feed resources become scarcer. As the regional camel herd increases there is a need to be on the front foot in managing this species to ensure it is a valuable weapon in weed control and a benefit to the recovery of the rangelands and not a liability for landholders.

Clear trends have been identified in grazing preferences, impacts on targets and non-target plants and the seasonality of these trends. As more landholders seek to manage cattle and camels in combination these preferences can be exploited and aid in recovery of degraded areas and form the foundations for new income streams.

Pasture recovery of desert bluegrass through dry years in central Queensland

Paul Jones

Department of Agriculture and Fisheries, Emerald, Queensland, Australia

Abstract:

Reduced condition of pasture and soil is evident in most pasture communities across northern Australia and is demonstrated through a decline in density and growth of desirable perennial grasses. The potential exists to improve pasture condition and therefore productivity by around $0.5b per year in Queensland with additional benefits to drought resilience. Resting pasture from grazing over the summer period for maintaining or improving pasture condition is a key recommendation. Desert bluegrass is one of the key perennial grasses in northern Australia.

The purpose of the study is to improve the understanding of perennial grasses when resting pastures to recover poor condition grazing land. The response of desert bluegrass to different resting regimes over the growing season; interactions with seasonal conditions and the effect of a moderate or high stocking rate are examined.

Trials were established on poor condition native pastures in 2011 with plots 20 x 20 m and each treatment replicated four times. Population dynamics of all perennial grasses were mapped in permanent quadrats and recorded annually.

Seasonal conditions have been very dry, and together with stocking rate, have been the major driver of perennial grass basal area. There are strong trends for pasture recovery with annual resting through increased basal area of desert bluegrass from existing tussocks as well as seedlings. There were significant mortalities (~60%) across existing desert bluegrass plants and also seedlings. Low numbers of desert bluegrass seedlings established each year and the surviving ones are now making an appreciable contribution to basal area.

While seasonal conditions and stocking rate have been the key driver of pasture condition, resting and moderate stocking rate is now beginning to recover desert bluegrass basal area from the low numbers of surviving plants and seedlings.

Yes, My Parents taught me

Shariqa Hussain*, Professor Vani Narula**

*PhD Research Scholar, Jamia Millia Islamia University, India
**Department of Social Work, Jamia Millia Islamia University, India

Abstract:

Passing on the skill and aspirations of animal rearing from one generation to another can be a valuable and rewarding experience.

The study highlights some of the steps that can be taken by parents and family members to ensure the transfer of knowledge. For instance, start early—encourage young family members to help with tasks related to animal rearing, such as feeding, grooming, and cleaning. This will help build their interest and skills over time. Another way to share experience is by telling children stories about their own experiences with animal rearing and sharing tips and tricks that have been learned along the way.

Hands-on experience with animal rearing, such as helping with tasks or even giving children responsibility for a specific animal or group of animals, can help the next generation understand the importance of it and motivate them. It is also found that encouraging questions about animal rearing, including why certain practices are important, and how to identify and address common issues, makes children aware of and sensitive to the environment.

Overall, passing on the skill and aspirations of animal rearing can be a great way to build family connections, promote sustainable living practices, and ensure that valuable knowledge is not lost over time. These traditional rearers have unique aspirations and knowledge that are critical for the effective management and protection of their moving wealth, which is animals, and to incorporate them into decision-making processes that affect their lives and environment to ensure sustainable outcomes that meet both Indigenous and non-Indigenous aspirations.

However, besides all these positive points, the question that arises here is: In spite of having a unique and holistic understanding of their environment and the interconnectedness of all things, including economic and cultural significance of their animals, why are these rearers still neglected?

Policy Development to Drive Regenerative Rangeland Management

Greg A. Brennan

Grazing Innovation, Geraldton, Western Australia

Abstract:

Semi-arid rangeland management suffers serious market failure that makes regenerative management commercially unattractive and rewards management that risks land degradation. This market failure is a product of the time value of money, slow rates of rangeland recovery and dry season risks. Enabling policies to mitigate climate change and biodiversity loss can be designed to correct this market failure by providing economic incentives that make regenerative management commercially attractive.

Managing total grazing pressure to improve vegetative ground cover is the first step towards improving forage productivity, carbon stocks and biodiversity. Similarly, reduction in ground cover is the first step towards their incremental loss. Development of cost-effective macropod control will be essential for ground cover management.

Research shows first that 50–60% of soil organic carbon (SOC) has been lost with modern agricultural practices; and second, improved management practices can replace lost SOC. Research showing improved SOC with increases in perennial cover and SOC differences in 20-to-40 year-old exclosures in mulga lands of New South Wales and Queesland, suggests that regenerative management could sequester 0.1 tCO2-e ha-1 yr-1 of SOC. This quantity of SOC is double that required to cover GHG emissions of pastoral businesses, without any contribution from increases in above ground carbon stocks.

However, in rangelands it can be 10–20 years before it is possible to measure SOC increases. Costs of measuring SOC in rangelands is prohibitive, however rapid global developments suggest that cost-effective SOC measurement and modelling is nigh. In the interim, revenue neutral incentives that drive regenerative management could be provided with Stage 1 Biodiversity Certificates earned solely with verified, management-related ground cover improvements. When stapled to woody carbon credits modelled with FullCAM under the pending Integrated Farm Management method, they will increase their value and contribute to costs of ground cover incentive payments.

The Brigalow Catchment Study: Conservative grazing management decreases runoff and erosion during extreme drought

C.M. Thornton*, A.E. Elledge*

*Queensland Department of Environment and Science, Rockhampton, Australia

Abstract:

Since the 1960s, millions of hectares of the Brigalow Belt bioregion in central Queensland, Australia, have been cleared for agriculture. The native vegetation of this semiarid, sub-tropical bioregion was dominated by brigalow (*Acacia harpophylla*), which has been replaced by improved pastures dominated by buffel grass (*Pennisetum ciliare*). The Brigalow Catchment Study has monitored the effects of this land clearing and land use change since 1965. Long-term data has shown that clearing brigalow for beef cattle grazing has doubled runoff, increased peak runoff rate by 50%, increased total suspended solid loads by 80%, decreased soil fertility, and decreased pasture productivity over time.

Rainfall at the study site was below the long-term (1965 to 2021) average of 641 mm for the seven-year period from 2015 to 2021. This is the longest run of below average rainfall years in the SILO dataset for the study site, with the exception of 1899 to 1905, which coincided with the Federation Drought. Despite this extreme drought, grazing management that failed to reduce stocking rate on rundown pastures to match the safe long-term carrying capacity still increased runoff and erosion compared to conservative stocking rate. Heavy stocking at 0.54 adult equivalents/ha/yr resulted in 3.6 times more total runoff, 3.3 times the peak runoff rate, and 3.2 times more total suspended solids in runoff than conservative stocking at 0.17 adult equivalents/ha/yr.

This study clearly indicates the effects of land clearing, land use change and land management on the natural resources of a system with a diminishing resource base. While the trajectory to improve land condition is likely substantially longer than that of degradation, land management strategies that decrease runoff and erosion, and hence increase pasture growth and sustainability, are essential if we seek to increase the resilience of grazing enterprises in a land of drought and flooding rain.

Collaborative Carbon Farming: Opportunities and Risks

Alex Baumber*, Rebecca Cross, Peter Ampt***, Bella Bowdler*,
Jen Ringbauer*, Andres Sutton*, Amanda Scott****, Lorraine Gordon****, Graciela Metternicht*****

*University of Technology Sydney, Australia
**The University of Sydney, Australia
***Ag&Env Consulting, Mudgee, Australia
****Southern Cross University, Australia
*****Western Sydney University, Australia

Abstract:

Rangeland areas of Australia have seen the greatest uptake of carbon farming to date, particularly via assisted regeneration, avoided deforestation and savanna burning projects. As carbon farming expands into new areas and employs new methodologies, the experiences of rangeland communities present an important learning opportunity.

Increased collaboration between landholders has been suggested as an avenue for increasing uptake of carbon farming in Australia. Collaboration has the potential to reduce barriers relating to information, scale and measurement costs, while maximising co-benefits for biodiversity, soil health and community development. However, it can also introduce new risks and complications, including around project registration, the sharing of benefits and costs, entry and exit processes and loss of independence over land management.

Our study involved 28 interviews with key stakeholders in the carbon farming sector across Australia. The results showed that the most promising avenue for collaboration was informal collaboration around knowledge-sharing and social support. This presents an opportunity to reduce information barriers and increase trust while avoiding risks around cost-sharing, credit pooling and joint project registration. It can also provide a pathway into deeper collaboration, including collaborative marketing (for example, selling credits for a premium based on a shared provenance story) and shared project management (particularly where the enhancement of co-benefits is a strong motivation).

Aside from landholders and the existing groups they may belong to, various other stakeholders also have a role to play in collaborative carbon farming. These include carbon service providers (aggregators), agricultural cooperatives, financial institutions, government agencies and emerging business/legal models. While there is no one-size-fits-all model for collaborative carbon farming, the variety of options available is an advantage in this diverse and rapidly-changing sector.

The Brigalow Catchment Study: A call for collaboration

A.E. Elledge*, C.M. Thornton*

*Department of Environment and Science, Rockhampton, Australia

Abstract:

The Brigalow Belt bioregion of central Queensland has been extensively developed for agriculture since the Fitzroy Basin Land Development Scheme commenced in 1962. When the *Vegetation Management Act* was introduced in 1999, it was estimated that 93% of vegetation communities dominated by brigalow (*Acacia harpophylla*) had been cleared. Since this time, grazing has remained the dominant land use covering more than 70% of the area.

The Brigalow Catchment Study was established in 1965 to capture changes in hydrology, soil fertility and productivity associated with land clearing and land use change. This involved monitoring three catchments in their native state for 17 years (calibration phase) before one catchment was developed for cropping, another for grazing and the third remaining virgin brigalow woodland. These three catchments were monitored for another 27 years (land use phase). At this stage two additional pasture catchments were added to the study, and all four agricultural catchments were monitored to compare leguminous pastures and grazing pressure (land management phase).

An independent review of the long-term study in 2004 summarised that ‘data collection, its storage and managements for this study are of a high order and represent a valuable national asset’, but ‘few findings from the BCS have been published in peer-reviewed literature’. The study’s two staff have been on a publishing frenzy for the last decade, both as primary authors and via collaborations (refer to Publications tab at www.brigalowcatchmentstudy.com), yet only a small dent has been made in publishing the available data after nearly six decades of monitoring. As highlighted in the 2004 review, ‘the study needs to tell its stories and embark on journeys with new methods, new questions and new users’. Hence, **our call to action is a call for collaboration**. So come talk to us about how we can work together in the future.

Greenhouse Emissions Accounting: the on-farm implications of the choice of metrics

J.R. Peart

Department of Agriculture and Fisheries, Dutton Park, Australia

Abstract:

The impact of enteric methane emissions on the climate has been a point of contention among climate scientists, the crux of which is around the short-lived nature of methane in the atmosphere, approximately 9.7 years (Masson-Delmotte *et al.* 2021). Over recent years, a variety of metrics to equate methane emissions to 1 tonne of carbon dioxide (CO_2-e) have been developed, including GWP100, GWP* and Radiative Forcing (RF). Each metric attempts to address different aspects of methane's atmospheric behaviour and/or emission source (Masson-Delmotte *et al.* 2021; Smith *et al*. 2021). Within the red meat industry, the outcome of different metrics can have significant on-ground impacts within individual grazing businesses wanting to pursue a climate target (Ridoutt and Mayberry 2021). This is especially true in Australia where extensive grazing systems limit the application of methane inhibitors (for example, 3-nitrooxypropanoal (3-NOP)) (Ungerfeld 2022), and where the red meat industry has committed to carbon neutrality by 2030 – the most ambitious red meat climate target set worldwide to date (Meat and Livestock Australia 2020). This study aims to produce a farm-scale assessment of how calculated climate impact varies between three metrics in respect livestock associated methane: the GWP100, GWP* and Radiative Forcing (RF), using average historical emissions calculated for a south-west Queensland beef business. The impact of each metric on the grazing businesses capacity to achieve carbon or climate neutrality will also be determined and discussed.

Due to the nature of rangeland grazing systems, emission offsets options were typically limited to vegetation related methods such as human-induced regrowth (HIR) and avoided clearing. Revegetating land at the scale required to offset ongoing enteric methane emissions as part of a grazing business, as calculated through the current GWP100 metric, significantly reduces the carrying capacity of the land over time. Understanding the longevity of each metric and its implications for the industry are therefore imperative to the sustainability of Australian grazing land.

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Where to from Here? A Reflection on the Land Services Program.

Christine Plummer*, Courtney Lallard**

*Western Local Land Services, Buronga, Australia
**Western Local Land Services, Broken Hill, Australia

Abstract:

The Land Services Program (LSP) is a two-year program specifically designed for landholders in Western Local Land Services (WLLS) region striving to implement change and increase profitability in their farm business. Since its inception in 2018, the LSP has assisted 25 pastoral businesses across the region. The program incorporates one year of group sessions focused on managing the human, financial and natural resource components of a farm business in the rangelands of New South Wales. The second year of the program allows participating land managers access to financial support for continued training of their own choosing, identified by their action plan. This is complemented by one-on-one support and guidance from WLLS staff, continuing the strong customer relationships built through ongoing work across the region.

An independent review of the LSP was undertaken to ensure the program was operating to best benefit land managers, stakeholders and the delivery team. The results of this evaluation demonstrated the high value of the program to participants; where all departed with an increased confidence in undertaking further investment in on-ground practice change for their enterprise. Key improvements of the program were also identified as a result of this process.

A recent succession in program staff presents the prime opportunity for a reflection and new perspectives on the LSP delivery, as well as the impartial incorporation of the evaluation recommendations. The objective is to increase the robustness of the program to evolve with both the early career deliverers, as well as the participants in the region over time.

As female, early career livestock professionals with varying backgrounds, our 12 months in the role has allowed for reflection on the approach we take to have successful careers in the rangelands.

Simple classification tree models to predict pasture condition

KL Reeves*, K Ryan, C Hetherington**, P Thomas* and RA Sudmeyer***

*Department of Primary Industries and Regional Development, Perth, Western Australia
**Department of Primary Industries and Regional Development, Kununurra, Western Australia

Abstract:

Pasture condition assessments allow land managers and pastoralists to make informed decisions around managing grazing, preserving natural resources and protecting biodiversity. Reliable qualitative assessments require extensive expertise and training, but different assessors may still reach different conclusions. The Framework for Sustainable Management (Fletcher 2022) proposed the increased use of quantitative approaches in the assessment of site-level pasture condition. Developing a simple set of decision rules using traits that can be easily estimated has the potential to provide a quantitative measure to support the qualitative condition assessments.

Simple parsimonious classification tree models to predict pasture condition for black, red and sandy soil pastures were trained on monitoring data collected from Western Australian Rangeland Monitoring System (WARMS) sites across the Kimberley. The WARMS data comprised quadrat-level data recording the presence of perennial species for 100 quadrats for 1001, 812 and 609 observations on black, red and sandy soil pastures respectively, together with an associated qualitative assessment of pasture condition.

Quantitative traits were derived from the quadrat data and assessed for importance for each soil type using a v-fold cross validation approach. The most important traits for each soil type were used to train classification trees on data sets split for training (70%) and testing (30%). Important traits included the frequencies of desirable species and quadrats without perennials. Model accuracy assessed on testing data sets varied from 0.68 to 0.77 with high sensitivity and specificity for predicting poor pasture condition. A simulation study was conducted to further investigate model performance and to assess the implications of sampling fewer quadrats.

Call to action: A simple robust pasture condition decision tree to inform pastoralists and assessors.

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Active extension in northern Queensland.

E. Corbett*, K. Steel**

*Department of Agriculture and Fisheries, Mareeba, Queensland, Australia
**Gulf Savannah NRM, Georgetown, Queensland, Australia

Abstract:

Rainfall variability and pasture growth within and between years provides the key limit to beef productivity in seasonally dry areas of Queensland. The GrazingFutures Livestock Business Resilience (GrazingFutures LBR) project aims to build profitable, resilient and drought-ready livestock operations across Queensland. GrazingFutures LBR includes collaboration between the Queensland Government, Natural Resource Management (NRM) Groups and Rural Financial Counsellors to better align inter-agency delivery, integrate emerging research messages and focus on improving business literacy and management at a producer level. The adoption of key strategies to build profit and drought resilience in northern production systems has been slow, despite considerable research and producer evidence that improving land condition by managing long-term carrying capacity and wet season spelling, supplying adequate wet season phosphorus supplementation, and the adoption of stylo pastures on phosphorus-deficient soils provide a positive return on investment and enable graziers to negotiate an extended run of dry years. Collaboration in north Queensland between DAF Mareeba beef extension, Gulf Savannah NRM and Rural Financial Councillors has focused on overcoming barriers to the adoption of these strategies by identifying three priorities to successful extension: (1) considering the context and methodology of delivery; (2) carefully planning and tailoring extension events; and (3) providing meaningful and ongoing follow-up. The success of the program is due to: (1) holding fewer workshops with more time allocated to building service provider/producer relationships through on-property and one-on-one support; and (2) knowledge transfer between the collaborative services. We recommend the application of these extension methods for the future delivery of adoption and practice change programs in northern Queensland and similar beef production environments.

A new method of generating pasture input data for CLEM bio-economic modelling

X. Zhang*, J. Carter*, G. Stone*, B. Zhang*, G. Fraser*

*Queensland Department of Environment and Science, Dutton Park, Brisbane, Australia

Abstract:

The Crop Livestock Enterprise (CLEM) model developed by CSIRO is a bio-economic model that is capable of simulating whole-farm enterprises for a range of livestock, pasture and farming management scenarios. Currently, model simulations for a grazing/pasture enterprise require the user to generate an 'input data cube', containing monthly time series of pasture growth and ground cover accessed from the Queensland Government's GRASP model simulation outputs for different stocking rates, grass basal areas (GBA), land condition and soil types. To streamline the complex process between the GRASP simulation outputs and the CLEM input data cube, we have developed a prototype system that can automatically run GRASP (cedarstack version) to generate the SQLite-formatted input data cube required for CLEM. The data-generator program will be embedded in the recently developed MyFORAGE Online Mapping Tool (via the Long Paddock website) to request the input data cube for any grazing property in Queensland or for selected project scale areas created in the MyFORAGE online interface.

In summary, the FORAGE data-generating program sets up the parameter files to run GRASP, each with a combination of property dominant land types and 13 levels of Foliage Projective Cover (FPC). The program averages pasture growth and ground cover output using the area-based weighting factor of each FPC level within a land type, concatenates the time series to one data file and converts the file to SQLite database cube (required CLEM format), then emails the user to download the dataset. Potentially the application of the program could be run in seasonal forecast or climate change forecast modes.

In anticipation that the CLEM model could be highly used by rangeland systems modellers, this innovative streamlined FORAGE data-generating process will save valuable time and increase modelling efficiency and consistency.

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Detecting change from grazing management in NSW rangelands using remote sensing

S.E. McDonald*, C. Strong, S. Orgill***, P. Tickle****, J.P. Guerschman******

*Trangie Agricultural Research Centre, New South Wales Department of Primary Industries, Trangie, Australia
**Fenner School of Environment & Society, Australian National University, Canberra, Australian Capital Territory
***Select Carbon, Perth, Western Australia
****Cibo Labs Pty Ltd, Point Arkwright, Queensland, Australia

Abstract:

There are a multitude of agricultural production and environmental benefits from practices which increase the quantity, composition, and persistence of ground cover. Incorporating periods of rest into grazing systems is promoted as one such practice, and producers in western New South Wales that have implemented rotational grazing systems and flexible stocking rates have reported improved landscape condition and regeneration whilst maintaining business profitability. Remotely sensed cover attributes can inform strategic grazing management decisions at the property scale and may provide evidence of the ecosystem services supported by livestock production in low input, extensive rangeland grazing systems.

This study sought to understand differences in fractional ground cover and pasture biomass resulting from changes in grazing management across four properties in western NSW. These properties were key sites for the Meat & Livestock Australia-funded Rangelands Living Skin Project. Each of the sites had been managed to improve productivity and ecosystem sustainability simultaneously through management of livestock.

In collaboration with Cibo Labs, time-series estimates of fractional ground cover and pasture biomass derived from Landsat and Sentinel imagery were analysed for the changed grazing systems. Benchmarking methods were used to compare similar land types within 10 km of the property boundary to control for variation with land type and seasonal conditions. This approach also avoided unnecessary conflict and confounding impacts of paired sites in such large landscapes. Spatially explicit data comparisons were designed to understand changes in cover and pasture biomass and identify where in the landscape and when these differences were apparent. Our methodological approach and initial results of this analysis will be presented in this paper.

Understanding and quantifying differences in cover and pasture biomass associated with grazing management can provide livestock producers with greater confidence in making and refining management changes and can potentially demonstrate and value their nature positive activities for emerging markets.

Estimating Pasture Biomass from Photographs Using Neural Nets

L. Woodrow*, J. Carter*, G. Fraser*, J. Barnetson*

*Queensland Department of Environment and Science, Ecosciences Precinct, Dutton Park, Australia

Abstract:

A neural network approach was used to estimate pasture biomass from a large training data set of quadrat scale photographs. This study was undertaken with the belief that mobile phone photographs may offer a faster and simpler way of estimating plot level pasture biomass for research, feed budgeting or calibration of satellite-based pasture biomass estimates. Traditional techniques of pasture biomass estimation such as clipping, visual estimation, and rising plate meters all have usability, cost and accuracy constraints. Further, some of these sampling techniques are time-consuming and laborious and usually involve cutting, drying and weighing pasture from a given area (quadrat) to generate pasture biomass measurements in kilograms of dry matter per hectare.

Artificial intelligence techniques to estimate pasture biomass from photographs have previously been developed and documented. However, these techniques have generally been applied to estimate grass yields for monoculture species and uniform swards, such as found in dairy pastures. The extreme diversity of pasture conditions found in Northern Australian rangelands are still a challenge.

We have used an extensive set of photographs sourced from remote sensing ground cover calibration sites. Up to 18 x 0.25 m^2 quadrats are photographed and harvested per site. These photographs are then used to train an ensemble of neural networks, using appropriate data cleansing, augmentation and use of independent data and hold out sets. The application is limited to pasture biomass amounts of less than about 6500 kg/ha.

Further photographic data sets need to be collated and evaluated for different locations and quadrat sizes. If the algorithm can provide reasonable biomass estimates, then it would be possible to evaluate a calibrated neural network, photograph-by-photograph directly on a mobile device, with potential upload of geolocated biomass estimates to a server for improving calibration of satellite-based estimates of pasture biomass that have the advantage of coverage at the paddock scale.

Initial results are promising; with further development this process could be turned into a highly-usable product for application by the rangelands community.

MyFORAGE an online system for free patch, paddock and property scale grazing land management reports

G.W. Fraser*, B.S. Zhang*, G.S. Stone*, J.O. Carter*

*Queensland Department of Environment & Science, Ecosciences Precinct, Dutton Park, Australia

Abstract:

The Queensland Government's online service—FORAGE—provides users with free access to 14 customised, lot plan scale reports covering a range of topics including Long-Term Carrying Capacity and Ground Cover (Zhang and Carter, 2018). These reports are compiled locally and emailed to recipients as concise and well-presented PDF documents. The systems behind these reports are complex and involve high performance computing systems, biophysical modelling, spatial mapping and remote sensing products.

Projects undertaken from 2017–2022 and co-funded through the Drought and Climate Adaptation Program and Reef Water Quality program have resulted in an increase in requested reports rising from approximately 7,000 per annum to >40,000 per annum. Currently, more than 80% of Queensland, by area, has had at least one FORAGE report requested.

While the suite of FORAGE reports are well-utilised, limitations with their application have led to the development of 'MyFORAGE'. MyFORAGE is an online mapping and report request tool that allows the user to further refine property features to obtain a more customised FORAGE report. Options include:

- map specific areas of interest rather than only a lot on plan area;
- modify land condition &/ pasture composition at paddock scale;
- modify incorrectly mapped land types which are used in the modelling;
- add water points;
- add exclusion zones;
- add rainfall for the last 12 months;
- make and save a simple GIS-based property map;
- Ppoduce a report at a paddock scale rather than lot plan scale.

MyFORAGE was soft launched on The Long Paddock in January 2023 (https://longpaddock.qld.gov.au/forage/features-map/). Further developments will be incorporated as feedback from users is provided and a general release with associated support material will occur in coming months.

Reference

Zhang B, Carter J (2018) FORAGE – An online system for generating and delivering property-scale decision support information for grazing land and environmental management. *Computers and Electronics in Agriculture*
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Ordination Analysis of Western Australian Rangeland Monitoring System data

K.L. Reeves*, M. Fletcher**

*Department of Primary Industries and Regional Development, Perth, Western Australia
**Formerly Department of Primary Industries and Regional Development, Kununurra, Western Australia

Abstract:

Ordination plots offer a useful tool for investigating patterns in a set of samples by graphically representing the similarities between data points, with respect to shared characteristics, as distances. Ordination analyses were implemented using 3076 sampling events taken from Western Australian Rangeland Monitoring System (WARMS) data collected over a period of 27 years in the Kimberley, to investigate the similarities between sampling events with respect to perennial species frequencies.

There are 380 WARMS sites in the Kimberley. A sampling event consisted of 100 quadrats where plant species, frequency (presence or absence) and other data were recorded, with each site being sampled up to nine times over 27 years. Dissimilarities between sampling events were derived from perennial plant species frequencies using the Bray-Curtis dissimilarity statistic. Ordination analyses were implemented on the pairwise dissimilarities using nonmetric multidimensional scaling. Pasture type, soil type, and condition were not used in the analysis but were assigned to points in the visualisations to elucidate patterns.

The ordination plot for the East Kimberley is given in Figure 1.1. It shows samples clustered into three distinct groups: (1) soft spinifex plain pasture (sandy soil); (2) ribbon and arid short grass pastures (red soil); and Mitchell, blue and ribbon grass alluvial plain pastures (cracking clays). The tool was used to investigate relationships between pasture groups, to identify sites misclassified to pasture groups and other data recording errors, and to look for patterns across years for individual sample sites. This analysis supports observations in the field of strong associations between plant species and soil types.

Call to action: Continued analysis of WARMS dataset to improve our understanding of rangeland science.

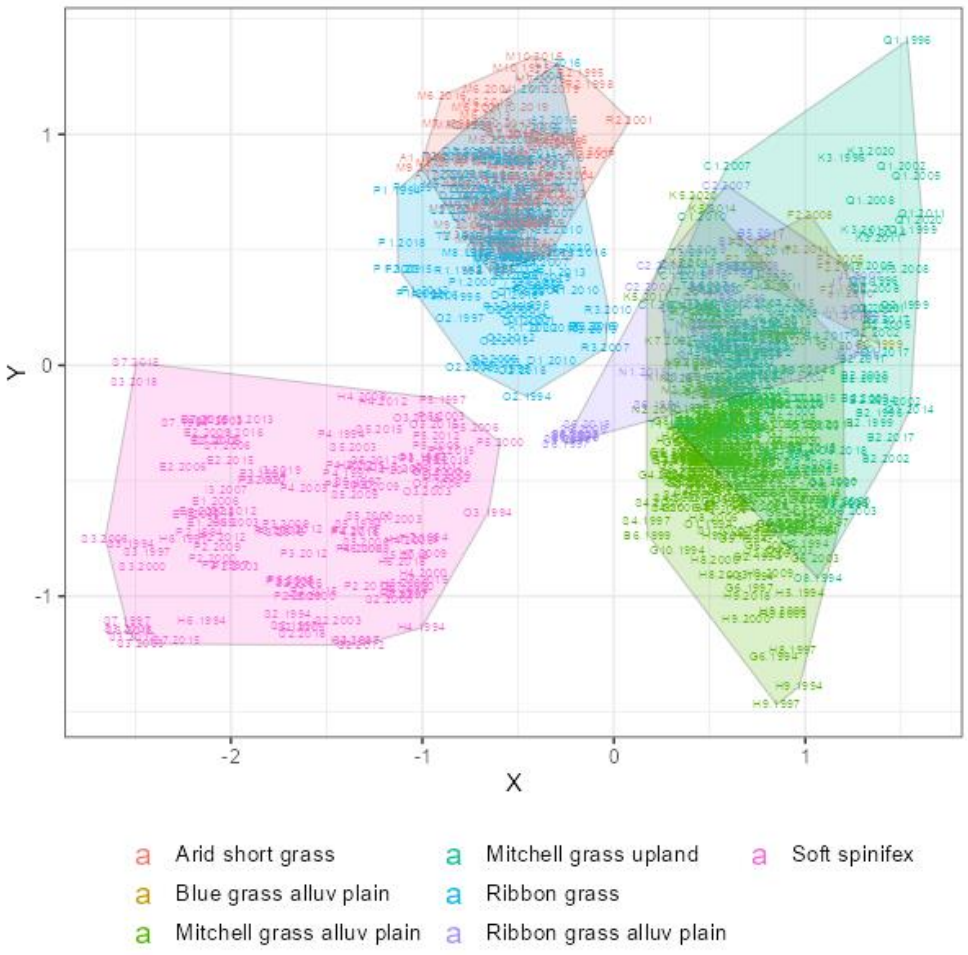

Figure 1.1 Two-dimensional ordination plot of East Kimberley WARMS observations.

Utilising livestock to implement landscape scale change

R.D. Kerr*, B.F. O'Sullivan**

*NQ Dry Tropics, Townsville, Australia
**Glenalpine Station, Bowen, Australia

Abstract:

The five-year Stomping out Sediment (SoS) project took an unconventional approach to gully management: testing and evaluating the use of livestock as a tool in the remediation of some gully types, as well as implementing more conventional gully remediation approaches. SoS built on a broader extension program utilising Holistic Management principles that has been underway in the Bowen/Collinsville area of the Burdekin Dry Tropics since 2014.

The Stomping out Sediment project aimed to support transformational change in grazing practices and expand the reach of properties involved, while making significant sediment reductions to the Great Barrier Reef.

Landscape scale planning should be undertaken for gully project sites, where a wide range of tools and techniques can be applied to improve the whole landscape, not just the erosion and gully features. Transformation of degraded landscapes is an environmental and productive imperative.

A key principle was the application of planned grazing principles in the restoration of landscape function and improved productivity in grazed landscapes, generally in D and C land condition.

The project provided insights into the impact of a range of management options on land condition and the remediation of a range of gully and erosion types. Some new monitoring techniques were tested, extension lessons learnt from previous projects were applied, and 1-on-1 technical support was offered to graziers to support improved grazing land management decision-making.

Some key findings:

- there was little observed or measured benefit of livestock exclusion when compared to planned grazing practices;
- a 'biological carpeting' approach (concentrated livestock impact) should be further tested as a lower cost remediation option to establish vegetation cover on hostile soil sites;
- graziers responded to activities where scientists, technical advisors and field officers were part of the debate/discussion;
- even at high resolutions, LiDAR was unable to detect fine-scale erosion processes, such as hillslope erosion.

A successful collaboration between NRM groups NQ Dry Tropics and Desert Channels Queensland on Maryvale Creek in the upper Burdekin catchment, Queensland

S. Wiggins*, C. Poole, C. Sims****

*Desert Channels Queensland, Longreach, Australia
**NQ Dry Tropics, Townsville, Australia

Abstract:

NQ Dry Tropics and Desert Channels Queensland collaborated in a complex project to improve the environmental health and functional condition of frontage country on three properties located on Maryvale Creek, in the upper Burdekin catchment of Queensland. The work has laid the foundation for project legacy through both landholder and organisational capacity building.

The aim of this project was to improve productive frontage pastures while stabilising waterways through threat mitigation, re-introduction of fire and improved grazing management.

The project area is remote, contains a major waterway that generates high sediment loads to the Great Barrier Reef, has high concentrations of weeds of national significance and a range of pest animals. Landholders, while having the commitment to co-invest in a large-scale project over multiple years, lacked the skills and knowledge to manage the multiple issues in a coordinated way, particularly as some of the threats had immature control techniques.

The complexity and scale of the project required collaborative approaches between the NRM groups, bringing together a diverse range of skills and experience to develop and apply novel solutions. A coordinated approach was implemented that fast-tracked the development of staff and landholder skills and knowledge, thus laying the foundation for the future application of complex projects.

This presentation will discuss the project methodology, the successes and challenges that NQ Dry Tropics and Desert Channels Queensland experienced in delivering this project, lessons learnt and how these experiences can be applied moving forward.

This successful collaboration between Desert Channels Queensland and NQ Dry Tropics provides exciting opportunities for future projects and the skills development of staff while also providing a framework that other similar organisations can apply.

Environmental stress and reproductive efficiency of cattle in the northern rangelands

J.B. Gaughan*, A.M. Lees*

*School of Agriculture and Sustainable Food Systems, The University of Queensland, Gatton, Australia

Abstract:

There are several challenges to beef production in the northern rangelands. These include climate variability (heat, cold, drought, flooding), nutritional limitations (quality and quantity of feed and water), P deficient soils, parasites and distance to feed and water. Cattle are often exposed to multiple stressors at the same time so we should not look at a single stressor in isolation. Lifetime performance of cows, calf survivability and growth performance, and bull performance are all impacted. Compounding these stressors is the increase in extreme weather events. The multi-stressor approach and their interactions is a different way of thinking about the solutions that we need. We need to think about and understand the lifelong implications and intergenerational impacts of management decisions. Are the feedbase and water resources being used efficiently? Are we optimising the genetic potential of our cattle? We know that *Bos indicus* beef cows are more resilient than *Bos taurus* but they are not immune to stress. Poor nutrition, environmental stress and early life setbacks lead to reduced reproductive performance. It is currently unknown what the impact of the increasing percentage of *Bos taurus* cattle in the north will have. Calf mortality is a major issue, and we need to understand what drives this (Bunter *et al*. 2014). *Bos indicus* calves respond to heat load more like a *Bos taurus* during the first 7 to 10 days and are more susceptible to cold. In addition to this the new-born calves are susceptible to dehydration and on hot days with little shelter and no milk because the cow has gone for water the calves may die. In addition, weak calves suckle less which impacts on growth performance and health. So, what are the pathways to improvement? Shade, nutritional supplements (what, when and how), improved pasture (legumes), water quality, genetics (trade-offs)?

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Objective assessment of a new 'Climate smart grazing forage budget tool'

G.L. Whish*, C. Holloway*, H.R. Pandeya*, G. Fraser, G. Stone**, J. Carter**, J. Barnetson****

*Queensland Department of Agriculture and Fisheries, Brisbane, Australia
**Queensland Department of Environment and Science, Brisbane, Australia

Abstract:

Extreme within-year and between-year variability in rainfall and forage supply pose significant challenges for sustainable and profitable management of extensive grazing enterprises in Northern Australia. Forage budgets can inform decisions at critical times such as adjusting stocking rates to meet animal growth, pasture utilisation and ground cover targets. To assist land managers a new and innovative pasture budget tool will be developed as part of the four-year project – 'Innovative science to support climate smart grazing land management' project funded through the Drought and Climate Adaptation Program (DCAP) and Queensland Reef Water Quality Program. This forage budget tool will combine the latest developments in pasture modelling, remote sensing and climate forecasts to provide up to six-month outlooks for land managers to use.

We will use the CSIRO Crop and Livestock Enterprise Model (CLEM) to undertake a whole-of-property analysis when applying the forage budget tool in hindcast mode to assess the value of the forage budget tool to inform critical management decisions (Meier *et al.* 2019; Zhang *et al*. 2023*)*. We will engage with four commercial properties throughout the life of the project to undertake the assessment. Property pasture, herd, husbandry, supplementation and market information will help characterise each operation in CLEM. Collaborators will review forage budget information, the management options implemented in CLEM, and the outcome of these management decisions assessed. Assessment may include pasture, land, herd and financial outcomes.

The hindcast whole-of-property analysis on four collaborating properties will increase understanding, value and confidence in using the forage budget tool to inform grazing land management decisions at critical times. The innovative science program of new pasture modelling research and end-user review and evaluation will provide relevant and valued information that can increase the capacity of climate smart grazing land management in Queensland.

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Zhang X, Carter J, Stone G, Zhang B, Fraser G (2023) A new method of generating pasture input data for CLEM bio-economic modelling. In 'Australian Rangeland Society 22nd Biennial Conference, Broome, WA, Australia.'

Legume-based production paddocks increase productivity and drought resilience in north Queensland

K. Cox*, C. Lemin*, E. Corbett*, B. English*, J. Rolfe* (deceased)

*Department of Agriculture and Fisheries, Mareeba, Queensland, Australia

Abstract:

Weaner and steer beef production enterprises in north Queensland are mostly based on uncleared savannah woodlands on soils of high to very low fertility and low-moderate annual rainfall with an extended dry-season. Rainfall-related cycles of native grass growth and maturation results in a dietary protein (and metabolisable energy) deficiency during the dry season. Considerable areas in north Queensland are also being invaded by low-biomass, early-flowering Indian couch (*Bothriochloa pertusa*). This, combined with decreasing land condition, limits marketing options for producers. Sown pastures can significantly improve seasonal supply and quality of feed for grazing and the adoption of stylos (*Stylosanthes* spp.) has been highly effective at increasing productivity on light-textured soils in seasonally-dry north Queensland.

Recent research by the Department of Agriculture and Fisheries (Queensland), co-funded by Meat and Livestock Australia, has focussed on using deep-rooted, perennial and palatable legumes (*Desmanthus, Macroptilium, Leucaena, Stylosanthes*) to develop dedicated grower paddocks for weaners, heifers and steers to negotiate extended dry periods. Fertiliser P or S is applied when considered limiting. Multi-site evaluation across the Gulf of Carpentaria, Herbert and Burdekin catchments has identified well-adapted grasses and legumes which are well-accepted by cattle and produce 2–3 times the herbage yields of native grasslands. Dry season feed quality (crude protein 14–18% and metabolisable energy 8–10 MJ/kg) of legume leaf was high when the quality of companion grasses became growth limiting. Combinations of high-yielding grasses and legumes also out-competed Indian couch. Live weight gain studies using leucaena or stylo/grass pastures resulted in set-stocked weaner steers averaging ~0.6 kg LWG/hd/day annually with the leucaena system maintaining double the stocking rates (1 ae/2.0 ha) of the stylo pasture. Bio-economic analyses indicate these systems can be highly profitable with internal rates of return up to ~30% on more fertile land classes. Demonstration and adoption of these systems is recommended.

Utilising a community of practice approach to perennial pasture regeneration in western NSW

G.L. Turnbull*, T.A. Atkinson, S.E. McDonald****

*Western Local Land Services, Bourke, Australia
**NSW Department of Primary Industries, Trangie, Australia

Abstract:

Diverse, productive pastures are linked directly to livestock productivity and profitability, and preparedness and resilience to drought events. However, overgrazing and prolonged droughts have contributed to a loss of key perennial and palatable species throughout western NSW. The Perennial Pastures, Resilient Rangelands project aims to develop and drive adoption of innovative strategies to re-establish diverse perennial pastures in western NSW.

Considerable work has been undertaken in the past trialling revegetation strategies in rangeland areas, however much of this information is not readily accessible or in a format that is conducive to aiding land managers when they are looking to make improvements for land management. Existing literature and information will be collated, and interviews conducted with both landholders and rangeland practitioners to capture specialised knowledge, past work and its outcomes.

The main component of this project is the development and facilitation of community of practice groups to encourage collaborative thinking and foster the sharing of knowledge between landholders, scientists and advisors. These community of practice groups will be established in three key regions of western NSW. Collectively, and using a facilitated process, the groups will identify priority areas for restoration and devise innovative strategies to increase key perennial species. Demonstration sites will be established and co-managed with the groups, to implement, trial and monitor the effectiveness of these strategies. These sites and a refined and tested facilitation process will provide a resource for future extension and adoption events in the rangelands.

Without innovative approaches to improve their regeneration and management, native perennial species will continue to decline, threatening the viability of the livestock industry and ecosystem function. Knowledge, experience and data collected through this project will contribute to the development of resources and tools to guide land managers in restoring diverse pastures and ensure an ongoing legacy of the work undertaken.

Quantifying plant available nitrogen from biocrusts at two long-term research sites in the Australian Rangeland

J. Eastaughffe*, W.J. Williams, S. Schmidt**, N. Robinson****

*Northern Territory Department of Industry, Tourism and Trade, Katherine, Australia
**NUE Lab, School of Agriculture and Food Sciences, The University of Queensland, St Lucia, Australia

Abstract:

Covering over 80% of Australia, rangeland ecosystems facilitate an abundance of ecological processes. Land management has the potential to alter the natural balance, often impacting ecological functionality. Biocrusts form a protective soil cover that includes carbon and nitrogen fixing organisms. We examined the role biocrusts play in generating bioavailable N in rangeland ecosystems. In a sub-humid open eucalypt woodland located at Wambiana Station (Queensland), long-term grazing trials were established over 25 years ago. These include moderate and heavy, set stocking as well as wet season spelling. We examined how different grazing management strategies affected the leakage of plant available N from biocrusts on both duplex clays and red-yellow earths. Bioavailable N was captured by placing sachets of resin beads directly under the biocrust. The first stage was carried out prior to the onset of the wet season. Following substantial rains over several months the sachets were retrieved. Overall, bioavailable N from the field differed significantly between stocking treatments, trending from high levels of nitrates in spelled paddocks to low levels within the heavily stocked treatments. At Victoria River Research Station (Kidman Springs, Northern Territory) a second field experiment was carried out in an open woodland set on calcareous soils. Post-fire and late wet season resin bags were deployed in a grazed region with good grass and biocrust cover as well as a heavily-trafficked degraded area. Preliminary results encourage wet season spelling and suggest that cattle stocking rates strongly affect the cycling of microbial nutrients.

Biocrusts, ecological indicators in the Australian rangelands

W.J. Williams*, M. Vega, C. Driscoll*, T. Myint Swe*, R. Cowley, P. O'Reagain***, A. Potgieter****, Y. Zhao****, P. Dennis*, S. Schmidt***

*School of Agriculture and Food Sustainability, The University of Queensland, St Lucia, Australia
**Livestock Industries, Department of Industry, Tourism and Trade, Katherine Research Station, Katherine, Australia
***Department of Agriculture and Fisheries, Charters Towers, Australia
****Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Gatton, Australia

Abstract:

The northern Australian rangelands are inhabited by some of the most extensive and diverse cyanobacteria-dominated biocrusts globally. Biocrusts occupy the interspaces between grass plants as a coherent layer that binds the upper millimetres of soil and form a living cover of photoautotrophic (cyanobacteria, algae, lichens and bryophytes), and heterotrophic (bacteria, fungi and archaea) organisms. During the dry season biocrusts are inactive, then recover at the onset of the wet season, actively participating in nitrogen and carbon fixation and accumulation. To identify the role of biocrusts as ecological indicators, we assessed their distribution, diversity and function across microhabitats. We determined how biocrust community dynamics had been influenced by long-term fire and grazing management regimes.

At Victoria River Research Station (Kidman Springs, Northern Territory), after 28 years of fire research, we compared early and late dry season burning in
2, 4 or 6-yearly intervals on two soil types (calcarosol, vertosol). Biocrust diversity and genetic function altered seasonally, between soil types, and fire regimes. Post-fire, after a wet season (cattle excluded), biocrusts recovered with significantly more carbon and nitrogen in the surface soils of early burn sites.

At Wambiana Grazing trial (Queensland), when paddocks were rested from grazing every second year, biocrusts in duplex soils recovered to levels comparable to ungrazed control sites. In red-yellow earths, biocrusts were resilient when there was a loss of grass cover during drought. Biocrust diversity and function differed between soil type and management (moderate and heavy stocking).

This research demonstrates that the top centimetre of biocrust-rich soil is central to ground cover integrity and is essential to soil nutrient cycling and fertility, and therefore an important indicator for the recovery from post disturbance: fire, grazing and drought. The principles of ABCD land cover condition should include biocrust presence as a metric that describes landscape resilience, as opposed to bare unprotected ground.

Building a national biomass service for producers

P. Scarth*, P. Tickle*, A. Rayner*, J. Paton*, N. Henry*, W. Gill*, T. Gill*, J. Guerschman*

*Cibo Labs, Point Arkwright, Australia

Abstract:

The Australian Feedbase Monitor (AFM) is a new grazing management tool that gives land managers satellite insights into their feed capabilities. It is an online portal co-developed between Cibo Labs and Meat and Livestock Australia (MLA) to improve the understanding and management of Australia's pasture and fodder feed base. It is free to MLA members and is supported through a broad-based extension program.

We used over 5000 site-based total standing dry matter (TSDM) measurements from pasture cuts, rising plate meter transects and expert observation to build a satellite-based TSDM estimate with similar accuracy to the field observations (Figure 1.1, MAE 204 kg/ha, MAPE 18.9%).

This model produces national TSDM estimates every five days based on the previous 30 days of imagery (Figure 1.1). The coincident application of a fractional cover model allows the TSDM estimates to be partitioned into green and dry components, allowing additional applications such as pasture quality estimation, bushfire risk assessment and ground cover analysis.

Based on the European space agency Sentinel-2 satellite, these products are available back to 2017. This enables producers to understand the trends in their farms' pasture production and includes rainfall, ground cover and biomass to place this season in the context of previous years.

As part of this tool, training and extension programs have been developed to support producers in using the data for feed budgeting and to improve planning to respond to seasonal changes. This data is also used to identify underperforming areas of the farm or areas that may benefit from management changes.

Further enhancements are planned to support a greater range of visualisations, farm metrics and comparisons to drive adoption and help producers understand the benefits and limitations of this tool. We'd love to get the rangeland community's ideas and feedback.

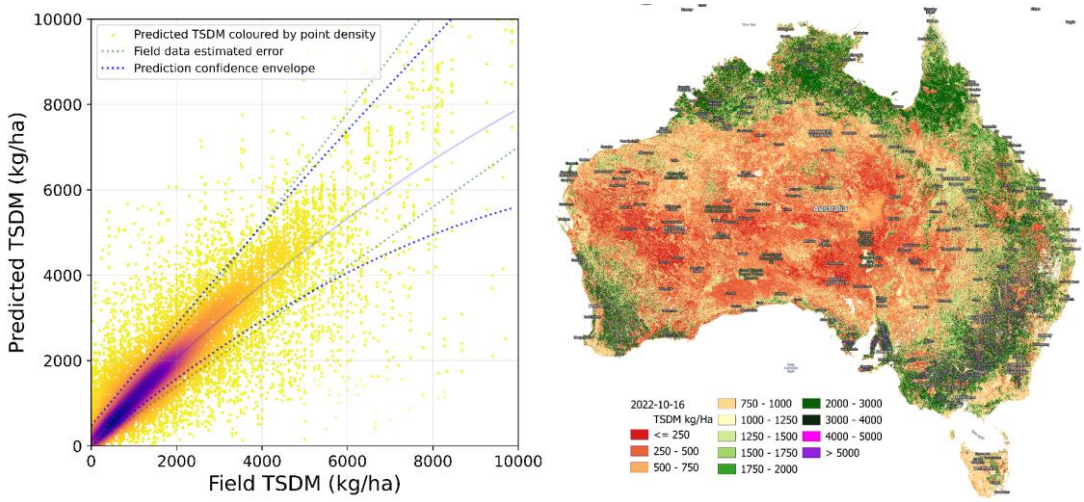

Figure 1.1 Australian feed base monitor predictions versus field-based estimates (left) and example model output for 16 October 2022 (right).

“Paddock Power”: A user-friendly tool for planning new pastoral infrastructure

D. Walsh*, C. Pettit, C. Pearson*****

*Range IQ Pty Ltd, Darwin, Australia
**NT Department of Industry, Tourism & Trade, Darwin, Australia
*** NT Department of Industry, Tourism & Trade, Katherine, Australia

Abstract:

Are you looking for a simple way to:

- Keep your own property maps up to date?
- Plan new water points, fences or pipelines and cost them out before you build them?
- Compare different infrastructure development options to see which one/s will deliver the best ‘bang for buck’?
- Generate reports to take to owners, shareholders or banks to secure funding for your development plans?

If so, the Paddock Power tool is for you!

Why did we develop this tool?

Many paddocks in northern Australia are too big and under-watered to achieve optimum livestock productivity. Expansive areas of rangelands with few water points leads to both over- and under-utilisation of forage (depending on distance from water) and limited opportunities to manage livestock herds for optimum animal and pasture performance.

To overcome these problems, the owners and managers of large properties are actively installing additional fencing and water points. However, the impact of any given infrastructure development on pastures, livestock and business performance is often still based on ‘gut feel’.

Given the expense of development at scale, producers have told us that they require evidence-based planning to better articulate the costs and benefits of proposed infrastructure investments to owners and financiers.

With funding support from Meat & Livestock Australia and the NT Department of Industry, Tourism & Trade, we have collaborated with Trailmarker, Holmes & Company and Bush AgriBusiness to develop a user-friendly mapping tool and investment calculator. The tools compare the costs and benefits of your selected infrastructure development options and evaluate their financial performance in the context of your property’s specific land types, carrying capacity, cost base and livestock productivity.

Curious to know more? Contact us if you are ready to start using these tools for better decision-making in your business!

Raising the voices of First Nations Peoples: challenges, achievements and opportunities in drought conversations.

Dr Raelene Ward

Southern Queensland & Northern NSW Drought Resilience Adoption & Innovation Hub
University of Southern Queensland, Toowoomba, Australia

Abstract:

It is essential that First Nations people are empowered to participate, lead, co-design, and partner in all circumstances where the commercial use of native plants, animals or knowledge is considered. First Nations people are the knowledge holders, they are resilient and continue to maintain cultural connections and traditional practices through ceremony on country. These knowledges are passed down through generations and are essential to a sustainable future. The Southern Queensland & Northern NSW Drought Innovation Hub will ensure that First Nations resource management and Traditional Ecological Knowledge is recognised. First Nations leadership in the Drought Hub is central to effective engagement and partnerships and plays a key role in ensuring that recognised and appropriate First Nations groups are engaged in all activities.

The Hub commits to recognise and respect First Nations expertise and knowledge and ensure appropriate First Nations participation and leadership in all activities. This position has formed part of the Hub leadership and executive group and is held by a First Nations person with appropriate cultural knowledge, skills and experience and work towards developing and maintaining an effective First Nations Partnership Strategy, including cultural awareness training, First Nations advisory groups.

Across the Drought Hub footprint, there are more than 35 First Nations groups engaged in drought conversations of which the challenges, achievements and opportunities for communities have been identified. Bringing First Nations people on the journey in every aspect of the whole project is key to building capacity of First Nations people and their communities in being resilient and sustainable beyond the project. Building capacity of researchers, partners, and industry in being MORE equipped, aware, and able to engage respectfully with First Nations people in a supportive and collaborative approach.

Mapping monthly deviation of expected total vegetation cover for the accumulated antedcedent percipitation in Australia

J.F. Leys*, J.P. Guerschman, M.J. Hill***, R.J. Donohue*, Y. Chen*, R. Bridgart******

*CSIRO Land and Water, Black Mountain, ACT, Australia
**formerly CSIRO Land and Water, Black Mountain, ACT, Australia
***Department of Earth System Science and Policy, University of North Dakota, Grand Forks, ND 58202, USA
******CSIRO Environment, Clayton, Melbourne, Victoria, Australia

Abstract:

Total vegetation cover (TVC), the sum of photosynthetic vegetation and non-photosynthetic vegetation, changes across Australia with rainfall, land management and extreme events like fire. This study aims to understand if the observed TVC at a location for a given month is higher or lower than what is expected, given the accumulated antecedent precipitation (AAP). To determine the number of months between 1 and 60 of AAP, which returns the maximum R^2 value for the MODIS TVC fractional cover product for each month of the year. Each pixel was then classified based on its highest R^2 as high confidence – R^2 above 0.7, medium confidence – R^2 0.5 to 0.7, or low confidence – R^2 below 0.5. Maps for each month from January 2001 to January 2023 are published in the RaPP Map tool showing anomalous pixels, that is, the upper or lower 95% confidence interval for the AAP/TVC relationship.

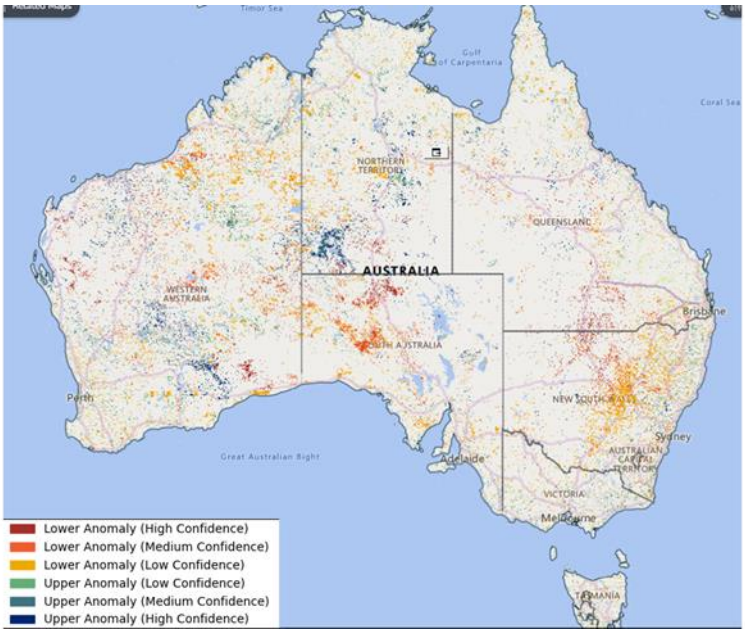

Figure 1.1 Expected total vegetation cover anomaly map for September 2018 (link) showing the upper and lower 95% anomaly with high confidence – R^2 above 0.7, medium confidence – R^2 0.5 - 0.7, or low confidence – R^2 below 0.5.

Figure 1.1 shows the anomalous TVC pixels (outside the 95% confidence interval) and R2 confidence classes for September 2018. Southwest Northern Territory shows an upper anomaly with high confidence, while central New South Wales shows a low anomaly with low to moderate confidence. To assess the anomaly's cause, we consider fire, flood, clearing or land management actions like grazing and cropping. The lower anomaly in central NSW, around Dubbo, has lower TVC than expected for the AAP experienced. This suggests possible over-utilization by livestock.

Using RaPP to evaluate the TVC monthly anomaly can help land managers understand if their management is improving or degrading TVC.

Technology adoption for grazing land management in the Burdekin Catchment, Queensland

A. Hogg*, B. Martin*

*NQ Dry Tropics, Townsville, Australia

Abstract:

The Federal Government and State Government have made reduction of fine sediment delivery to the Great Barrier Reef lagoon a key priority, now and into the future, and it is therefore critical that graziers integrate good spatial data into their management plans to account for this priority. Since 2021, NQ Dry Tropics has been delivering the Maps & Apps workshop at various locations throughout the Burdekin Dry Tropics Region. The intention of this workshop is to enable landholders to utilise freely available software platforms to produce detailed, accurate property maps. Property maps are the foundations of best-practice grazing management plans that aim to increase groundcover and reduce sediment loss, while simultaneously providing an avenue for productivity-driven infrastructure planning.

While NQ Dry Tropics has the capability to produce property maps, the Maps & Apps course aims to enable our client landholders to create, update and produce solutions for themselves that best fit their enterprise.

Providing this training has not been without challenges, chief among them is that no single software solution exists for this mapping. There are subscription platforms available, however to this point they have been cost-prohibitive or impractical to teach in a one- or two-day course.

Maps & Apps currently promotes the use of Queensland Globe, Avenza maps, MyFORAGE and the Google Workspace. These four platforms provide the ability to produce a property map, use and update that map in real time across areas of little or no reception, produce customised property reports centred on groundcover, soil stability, rainfall, pasture growth etc. and the tools to effectively run a business in the shared cloud space of the digital age. Additionally in 2023, NQ Dry Tropics has adopted the use of Starlink Roam satellite internet units that allow these workshops to be taken anywhere in the catchment, irrespective of NBN or mobile coverage.

Digging Deep to better manage pastoral country – understanding soils in arid landscapes

A.K. Tschirner

South Australian Arid Lands Landscape Board, Port Augusta, Australia

Abstract:

Global interest in regenerative agricultural practices has accelerated questions about how this applies to managing the rangelands in South Australia's pastoral country. Improvements to ground cover and species diversity at a paddock and property scale is the best tool available to rangeland managers looking to improve soil productivity and drought resilience. Understanding soils and taking a 'From the Ground Up' approach at managing pastoral businesses has been the focus of a series of demonstration sites and field days in the southern rangelands of South Australia.

Working with pastoral land managers, a series of soil and feed tests have been sampled across pastoral lands to better understand the importance of soil organic carbon, soil properties and water holding potential. Understanding the complex evolutionary adaptations of rangelands plants has also been integral to understanding both the limitations and benefits of soils of Australia's interior.

Improving the understanding of soil physics, chemistry and biology amongst our community of rangeland managers is integral to building climate resilient businesses and management practices. The question is 'how deep do we dig?'.

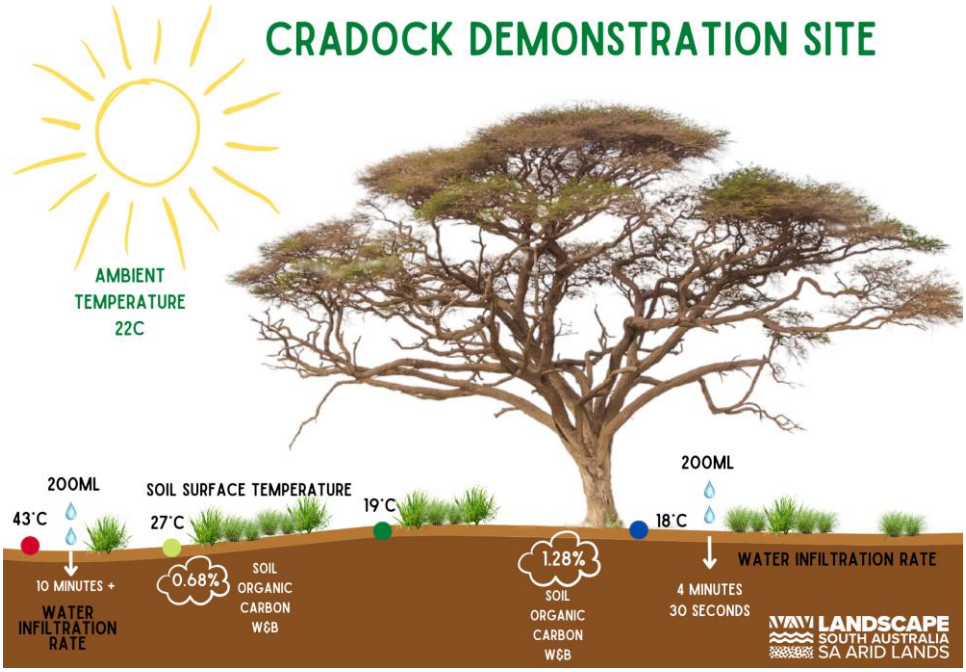

Figure 1.1 An example of data being collected with pastoralists to better understand the importance of soil cover to rangelands productivity.

Using climate information in the Kimberley for drought and flood resilience

Anne Marie Huey

University of Southern Queensland, Northern Australia Climate Program, Broome, Australia

Abstract:

Understanding the climatic conditions and forecasts that determine whether the upcoming wet season is likely to be abnormally wet or dry is critical for Kimberley producers. Properties in the Kimberley tend to be large, remote and many have limited road access during the wet season. Seasonal planning is therefore critical.

While flooding created by cyclones and low-pressure systems cannot be predicted in advance, climatic conditions that predispose northern Australia to extremes can be monitored. For example, when the oceans around the north of Australia are warmer than usual, there is an increased risk of tropical cyclones and lows.

Large-scale climate drivers, such as the El Niño Southern Oscillation and the Indian Ocean Dipole, can create conditions that make droughts and floods more or less likely during the wet season. They also influence the timing of the wet season – an important planning period for producers. These climate drivers are forecast months in advance.

Long-term forecasts (monthly, seasonal) can provide important information about the likely prevailing conditions for the coming wet season. For example, having an indication as to when the wet season break is likely to occur allows us to optimise logistics such as ensuring there is enough hay and supplement on hand, without incurring the extra expense of carrying fodder beyond the break of season.

These long-term forecasts are often underutilised by producers in the Kimberley and have the potential to inform management planning and improve outcomes.

- Long-term forecasts can provide useful information about the coming wet season and whether droughts or floods are more likely than usual.
- Forecasts give an ‘early warning’ for seasonal extremes and allow for a longer lead time in planning risk mitigation strategies, especially for remote properties.
- Planning early for droughts and floods can save time, money, and stress.

Remote Sensing technology supporting forage budgeting, natural capital and landscape carbon in the northern rangelands

P. Scarth*, J.P. Guerschman*, P. Tickle*, N. Wilson, D. Chapman****

*Cibo Labs, Point Arkwright, Australia
**Australian Agricultural Company (AACo), Newstead, Australia

Abstract:

Cibo Labs, established in 2018, has been investing in data science, high performance computing, machine learning systems, targeted field data collection, and most importantly strong engagement with producers, to routinely deliver paddock level estimates of pasture biomass on a weekly basis to over 55 million ha.The Australian Agriculture Company (AACo) has been a significant supporter of these developments which now underpin many management decisions across the company. In the last two years Cibo Labs and AACo have enhanced their partnership to use remote sensing for helping AACo achieve their sustainability framework goals, particularly on Landscape Carbon and Natural Capital.

Using long time series of satellite datasets Cibo Labs has developed ‘Landscape Response Units’ (LRUs) that describe landscape variability across the AACo estate and improve on the manual and disparate land type mapping done by the state governments. The LRUs have been used in combination with a dataset of 3341 field observations of Land Condition taken between 2018 and 2022 for characterising Land Condition across the landscape. Using a random forest regressor and the richness of information used for generating the LRUs as covariates, we achieved an overall accuracy of 80.4%. Land Condition complements pasture biomass estimates and underpins AACo’s forage budgeting process.

Regular pasture biomass estimates together with the ability of mapping Land Condition also underpin AACo’s sustainability goals. For example, the LRUs are being used for stratifying the landscape and guiding the field sampling process currently ongoing for characterising soil and woody vegetation carbon, and used as covariates for expanding field observations of landscape carbon using machine learning. The LRUs and Land Condition are also used as a broader descriptor of whole of ecosystem health and provides a basis for monitoring and assessing Natural Capital.

Cibo Labs and AACo are at the forefront of the science and innovation landscape in Australian rangelands and their combined efforts already spelling into benefits to the wider livestock sector.

Runoff sediment characteristics of four Fitzroy Basin grazing soils in Central Queensland, Australia

B. Bosomworth

Department of Environment and Science, Rockhampton, Australia

Abstract:

Managing soil in rangelands is a crucial component of soil conservation and maintaining productivity. Pressures of grazing can increase sediment export through ground cover reduction, increasing the detachment potential of soil particles exposed to raindrop impact and increased overland flow. In the Great Barrier Reef catchments, grazing is a significant source of fine sediment export into the Great Barrier Reef Lagoon. This study investigated sediment export characteristics of four different grazed soil types in the Fitzroy catchment, Queensland, where 75% (>117,000 ha) of the catchment is utilised for grazing. Rainfall simulation was applied over four bare soil types—Tenosol, Black Vertosol, Brown Sodosol and Black Dermosol—to determine erosion parameters for modelling sediment loss using the Revised Universal Soil Loss Equation. These four soil types are representative of 75% of the Fitzroy Basin and 57% of the Great Barrier Reef catchment. Data collected provided an understanding of detachment properties and particle size distribution of eroded sediment, and found that hydrological properties, sediment loss and particle size distribution differed depending on soil type.

Table 1.1 Summary of steady state hydrology and sediment loss for soils investigated.

	Black Dermosol	Black Vertosol	Brown Sodosol	Tenosol
Number of plots	3	13	9	3
Time to runoff mean	2	3	3	2
Infiltration mean(sd)	12.5 (0.5)	13.8 (4.3)	11.2 (1.8)	8.0 (0.6)
Runoff (mm/hr) mean(sd)	72.3 (1.2)	76.9 (3.9)	81.7 (2.2)	81.1 (3.9)
Sediment loss (t/ha) mean(sd)	0.32 (0.04)	0.51 (0.20)	0.70 (0.18)	0.92 (0.16)

Of the soils studied, the Tenosol appears to have the highest risk of sediment loss and suspended particle export where bare soil is exposed, however of the soil types studied, this is the least common across the Fitzroy catchment. The Black Vertosol and Brown Sodosol present the greatest risk of sediment export with a combined proportion of the catchment of 54%. Data from vegetated plots (not shown) exhibited higher infiltration rates, lower runoff rates, and markedly less sediment loss. Management of ground cover is therefore a critical component of reducing sediment loss in Reef catchments, where ground cover targets of 70% are recommended in the late dry season. Understanding the processes of sediment detachment, entrainment and deposition are applicable across all rangelands.

Native Pasture Restoration in the Kimberley Region, Western Australia

P.J. Golos*, C.K. Revell**

*Kings Park Science - Department of Biodiversity, Conservation and Attractions, Perth, Australia
**Department of Primary Industries and Regional Development, Perth, Western Australia

Abstract:

The pastoral industry in the Kimberley region is an important economic contributor to Western Australia. However, as result of past land management practices and variable wet seasons, there has been a decline of the more desirable native pasture grasses resulting in a loss of feedbase productivity. To reverse this decline, Kings Park Science - Department of Biodiversity, Conservation and Attractions, in collaboration with the Department of Primary Industries and Regional Development, are undertaking research to help restore important native pasture grasses in this region.

Seeds of 10 native grass species have been collected with seed quality and germinability assessed. Seed fill varied widely between species (0 to 63%) and within species (Table 1.1). There tended to be a higher germination total and rate of gemination when seed was removed from florets and a further increase in germination total and rate when treated with gibberellic acid (GA). All species showed a maximum germination of 81-100% except for *Panicum decompositum* which only reached a maximum germination of 15%. This species is likely to require after ripening treatment during storage (post seed harvesting) to improve germination.

Six species have been planted out on a small scale to trial a seed production area (with irrigation) at The University of Western Australia research facility in Perth. These plants will be used to observe plant growth and phenology as well as provide a source of seed for further experiments.

Six grazing exclosures have been constructed across two Kimberley pastoral stations and include the more productive pasture types of the ‘Black’ soil group like Bluegrass, Mitchell grass and Ribbon grass, and the less productive but more extensive pasture types of the ’Red’ soil group like Curly spinifex, Ribbon grass and Black Speargrass.

We thank Napier Downs and Mount House stations for providing logistical support for seed collecting and fencing exclosure sites.

Table 1.1 Seed fill, germination without and with treatment for 10 grass species collected from Napier Downs station, Kimberley Region, Western Australia.
(F-floret, S-seed, GA-gibberellic acid).

Common name (species name)	Seed fill	Germination after 6 months storage					
		Control			After treatments		
	(%)	Total (%)	Rate t^{50} (days)	Seed or floret	Total (%)	Rate t^{50} (days)	Optimal treatments
Ribbon Grass (*Chrysopogon fallax*)	0-3	-	-		-	-	-
Bundle-Bundle (*Dichanthium fecundum*)	13-39	88	4	F	100	1	S+GA
Qld Bluegrass (*Dichanthium sericeum*)	43-63	34	9	F	100	1	S+GA
Pan Wanderrie Grass (*Eriachne glauca*)	32	74	4	F	81	1	S
Black Speargrass (*Heteropogon contortus*)	32	82	4	S	92	1	+GA
Red Flinders Grass (*Iseilema vaginiflorum*)	21	75	8	F	100	1	S, S+GA
Native Millet (*Panicum decompositum*)	56-94	2	-	S	15	28	+GA
White grass (*Sehima nervosum*)	23-37	90	2	F	100	1	S, S+GA
Plume sorghum (*Sorghum plumosum*)	26	30	1	F	100	1	S+GA
Annual Sorghum (*Sorghum stipoideum*)	50	57	1	F	-	-	-

T^{50} - time taken to reach 50% of total germination.

Partners for Cultural Fire Management in the Dry Tropics

K.P. Vidler*, T.M. Georgetown*, NQ Dry Tropics Traditional Owner Management Group*

*NQ Dry Tropics, Townsville, North Queensland, Australia

We acknowledge the Traditional Owners and their enduring custodianship and connection to Country; we pay respect to Elders past and present.

Abstract:

Call for action: 'Traditional Owners and graziers make good partners.' Cultural fire management is receiving growing recognition as an important land management tool. Western science and land managers are now increasingly starting to understand, recognise, and appreciate the complexity and intricate detailed Traditional knowledge systems that have been passed on and refined over the past 60,000 years. There has been great interest in Cultural fire on a national level due to the 2019–2020 fires that severely impacted the south-east of Australia.

In the Burdekin Dry Tropics region there has been major displacement of Traditional Owners and today few live on or have access to Country. Connection to Country by Traditional Owners has endured, however much knowledge has been dispersed and lost. With the resurgence of respect for Traditional knowledge has come opportunity for initiatives such as this project which draws on the ancient knowledge systems, to rebuild respect, connection, and capacity of Traditional Owners across our region.

Over 90% of the Burdekin region is under grazing land management. Fire as a land management tool has historically been used across the region and has a chequered reputation. While some landholders still utilise fire on their properties, the vast majority do not use fire or do not use appropriate fire management. Grazing property owners in the region talk of 'fear' of fire due to a lack of knowledge and also fear of litigation. Both property owners involved in the proof of concept were multigenerational graziers with land management issues on their properties that they had tried to address through other means and were struggling to manage. The design of the project engaged Firesticks Alliance lead fire practitioner Victor Steffensen to share his experience, and after spending time together to read Country and discuss the issues with local Traditional Owners, both property owners committed to be involved. While the project has a strong focus on rebuilding the capacity and capability of Traditional Owners around reading Country and Cultural fire management, we are also building confidence in appropriate fire management with landholders and the importance of engaging with Traditional Owners to re-introduce Cultural fire management for the Burdekin region. Through the project we are creating spaces and opportunities to initiate or rebuild partnerships and networks between Traditional Owners and graziers.

Pasture and Land Condition Assessment in the Arid Shrublands Using Off-The-Shelf Drones

R.A. Marver

Contour Environmental and Agricultural Consulting, Western Australia

Abstract:

With the advent of cheap and easy to use drone technology many pastoralists and graziers now own at least one drone. They're fun and can take great photos but can off-the-shelf drone technology be used by pastoralists and graziers to accurately and repeatably assist them in making stocking decisions in their landscape?

Proactive stocking rate adjustments required to maintain or improve resource condition are strongly dependent on timely and accurate monitoring. An objective, accurate, reliable, and easily repeatable pasture assessment methodology in the diverse vegetation communities found within the Southern Rangelands will assist pastoral land managers to improve total grazing management, pasture condition and water use efficiency, thus allowing them to be more resilient to seasonal variability and drought.

This project developed a tool using drones that can be obtained and operated by people working on the land. The process assesses vegetation and landscape condition through repeatable drone data collection in the field, combined with a simple set of post data collection analyses. Using the tool, in combination with other decision-assisting tools, will allow pastoralists and graziers to make stocking rate decisions through movement of stock within their station, or on or off the station, as well as provide monitoring data of unstocked areas to gauge grazing impacts by non-domestic grazing. Longer-term, the monitoring tool will assist the pastoralist to detect changes in the vegetation condition and resilience of their landscape and help to complement other monitoring activities that may be undertaken.

Considering geomorphic processes in rangeland rehabilitation works

P. Theakston*, C. Anderson**

*Western Local Land Services, Cobar, Australia
**Western Local Land Services, Broken Hill, Australia

Abstract:

The Soil Conservation Service (SCS) of NSW developed techniques to control sheet and scald erosion, these types of erosion having the largest impact on an area basis. Less effort was applied to gully erosion since it was seen as a lesser impact on an area basis (Green 1989). The reasoning to concentrate on broad scale erosion was to reduce runoff rates on a large scale such that eroding gullies will stabilise (Tatnell 1987). Field observations of contour furrowing suggest this technique may slow down the gully problem (Wakelin-King 2010).

In some situations, contour furrowing has exacerbated erosion issues (Macdonald and Melville 1999; Wakelin-King 2010) and the author's field observations have found active gullies in contour furrowing and waterponding areas. The pervasiveness of gullies across the region is described by Fanning (1999). Also, Pearson (2022) recorded 4,854 erosion gullies along the Darling River from Mungindi to Wilcannia. Pringle and Tinley (2003) have stressed the role incised base levels play in landscape degradation and the need to consider gullies in landscape rehabilitation. A review of contour furrowing by Wakelin-King (2010) stressed the importance of considering geomorphic processes in rangeland rehabilitation.

The Ecosystem Management Understanding (EMU)TM approach (Pringle and Tinley 2001) was engaged by Local Land Services to incorporate geomorphic considerations in rehabilitation earthworks (Pringle and Theakston 2019; Tinley and Pringle 2014a; 2014b).

Critical geomorphic processes are addressed when planning and implementing rehabilitation projects. Lowering of base levels due to landscape incision are treated first. Once expanding landscape incision is stabilised, the broader areas of sheet or scald erosion are 'filled in' with contour furrowing, waterponding and/or grazing management. Such an approach continues to use the well-developed SCS techniques and addresses the pervasive issue of gully erosion. Recent rehabilitation projects will be used to demonstrate this approach.

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Know Your Value! The Importance of Independent Advice in a Changing World

R.A. Marver*, R.J. Brake**

*Contour Environmental and Agricultural Consulting, Northcliffe, Australia
**Richard Brake Consulting, Gingin, Australia

Abstract:

In the emerging and constantly changing space of carbon and natural capital markets, the dominant source of the advice and consultancy being provided to land managers is from the people who stand to gain from promoting and in some cases overhyping the opportunity, while minimising the potential downsides. In much the same way that the agronomy industry is dominated by the companies that sell the products they are advising on.

The increasing requirement for agriculture to move towards demonstrated carbon/ecological neutrality means there is high demand for services that scope, and provide recommendations on maximising, the opportunities this movement will bring. In general land managers in the Australian Rangelands are not well-informed about the potential impacts of the expectations being placed upon them in the Carbon/Natural Capital space. This is not to say they are not aware of the issue. Indeed, many of them are being repeatedly faced with it. The knowledge gap lies in their awareness of their current position as far as Carbon and Natural Capital, and the strategies they can implement to capitalise on the opportunities, rather than be penalised.

We advocate for land managers to seek, and have access to, independent, scientifically rigorous and practically implementable advice on the opportunities and threats these developing industries present. We present an example of one such service. The Landscape Evaluation and Financial (LEAF) planning process delivers whole of landscape, triple bottom line plans that provide guidance and clarity for land managers to have confidence in the merit of their investments of time and money into their landscape. It is only from the position of knowing your landscapes' values (from all perspectives) that a land manager can make an informed decision on how best to engage with an industry that is becoming an important part of successful Rangelands businesses.

Using spatial remote sensed total vegetation cover time series to trigger destocking for erosion control

John F. Leys*, Mary Goodacre**

*Fenner School of Environment and Society, Australian National University, Canberra, Australia
**Southern New South Wales Drought Resilience Adoption and Innovation Hub, Charles Sturt University, Wagga Wagga, NSW, Australia

Abstract:

Avoiding erosion during droughts relies on making early management decisions. Knowing when to destock to maintain ground cover is critical to reducing the impact of drought on-farm. The Southern NSW Innovation Hub (the Hub), in collaboration with the New South Wales (NSW) Farmers' Association and a pastoralist, is delivering a project to contribute to the "Managing Rangelands for Drought Resilience (MRDR)". The MRDR is led by the Northern Western Australia and Northern Territory Hub in collaboration with the Southern NSW Innovation Hub, South-West Western Australia Hub, the South Australian Hub, the Southern Queensland and Northern New South Wales Hub and the Tropical North Queensland Hub funded under the Future Drought Fund's Drought Resilience Adoption and Innovation Hubs Program Projects Grant.

The Hub project aims to demonstrate how drought planning technology can be used to increase drought resilience. For a property in the western Riverina of NSW, the project will evaluate if satellite-based ground cover technology can predict, up to six months in advance, if ground cover is likely to fall below a critical erosion-controlling threshold. This will provide an early warning trigger for the pastoralist to change their management to maintain ground cover in the forthcoming erosion season. A field day will demonstrate the new technology with western NSW pastoralists.

Findings of how the technology worked and how usable and valuable it was for the participating pastoralist will be presented.

LEAF Planning for Landscape and Business Management Direction

R.A. Marver*, R.J. Brake**

*Contour Environmental and Agricultural Consulting, Northcliffe, Australia
**Richard Brake Consulting, Gingin, Australia

Abstract:

The LEAF planning process delivers whole of landscape, triple bottom line plans that provide guidance and clarity for land managers to have confidence in the merit of their investments of time and money into their landscape.

Building on the Ecologically Sustainable Rangelands Management (ESRM) planning process, LEAF plans deliver best practice landscape and business management strategies to the agricultural and pastoral industries.

In collaboration with Richard Brake Agri Business Consultants Pty Ltd these plans are a one-stop shop to ensure that both your landscape and business are performing at their peak.

The poster and lightning presentation will outline the process, the rationale and the outcomes we are seeing in the landscapes and businesses we work in.

State and transition models for tussock grasslands and woodlands of the Kimberley

Anna Richards*, Brett Abbott, Suzanne Prober***, Jodie Hayward*, Rob Sudmeyer****, Matthew Fletcher****, Kath Ryan****, Chris Hetherington****, Pouria Ramzi****, Philip Thomas****, Karyn Reeves****, Wayne Fetcher****

*CSIRO Darwin, Northern Territory, Australia
**CSIRO Townsville, Queensland, Australia
***CSIRO Perth, Western Australia
****Department of Primary Industries and Regional Development, Western Australia

Abstract:

Setting appropriate threshold and limits for pasture condition standards in the Rangelands requires an understanding of ecosystem dynamics and the drivers of transitional change between states. Accurately identifying the threshold at which natural pastures undergo a transition to less productive states is a critical factor.

To help provide practical information on how ecosystems are likely to respond to man-made or natural disturbances, State and Transition models, (S&TMs) have been developed for Kimberley tussock grass pastures by the DPIRD Rangelands Science Team in collaboration with CSIRO and a panel of experts.

The models were developed using the Australian Ecosystem Models framework archetype as templates. Nineteen states were described, including two reference states and 17 modified states, across two ecosystem types. The S&TMs also described 58 transitions between modified states. Transitions included information on drivers, pre-conditions and timeframe for transitions.

The objective of this project was to develop state and transition models as a tool to support monitoring and compliance programs in the Kimberley. The models were developed to meet three key outcomes: a shared understanding of grassland dynamics; informing management and regulation of grassland ecosystems; and providing support for producing methods for quantitative measurement of pasture condition.

Call to action: With a shared understanding of grassland dynamics, we can support monitoring and compliance programs and work towards sustainable management of these vital ecosystems.

Reference

Richards AE, Abbott BN, Sudmeyer R, Fletcher M, Ryan K, Prober SM, Thomas P, Ramzi P, Hayward J, Hetherington C, Reeves K, Fletcher W (2023) State and transition models for tussock grasslands and woodlands of the Kimberley: Final project report. CSIRO and Department of Primary Industries and Regional Development, Western Australian Government, Australia.

The art of creating good cost-effective science communications

Chris Hetherington

Department of Primary Industries and Regional Development, Kununurra, Australia

Abstract:

Join Chris Hetherington, a former broadcast media professional turned station lease inspector based in Kununurra, Western Australia, as he shares his insights on producing cost- effective science communication videos.

In today's digital landscape, it's essential to communicate your message effectively, but posting aimlessly and without a clear strategy can be costly and ineffective. This talk will delve into how you can produce professional and engaging science communication that won't break the bank. Chris will provide valuable tips and tricks for maintaining professionalism and integrity while creating slick messaging that resonates with your audience. Learn how to use affordable tools such as mobile phones, mini drones, and editing software to create fast and effective videos that capture attention across various platforms. Join in for this three-minute tutorial that will help you keep your target audience engaged and informed.

Call to action: If a tree falls in the rangelands and no one is around to hear it, does it matter? Don't let your message fall on deaf ears. Take action to ensure that your voice is heard loud and clear.

Rain ready rangelands paddock challenge: Trialing research station grazing strategies on commercial Central Australian properties

L. Taber*, C. Materne*

*Department of Industry, Tourism and Trade, Alice Springs, Australia

Abstract:

Can you improve land condition on your property, while still producing quality beef? The Quality Graze project, a long-term grazing trial on Old Man Plains Research Station (OMP), located south-west of Alice Springs shows that it is possible, using stocking rates based on long-term carrying capacity (Materne *et al*. 2021). The Paddock Challenge is working with commercial producers to adapt the Quality Graze strategies for their own circumstances, including monitoring to record any gains in herd efficiency and land condition.

The Paddock Challenge is a component of the Rain Ready Rangelands Project funded by the Australian Government Future Drought Fund. The Department of Industry Tourism and Trade will be working with two stations, one 400 km south-west and the other 300 km north-west of Alice Springs. The prevailing grazing management of each station will be compared to a 'challenge paddock' where a strategy adapted from Quality Graze is being applied.

Comparisons and benchmarking will be at the whole paddock or waterpoint scale, depending on station infrastructure. Pasture dynamics and herd behaviour, performance and health will be monitored over the two-year challenge. Site data will inform pasture, herd and economic modelling to extrapolate site results over the longer-term climate variability. Results will be documented through case studies and field days to promote peer-to-peer learning.

Reference

Materne C, Kain A, Cowley R, Hearnden M (2021) Quality Graze: turning off beef while improving land condition in Central Australia. In 'Proceedings of the NRM in the Rangelands Conference: Shaping our Future, 2021'. (NRM in the Rangelands Conference: Shaping our Future: Longreach)

FIREGRAZE: Using strategic patch burning to influence cattle landscape preference and improve land condition.

C.L. Pettit*, G. Bailey-Preston**

*NT Department of Industry, Tourism and Trade, Darwin, Australia
**NT Department of Industry, Tourism and Trade, Katherine, Australia

Abstract:

Fire can be used to better distribute grazing pressure into underutilised areas, reducing the potential degrading impacts of high utilisation rates surrounding water points, or preferred soil types (Dyer *et al.* 2003). At Victoria River Research Station in the Northern Territory, the FireGraze project is trialling prescribed burning to alter landscape preference of cattle, to draw cattle to underutilised parts of a paddock with fire and reduce grazing pressure on preferred land types.

Conkerberry paddock is 14 km^2 and a mix of calcareous red earths with black spear grass (*Heteropogon contortus*) and alluvial cracking clays dominated by ribbon grass (*Chrysopogon fallax*) and Flemings bush (*Flemingia pauciflora*). In 2020 most of the paddock was in B to C condition with some areas of the alluvial clays in D condition. There has been a decrease in palatable, productive perennial (3P) grasses since 2003 (Figure 1.1) at long-term monitoring sites in the paddock. It is hoped fire will reduce grazing pressure in areas where 3P grasses have noticably declined on the alluvial clays and move cattle grazing onto the burnt area which was previously dominated by large areas of underutilised black spear grass.

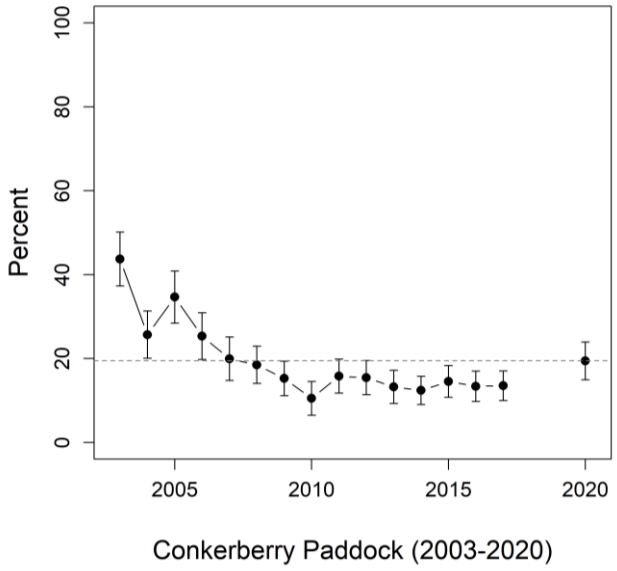

Figure 1.1 Percentage 3P grasses in Conkerberry paddock from 2003–2020.

In September 2022, 20 GPS collars were deployed randomly within a herd of 55 pregnant Brahman cows. In November 2022 a prescribed burn was conducted in a 1.5 km^2 area within the red earth land units dominated by underutilised black spear grass. Five photo monitoring points were established in the burnt area prior to the burn and are revisted monthly. Species composition, grazing intensity and ground cover will also be assessed across the paddock in June 2023 at pre-existing long-term monitoring sites.

Reference

Dyer R, Café L, Cobiac M, Cowley, R (2003) Developing sustainable grazing management systems for the semi-arid tropics of the Northern Territory. MLA Project Report NAP3.211.

Increasing adoption of phosphorus supplementation in Northern Australia – Are your heifers deficient?

A.I. Bone

Department of Primary Industries and Regional Development, Broome, Australia

Abstract:

Phosphorus (P) is an essential nutrient for cattle to survive. It is important for many biological processes such as milk production, fertility, and bone development.

Despite the well-established benefits of P supplementation for herd health and production, the adoption of using P remains low. This is believed to be due to the general lack of knowledge and understanding, perceived lack of value, and logistical challenges.

The project ‘Are your heifers phosphorus deficient?’ seeks to engage pastoralists over Western Australia's north to increase the uptake of phosphorus. The project aims to do this by making pastoralists aware of current phosphorus levels in their heifers. Both blood and fecal samples from a small number of heifers from the herd will be sent off for analysis, along with soil samples. If the results come back as deficient, a nutritionist will be engaged for a one-on-one session to develop a supplementation plan.

This is a component of the larger project ‘Increasing adoption of phosphorus supplementation in northern Australia’, where one producer demonstration site (PDS) is already running. This PDS is comparing Wet season P to Easy P, which is the term coined from the Northern Territory P trials (Schatz, 2020). There is an opportunity for another station to establish a PDS, which will compare the recommended supplementation plan by a nutritionist to the current station practice.

This project is funded by Meat and Livestock Australia (MLA) and the Western Australian Department of Primary Industries and Regional Development (WA DPIRD) through the Northern Beef Development Program.

References

Schatz T (2020) Kidman Springs Phosphorous Supplementation Project. Northern Territory Department of Industry, Tourism and Trade.

A northern Australian citizen-based groundwater sampling program

J.A. Davis*, E.A. Garcia*, D.J. Irvine*

*Research Institute for the Environment and Livelihoods, Charles Darwin University Casuarina campus, Darwin, Northern Territory, Australia

Abstract:

Groundwater is 'out of sight and out of mind' because it is underground. The aim of this program is to empower local people to manage and protect their groundwater through direct engagement with data gathering, recording and interpretation. The remoteness and vastness of the tropical and arid regions of northern Australia means that community involvement is the only way that information can be collected effectively across such a large spatial scale. Here people power far exceeds the ability to install infrastructure to collect much-needed water quality data. The project is run via a free app (available from the App Store and Google Play) and a website. Participants are provided with a groundwater sampling kit, instructions and a pre-paid envelope for delivery of water samples to Charles Darwin University (CDU) for analysis. Groundwater analyses include salinity/electrical conductivity (EC), pH, and hydrogen and oxygen isotopes. The latter provide information on water sources (recent or past rainfall). Environmental DNA (eDNA) analysis is used to detect the presence of stygofauna (a groundwater ecosystem service bioindicator). A sample will be frozen and stored (banked) at CDU to provide a baseline sample against which samples from the same bore can be compared in the future if pollution becomes a concern. Results will be publicly available from the project website in user-friendly maps, graphs and text formats. Where pollutants are detected, or other issues of concern arise, participants will be invited to join a second stage of investigation where more comprehensive water quality measurements will be made in conjunction with the CDU research team. More information and sampling kits are available from the Drought Resilience Adoption & Innovation Hubs booth at this conference.

Lessons learnt from a 45 year-long feral donkey management program in Western Australia

M. Zabek*, D. Pasfield, J.P. Slaven*, S. Marwick*, L. Strange***

*Department of Primary Industries and Regional Development, South Perth, Australia
**Kimberley Rangelands Biosecurity Association, Waggrakine, Australia

Abstract:

For established pest species, such as large feral herbivores (LFH – donkeys, horses, camels), effective management aims to reduce the damage they cause, thereby preventing further impact to agriculture and biodiversity. Effective management also includes monitoring the density and distribution of established LFH populations to delineate their extent and monitor effectiveness of control activities.

In the remote Western Australian rangelands, aerial control is the only method able to reduce LFH population numbers, but with a cost of $10,000/day, which absorbs a considerable proportion of landholders' and state budgets. This high cost of control forces land managers to seek more cost-effective ways of management. In the Kimberley region, feral donkeys (*Equus asinus*) have been the focus of intensive control, which has significantly reduced their population densities. In the absence of information regarding the initial population size, management decisions were based on annual harvest rate, which has decreased from 0.74 to 0.01 donkeys/km^{-2} over 40 years in targeted areas.

We will present the results of a 45-year-long collaborative management of feral donkeys in the Kimberley region. After an initial population reduction of approximately 500,000 animals from 1978–1994 by aerial culling, the implementation of the Judas technique has been an important tool to control feral donkey populations at low densities and as a monitoring tool to facilitate local eradication. We will discuss how effective management of feral donkeys is currently being achieved by adopting new approaches and technological tools to increase animal detection and harvesting effort to further suppress the population and ultimately improve efficiency and cost-effectiveness of the program. We will also discuss the benefits of strategically targeting populations or areas by determining genetic dispersal, re-colonisation ability, and the connectivity of feral donkeys across remote Western Australian landscapes.

Do Carbon Projects Work in the Rangelands? Lessons from a Pastoralist and Project Developer

Shanti Mors*, Louise Turner**

*South Pole Australia, New South Wales, Australia
**Western Landcare NSW, New South Wales, Australia

Abstract:

Managing rangelands can be challenging, but they also provide an avenue for carbon farming by changing or introducing new management practices. Carbon management practices in the rangelands cover measures such as human-induced regeneration of native vegetation by removing suppressors of vegetation growth, avoiding greenhouse gas emissions through controlled burning during wet seasons and increased beef cattle herd efficiency.

We partner with rangeland owners and undertake different approaches to maximise the carbon (abatement or potential) without compromising the agricultural enterprise in place. By effectively implementing carbon projects, agricultural landscapes benefit from the many co-benefits that a healthy and well-functioning ecosystem provides.

What is different in the rangeland?

The change of the viewer's eyes. We look at resources that have always been there; sun, wind, water and a unique vegetation capable of storing carbon, healing resilient soil and repairing nature. This is the rangeland landowners' 'natural capital'.

Through transparent natural capital accounting, landholders can continue with an agricultural business and undertake a carbon project that improves their ecosystems while keeping their stock healthy. This opens a new market opportunity under the Emissions Reduction Fund and the Nature Repair market.

We measure the improvement of the land in terms of carbon abatement, biodiversity gain and a holistic approach on ecosystem conservation and restoration through the application of scientifically robust methodologies and practices.

Why be an early adopter of natural capital accounting in the rangelands?

There is increased interest to repair nature and improve the health of the ecosystem while implementing carbon projects. From financial institutions, renewable energy projects, to telecommunication industries, there is proof of investor appetite to implement land-based projects.

Rangeland landowners can benefit from the Australian carbon market expected to grow following Australia's commitment to the 43% x 2030 emission reduction target and the global 30% x 2030 nature target.

How does the Department of Primary Industries and Regional Development, Western Australia assess rangeland condition?

N.R. Penny

Department of Primary Industries and Regional Development, Perth, Australia

Abstract:

Rangeland condition assessment (RCA) is the process the Department of Primary Industries and Regional Development, Western Australia (DPIRD) uses to assess the pastures and soils (erosion) of pastoral stations. RCA is required by the *Soil and Land Conservation Act 1945* (SCLA) and the *Land Administration Act 1997* (LAA).

It is the intention that all pastoral leasehold land is regularly subject to RCA. Leases are prioritised where the risk of land degradation is considered to be high and an up-to-date assessment is required.

The RCA focusses on the most productive pastures and measures their condition and the impact of pastoral management as outlined in the *Framework for sustainable pastoral management – Land condition version* (Fletcher 2022). These pastures are most important pastorally and most indicative of the combined effects of seasonal conditions and grazing management. The traverse route generally assesses pastures providing at least 80% of the potential carrying capacity of the lease.

On arrival at the lease, DPIRD rangeland officers will attempt to meet with the lessee or their delegate who are invited to attend during the inspection so that they can observe and understand the RCA process. The inspection is a valuable opportunity for the lessee or their delegate to gain skills and knowledge of the lease's pasture species, their productivity, condition, landscape function and management. It is also a valuable opportunity for DPIRD to gain an understanding of the lessee's perspective and management. The lessee's feedback is incorporated into the RCA.

During the RCA, rangeland officers use available lease tracks to travel across the lease and assess the condition of sites located every 1 km interval along the traverse route (Figure 1.1).

Depending on the results of the RCA, regulatory action may be undertaken under the SLCA or the LAA to improve unacceptable or suboptimal pasture condition.

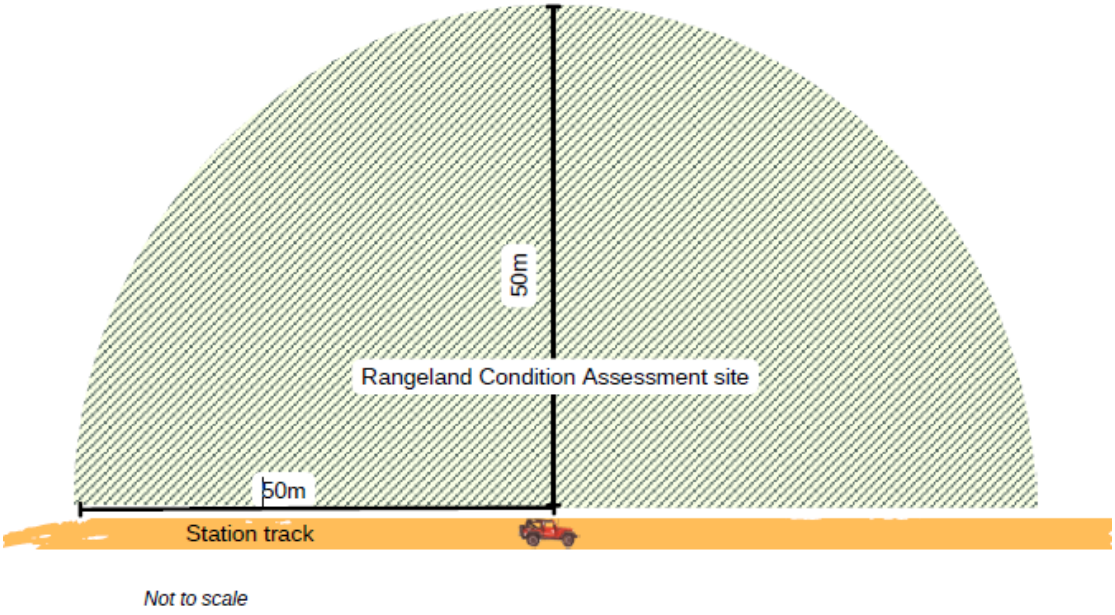

Figure 1.1 The rangeland condition assessment site.

References

Fletcher R (2022) Framework for sustainable pastoral management: Land condition version. Department of Primary Industries and Regional Development, Western Australian Government.

Ord valley cotton and maize production. Can it complement cattle?

Jack Daniel

Northern Australia Crop Research Alliance, Kununurra, Australia

Abstract:

After years of small-scale horticulture and specialists niche crops, cotton and maize have established themselves as viable options in the Ord River Irrigation Area (ORIA). Whilst currently both are grown primarily for other reasons, they can be utilised as cattle feed to service a local market, particularly the cotton seed by-product. Opportunities may also exist for fodder crops, however the agronomy package for these is far less refined compared with cotton and maize. However, it is not the first time the Ord has been touted as producing feed for surrounding cattle stations. This idea has been around before Lake Argyle was built and there have been several reincarnations since. So, what needs to be different this time for it to be successful?

Mapping and Monitoring Feed from Space

T.D. Randall

Knowledge Broker, South Australian Drought Resilience Adoption and Innovation Hub, Australia

Abstract:

Understanding the volume and quality of feed available to cattle in rangelands environments and making appropriate decisions on stocking rates and locations is critical to the health and wellbeing of not only livestock, but also the landscape and the pastoral business.

The national ‘Managing Rangelands for Drought Resilience’ project is a partnership between six Drought Resilience Adoption and Innovation Hubs (Drought Hubs) and their partner organisations to showcase technologies and techniques that use mapping to improve rangeland management across the breadth of Australia’s rangeland environments.

The South Australian Drought Hub component of the national project was delivered by The South Australian Arid Lands Landscape Board and utilises remote sensing technologies such as the Australian feed base monitor to map vegetation cover and structure and determine feed volume in semi-arid shrublands and grasslands on two South Australian pastoral stations. Remote vegetation mapping data was ground trothed using standardised AusPlots methodologies and correlated to pastoral land management practices. This data is applied to guiding optimal grazing management to ensure maintenance of ground cover and promotion of plant species diversity through grazing management.

Feed base and land condition were also monitored remotely on four additional properties using satellite technology to broaden the data set and engage additional pastoral properties in the project.

Results of the project have been shared with pastoralists across the state and through the other Drought Hubs participating in the project. This information will be presented at the Rangelands conference by pastoralists who have participated in the project.

Seeing is believing – Barkly Mitchell Grass Recovery Project

J. Eastaughffe*, C. Pettit*

*Northern Territory Department of Industry, Tourism and Trade, Katherine, Australia

Abstract:

Mitchell grass is a major component within the alluvial cracking clay grasslands on the Barkly Tablelands in the Northern Territory. Mitchell grasses are palatable, productive and perennial pasture species and contribute significantly to the diet quality and quantity in the region. Several years of below-average rainfall has resulted in a noticeable reduction in Mitchell grasses, with some areas experiencing a 'dieback' where large areas of Mitchell grass have completely disappeared.

The Barkly region component of the Rain Ready Rangelands project aims to trial the commercial scale application of wet season spelling to promote Mitchell grass recovery. The producer-led demonstration at Anthony's Lagoon Station involves wet season spelling paddocks where Mitchell grasses have declined. Wet season spelling will be achieved using a three-paddock rotation. A nearby set stocked paddock will also be monitored as a control. Each paddock has a 100 m x 100 m fenced exclosure to monitor and quantify changes under no grazing (inside exclosure) compared to wet season spelling and set stocking (outside exclosure). On-ground assessments will collect pasture composition, yield, grass basal area and soil health data before and during the demonstration. New technology including a multi spectral drone to monitor ground cover change and Farmbot rain gauges and cameras have been incorporated to provide real-time visual data.

The project will be documented and presented as a case study and include field days and a suite of extension activities to increase awareness and interaction with other producers. The project aims to bridge the gap between research-derived management strategies and adoption from producers using a 'seeing is believing' method supported by tangible scientific data.

Mitchell grass response on flood affected country in the northern downs region of Queensland

Katie Hay

Department of Agriculture and Fisheries, Richmond, Australia

Abstract:

In 2019 Northwest Queensland experienced unprecedented monsoonal rain that saw upwards of 800 mm recorded in less than a week. Hundreds of thousands of hectares of grazing land was flooded for periods of 8–10 days. In the four years since the event, previously productive Mitchell Grass Downs appears to have made highly-variable recovery across a wide area.

To determine the cause of lack of pasture response in previously-flooded downs country, soil testing and biological activity testing will be supported by land condition assessments, pasture monitoring, and botanical analysis to document native pasture response as well as determine the viability for sown pastures trials or other interventions to take place.

The potential to utilise sown pastures or other interventions such as soil disturbance and/or soil amendments, in the Northwest as a form of restoration will enable land rehabilitation, pasture productivity and animal performance, within beef production systems. Although difficult in areas that received under 700 mm of rainfall annually, establishing improved grasses and legumes on Mitchell Grass Downs country in Northwest Queensland has the potential to contribute to pasture and business resilience in a highly-variable rainfall climate prone to drought.

Rapid Assessment of Mitchell Grass on Southern Gulf Rangelands using Drone Imagery and Machine Learning

L. Gardner*, D. Phelps, J. Koci*, T. Huang*, B. Jarihani*, P.N. Nelson*, G. Penton*****

*James Cook University, Townsville, Queensland, Australia
**TNQ Drought Hub, James Cook University, Townsville, Queensland, Australia
***Southern Gulf NRM, Mt Isa, Queensland, Australia

Abstract:

Rangeland production systems require accurate and consistent data on land condition to support sustainable decision-making to ensure long-term sustainability, productivity, and profitability. Current approaches to land condition assessment involve subjective on-ground visual assessments which are limited to small spatial extents (< 1 ha). The increasing accessibility of lightweight and low-cost drones (< 2 kg, < AUD$3,000), coupled with the development of machine learning technologies, makes it possible to now use machine learning-based image processing to achieve efficient, consistent, and reliable land condition evaluation using high-resolution drone images. The aim of this study is to develop a systematic approach to quantitatively assess Mitchell grass tussock density on Mitchell grass rangelands of the Southern Gulf region in north-west Queensland, Australia. Sites will be surveyed with a lightweight quadcopter drone that will collect images at a range of elevations (25–100 m above ground level) to determine the optimum ground sampling distance required to detect individual Mitchell grass tussocks. The captured raw images will be stitched together using a structure-from-motion with multi-view stereo photogrammetry software to create high-resolution ortho-photo mosaics. A state-of-the-art supervised machine learning model will be trained to identify individual Mitchell grass tussocks to determine the land condition quantitively. Finally, the accuracy of the model will be assessed. Through this research, we hope to develop a reliable and efficient approach for quantifying Mitchell grass tussocks in paddocks, providing graziers, natural resource management groups and others involved in land condition assessment with valuable new knowledge. This will support better decision-making and improve the sustainability of grazing land management. We invite all stakeholders with drone imagery across Mitchell grass rangelands to contribute to our research. Your contribution will help to advance the rapid land condition assessment of Mitchell grass rangelands.

Meeting the challenges of emissions reduction, profitability, and drought resilience in Western Australia's Southern Rangelands.

Christophe d'Abbadie

Department of Primary Industries and Regional Development, Perth, Western Australia

Abstract:

The semi-arid mulga lands of the Southern Rangelands in Western Australia has some of the most degraded agricultural landscapes in the state. Pastoralists managing this environment operate in a highly variable climate with frequent droughts. For enduring profitability, they need to strike a balance between profitability of their livestock enterprise and maintaining (or increasing) the condition of the land that underpins the feed resource. Another emerging managerial consideration are the level of greenhouse gas (GHG) emissions from their cattle production systems.

The profitability and GHG emissions of 15 different cattle production systems with differing in herd structures and stocking rates, were assessed against drought and price scenarios using a bio-economic model over a 30-year period. The study focused on enterprise profitability, the relative riskiness of each system, the ability to recover from drought impacts and the extent to which GHG emissions could be reduced.

The economic optimum for herd structure identified in this study was the production of 500–560 kg slaughter steers and heifers. This structure relied on a conservative stocking rate that left enough standing fodder (haystack) to provide resilience during consecutive droughts. Carrying a haystack is expected to improve land condition. This strategy also had the lower emission intensity per kilograms sold. With infrequent droughts, this strategy had lower average yearly GHG emissions relative to other strategies. However, when this herd structure was tested under more frequent droughts, it resulted in higher average yearly GHG emissions relative to other production systems. This was since the selected strategy did not require destocking during droughts, which ultimately resulted in higher average yearly emissions.

The cattle production's carbon footprint is under increasing scrutiny. However, the financial implications of reducing stocking rates, lowering emissions intensity and increasing biomass to create income streams from carbon projects needs to be assessed.

The Next-Generation Land Managers Project - creating future sustainable land managers through Rangeland Management Courses

S.L. Holzapfel*, M.G. Williams*

*Northern Territory Department of Industry, Tourism and Trade, Katherine, Australia

Abstract:

The Northern Territory Department of Industry, Tourism and Trade (DITT) have been offering the free, on-station, Rangeland Management Course targeting first and second-year station hands for over 20 years. The aim is to educate young people working in the pastoral industry about the fundamentals of land and pasture management at the beginning of their career, creating a stepping stone to more advanced courses such as Meat and Livestock Australia's EDGENetwork workshops. The course also builds a relationship between station and DITT Livestock Industries staff, which is important for increasing industry interaction with government.

The Rangeland Management Course covers land and pasture condition, species identification, ruminant nutrition, fire as a management tool, weeds and poisonous plants, and carrying capacity. Different learning styles are stimulated through theory, demonstrations, and practical sessions in the paddock.

Feedback collected from 63 participants over five courses in 2022 and 2023 shows a positive response to the course. Table 1.1 shows the average rating to some of the feedback questions asked, indicating that many participants did not feel they had good prior knowledge, but found the course very valuable; with the accessibility attracting participants who would not normally attend on their own accord.

Table 1.1 Average scores out of 5 for feedback questions (1=strong no/never/not valuable; 5=strong yes/highly likely/very valuable).

'Prior to the course, would you say you had good knowledge of the topics covered?'	2.5 / 5
'Is this course something you usually would have attended off your own back?'	3.3 / 5
How likely are you to use the things you have learned today?'	4.6 / 5
'Overall, how valuable did you find this course?'	4.6 / 5

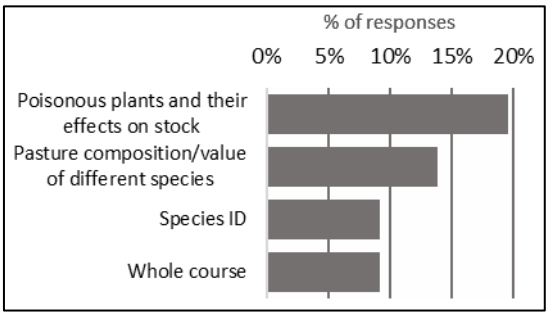

Figure 1.1 The top themes of answers to 'any standout things that were useful, interesting or surprising?'.

Figure 1.1 lists the most popular parts of the course, as per the themes of comments from participants. When ideas for improvement were asked for, an overwhelming 45% of responses revolved around making the course more interactive with more activities and more time outside, highlighting the importance of tailoring training material to the audience.

Content updates, modernisation and expansion of the Katherine and Barkly region Rangeland Management Course, and the development of an Alice Springs region course will be delivered as part of the DITT and Northern Hub Next Generation Land Managers project.

Determining methods for the assessment of biocrusts and ground cover using digital phone photos

T. Myint Swe*, Y. Zhao, A.B. Potgieter**, R. Cowley***, S. Schmidt*, W.J. Williams***

*NUE Lab, School of Agriculture and Food Sciences, The University of Queensland, St Lucia, Australia
**The University of Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, St Lucia, Australia
***Department of Industry, Tourism and Trade, Berrimah Northern Territory, Australia

Abstract:

Effective monitoring of biocrusts and ground cover is essential for understanding ecosystem dynamics in northern Australia's savanna rangelands. Biocrusts are a critical component of soil health and ecosystem services. Digital photos have emerged as a cost-effective and accessible method for assessing ground cover including biocrusts. In this study we examined how we could effectively use mobile phone photos as a ground cover monitoring tool. At Victoria River Research Station (Kidman Springs, Northern Territory) we captured high quality RGB photos from mobile phones using six replicate 1-metre square quadrats along multiple 30-metre transects. We processed the photos to determine the relationship between grasses and biocrusts post-fire and during recovery by determining the percent ground cover of grass, litter, biocrusts and bare ground. We carried out visual estimates to compare with derived metrics from RGB photos. A traditional decision-tree based model (DTSM) was used to analyse ground cover changes using RGB photos to determine the most effective sampling strategy. DTSM derived ground cover were statistically similar to field observations. Mobile phone photos were effective in discriminating between biocrusts, grasses, litter, and bare ground. Our results showed that metrics for biocrusts derived from the use of mobile phone photos can enhance the ability to detect biocrust cover when there was adequate contrast between colours. The sampling method and different light conditions when taking the picture were important aspects that improved the accuracy and reliability of the results obtained. Such metrics could be applied as complementary and informative monitoring tools for early and objective assessment of ground cover including biocrusts.

Rubber vine eradication in the East Kimberley: collaboration to fight a common enemy.

S. Marwick*, C. Yates*, J.P. Slaven, D. Chemello***, D. Pasfield****, L. Strange*, M. Zabek***

*Department of Primary Industries and Regional Development, South Perth, Australia
**Department of Primary Industries and Regional Development, Kununurra, Australia
***Department of Biodiversity Conservation and Attractions, Kensington, Australia
****Kimberley Rangelands Biosecurity Association, Waggrakine, Australia

Abstract:

Rubber vine (*Cryptostegia grandiflora*) poses a serious threat to pastoral production, agriculture, and biodiversity. This pest has been a focus of an intensive and collaborative eradication campaign across approximately 20,000 ha in the East Kimberley region by Department of Primary Industries and Regional Development, Department of Biodiversity Conservation and Attractions, and the Kimberley Rangelands Biosecurity Association since 2009.

The eradication program has substantially reduced the infestation from 2011–2021 by removing over 72,000 plants for a total average annual cost of $214,000 per year. Due to an intensive aerial and on-ground surveillance and control, density of plants within the managed areas decreased from approximately 40 plants/ha in 2014 to 9 plants/ha in 2021. At the end of 2021, the majority (59%) of the management area was eradicated, 26.4% was under monitoring, and 14.6% was under active control (Figure 1.1).

The ephemeral nature of rubber vine flowers poses a considerable challenge to the program, which aligns its control activities with the locations of detected flowering vines during aerial surveys. To increase the effectiveness of this collaborative eradication campaign, the program must increase detection rate of vines within a dense savannah environment. This is currently being achieved by aligning aerial surveys with the peak of rubber vine flowering, by systematically searching the most suitable habitats within the infestation, and by investigating remote sensing methods to detect flowering and non-flowering parts of rubber vine during aerial surveys.

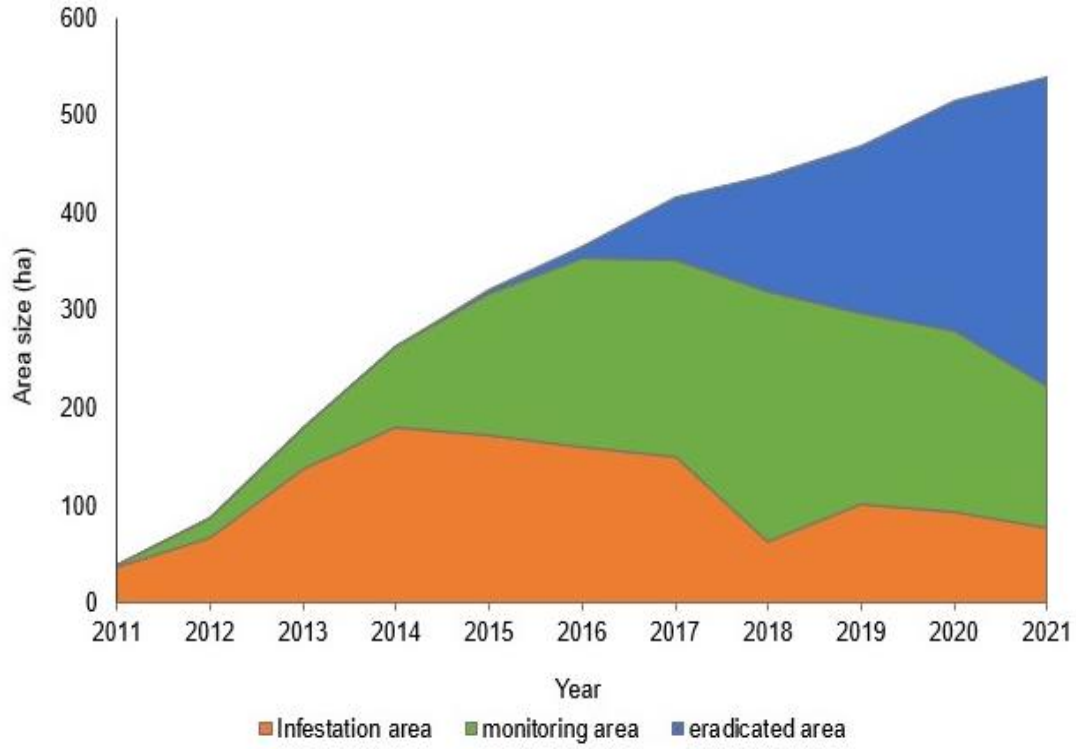

Figure 1.1 Cumulative size (ha) of the rubber vine management area in the East Kimberley from 2011–2021; orange – area infested and controlled;
green – area monitored where no plants were detected within 1–3 years, and blue – area eradicated with no plants detected ≥3 years.

Kangaroo Partnership Project: Optimising kangaroo management in South Australia

E.A. Gregg*, J. Gregg-Smith**

*Kangaroo Partnership Project, South Australia
**South Australian Arid Lands Landscape Board, South Australia

Abstract:

The Kangaroo Partnership Project aims to manage the significant threat to the environment posed by unsustainably high populations of kangaroos, and ultimately improve the landscape and economic resilience of communities in regional South Australia.

The project is funded by the Landscape Priorities Fund and led by the SA Arid Lands Landscape Board, in partnership with landscape boards across five South Australian Landscape regions. The program involves landholders, producers, kangaroo industry, conservation, First Nations, government, and animal welfare organisations. The partnership aims to find the common ground between environmental, economic, social, and cultural interests that provide a basis for collaboration and shared responsibility for kangaroo management.

In this presentation, we will summarise the work and progress made through the Kangaroo Partnership Project over the past two years. This will include sharing the progress and outcomes of our three funded projects:

- Increasing kangaroo value through quality, product diversity, reliability, and branding – *Australian Wildlife Services*
- South Australian Rangelands Kangaroo Collective Pilot – *South Gap Station and neighbouring properties*
- Kangaroo management raising awareness – *Nature Conservation Society of South Australia*.

This will include discussion of the issues and opportunities we have identified through the project, including aspects related to animal welfare, land conservation and management, sustainable agriculture, public perceptions and more.

The Kangaroo Partnership Project has made some crucial steps forward for this complex issue in South Australia and beyond, including collaborating with the NSW Kangaroo Management Taskforce and assisting in the formation of an NRM Regions Australia Community of Practice for Kangaroo Management. However, there remains much work to be done to ensure long-term sustainable and ethical approaches to kangaroo management on a national scale. By implementing more strategic kangaroo management approaches, we can ensure the welfare of kangaroo populations and protection for ecological and cultural landscape values, while supporting sustainable land use practices and the livelihoods of local communities.

Mitchell Grass response to moisture stress and defoliation

D.G Phelps*, W.J. Phelps, J.E.G. Phelps****

*James Cook University (TNQ Drought Hub), Townsville and Longreach, Australia
**Longreach, Australia

Abstract:

The Mitchell grasslands are unique to Australia and make important contributions to grazing, conservation, cultural heritage, and rural socioeconomics.

Previous studies suggest there is an optimal range of defoliation height and frequency which can increase the responsiveness and resilience of Mitchell grass leading into, during, and exiting drought.

A long-term drought resilience experiment is underway in Longreach to determine the role of defoliation and water stress on Mitchell grass response to rain. Forty plants were established over December 2021–March 2022, and irrigated until all plants had reached maturity in October 2022. During this time, heatwaves and insect incursions killed many young seedlings, and set-back the growth of others.

In this experiment, water stress is alleviated through supplementary irrigation during the wet season, whilst stressed plants rely on rainfall received. Plants are cut to 15 cm or 0 cm height annually or every two years in October, and compared with un-cut control plants. Soil moisture and key plant parameters are monitored monthly.

The preliminary findings of plant recovery from a single defoliation indicate that cutting: increased end-of-wet-season photosynthetic area at both heights; increased tiller production, basal area and canopy area at 15 cm height but; reduced tiller production and basal area at 0 cm. In contrast with other studies, defoliation did not increase seed-head (inflorescence) production.

These early results support previous studies that Mitchell grass responds positively to ‘light’—but negatively to severe—defoliation. The current study has been during above-average rainfall and following a single defoliation. Further papers will report longer-term results that should include greater rainfall—and hence water stress—variability, and also include bi-annual cutting treatments.

Investment into long-term research is needed to continuously improve our understanding of Mitchell grass as a changing climate brings new challenges through increased temperature and potentially more variable rainfall conditions.

Resilience in our land of droughts, flooding rains and this thing called carbon

D.K. McLean

Resource Consulting Services, Yeppoon, Queensland, Australia

Abstract:

No matter which way those involved in rangeland management turn, we see droughts, we see floods, we are encouraged to be more resilient and we keep hearing about carbon. What is the relationship between these and what are the key factors that actually allow us to be more resilient and exactly how does carbon fit into this?

The good thing is that increasing soil carbon will improve rangeland resilience to droughts and floods through improved water cycle and ecosystem function driven by carbon. This will also result in increased productive capacity. The goal is improving the health of our rangelands. And we must profitably do this for the future of any business or community.

Based on personal experience and observations from my professional career with Resource Consulting Services, I'd like to discuss these topics. I am concerned about the resilience of many rangelands operations to withstand a missed wet season or market closure.

The hard question in the rangelands, with the extensive and remote nature of this landscape, is HOW?

There are two key questions for livestock managers in the rangelands to consider as a primary focus in working out how they improve rangeland health.

1. How can they incorporate growing season rest and grazing into their management programs?
2. How can they structure their management programs to allow for easy, profitable adjustment of livestock numbers in variable seasons?

It is encouraging to see the change that is occurring and resulting outcomes.

Some could make changes now, for some it might not be feasible right now, however unless we start to discuss what it will take, then nothing will change and businesses will remain fragile and lack resilience as a result. Change in management programs occur purely as a result of a change in the people, the decision makers.

Pasture type maps for the Kimberley: giving old data a new purpose

K.W. Holmes*, P.W.E. Thomas*, K.G. Ryan**

*Department of Primary Industries and Regional Development, Perth, Western Australia
**Department of Primary Industries and Regional Development, Kununurra, Western Australia

Abstract:

- We mapped pasture types across the Kimberley rangelands.
- More than 12,000 historical and current pasture type observations were combined with remotely-sensed and modelled spatial datasets to train a machine learning model (random forest) and predict at a pixel size of 90 m.
- Data collation and cleaning was time-consuming, and the number of observations per class and choices around how to group pasture types affected the final maps.
- The map evaluated on data withheld from modelling had good overall accuracy for pasture types (74%) and more generalised monitoring assessment units (80%).
- DPIRD plans to more thoroughly validate this map in 2023, and map pasture types across other Western Australian rangeland regions in the near future.

Rangelands pasture types have been used for decades in Western Australia to identify landscapes with similar vegetation and landscapes that require similar management. Quantitative maps of these practical rangelands management units will be used to stratify the landscape to improve interpretation of field-collected measurements and remotely-sensed vegetation trends. This is an improvement over stratification using political boundaries such as leases or shires which tend to cut across ecological gradients. It also avoids the ‘mixed polygon’ problem of landscape system maps whereby large polygons contain proportions of many different land and vegetation types.

Here we present the mapping approach, the Kimberley pasture type map (version 1.0), and highlight pros and cons of using inspection data for geographic modelling. On-ground collection of observations for map validation plus additional map improvements are planned for 2023. Pasture type datasets are also being prepared for developing maps across other rangelands regions for a more consistent state-wide approach to land condition monitoring.

Passing the Baton - sharing some thoughts on Station management

Mervyn Wortley

Ruby Plains Station, Halls Creek, Western Australia

Abstract:

Mervyn Wortley started working in the Ruby Plains Station stock camp in 1986. In 1998 he took over as manager. Below are a few insights Mervyn gained along the way and would like to share with the next generation.

- Leave the country in better condition than you found it.
- Give young managers a say; for example, let them alter stock numbers.
- Spell paddocks over the wet season, then use them during the dry; use less-desirable paddocks over the wet and rotate paddocks throughout the year so they are not eaten out.
- Use of whoa boys along roads, fence lines and in paddocks to help control erosion.
- Weed control and feral animal programs are important.
- It is not about how many cattle you have but how many you brand. There is no point having 20,000 cows if you only brand 8000 calves. Focus on getting your herd nutrition and fertility to a point where the percentage of calves is higher. Or focus on less breeders and have a higher calving percentage by maintaining healthier pastures to lift fertility. My favourite quote is **'There is not many bad breeders but a lot of bad managers'**.
- Quiet cattle: Cattle do better if they are not stressed or scared of contact. Get them used to people moving them about in a quiet manner; this also helps with cows keeping their calves with them during musters.
- Segregation/control breeding: Have cows calve at the right time of year so they are feeding calves during the growing season. This also helps target cows that are out of sync and you can help with their nutrition.
- Supplement cows during the wet and dry seasons to maintain condition. This can be done on bare flats to create areas where water is held up and seeds from dung are dropped to increase groundcover.
- Photos/data from permanent monitoring sites don't lie.

Effects of grazing and fire management on rangeland soil and biocrust microbiomes

P.G. Dennis*, M.V. Vega*, Jiarui Sun*, Wendy Williams, Susanne Schmidt****

*School of Earth and Environmental Sciences, The University of Queensland, Brisbane, Queensland, Australia
**School of Agriculture and Food Sciences, The University of Queensland, Brisbane, Queensland, Australia

Abstract:

Biocrusts play important roles in rangeland ecosystems by protecting soil surfaces and fixing carbon and nitrogen. Their responses to rangeland management practices, however, are poorly understood. Here, we characterised the impacts of cattle grazing and fire management (controlled two- or four-yearly burning versus no fire) on the diversity and composition of biocrust and associated soil bacterial communities (0-1 cm depth) in a long-term (30-60 years) field experiment in the Northern Territory, Australia. Both experiments were replicated on two soil types (vertosol, calcarosol). For the grazing experiment, we also characterised samples from 0-10 cm depth. Significant effects of grazing on bacterial community composition were only detected in the vertosol, where it was generally associated with enrichments of cyanobacterial taxa in the 0-1 cm samples, and more varied responses in 0-10 cm samples. In contrast, despite some minor reductions in the relative abundances of Bacillus populations in more frequently burned sites (late season two-yearly burning), we did not observe any significant impacts of fire management on the overall composition of bacterial communities. Our findings indicate that the presence of livestock in rangelands increases the proportional representation of cyanobacteria within biocrust and associated soil microbiomes, and that these communities, at least from a taxonomic perspective, are not strongly impacted by fire management.

Defining Safe Utilisation rates to improve land condition in central Australia

C.M. Materne*, R.A Cowley**

*NT Department of Industry, Tourism and Trade, Alice Springs, Australia
**NT Department of Industry, Tourism and Trade, Darwin, Australia

Abstract:

Safe pasture utilisation is a critical component in calculating long-term safe carrying capacity. The Quality Graze trial at Old Man Plains Research Station (OMP) aims to identify grazing strategies that maintain or improve land condition, while consistently turning off premium beef (Materne *et al.* 2021). The Quality Graze strategies applied stocking rates based on the long-term safe carrying capacity, aiming for utilisation rates (the proportion of annual pasture growth that is eaten) between 10 and 15%, depending on land type. Average stocking rates varied through time between 2.2 and 3.9AE/km^2 for the various strategies, but annually ranged from 0.0 to 8.0AE/km^2. Annual pasture utilisation was calculated retrospectively using the GRASP pasture growth simulation model. The average pasture utilisation across all sites and years was 15%, but annual utilisation in the different grazing strategies varied between 0 and 103% (Figure 1.1).

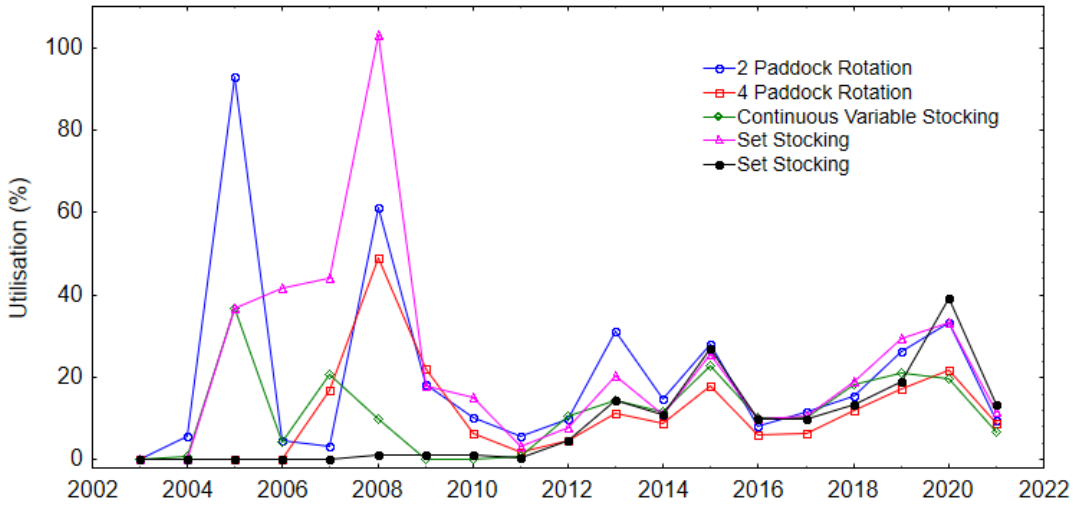

Figure 1.1 Simulated pasture utilisation for the different grazing strategies at Old Man Plains, Alice Springs.

Modelling suggests a step change in land condition occurred with the very wet double La Niña of 2010–2011. Rainfall use efficiency increased after this time, but more so in the driest years. Our analysis suggests that targeting stocking rates to achieve 15% pasture utilisation promotes land condition recovery in these calcareous shrubby grasslands and mulga woodlands on sandy red earths. To further explore safe utilisation rates across a broader range of land types in Central Australia, we plan to work with producers with long-term stocking rate records and good and/or recovering land condition to model the utilisation rates they achieved.

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Researching the rangelands - tips for young players

R.A. Cowley

Northern Territory Department of Industry, Tourism and Trade, Australia

Abstract:

The presentation will cover:

- Research design in extensive variable and dynamic rangelands systems. To replicate or not to replicate – difficulties at the extensive rangeland scale and alternatives to replication. Tracking change through time to account for initial site differences. Is your control really a control? Research stations and long-term studies, limitations and advantages.
- Are you comparing apples with pears? Modelling to adjust for variation between research sites in pasture growth, infrastructure and animal class and performance on the effective stocking rates and utilisation.
- Working with successful producer collaborators to learn from their long-term natural experiments, combining knowledge engineering and modelling.
- Working with producer collaborators in a co-designed approach to learn the impacts and practical aspects of implementing new management.
- Combining ground and remotely sensed data and modelling to gain longer-term insights beyond the initial study conditions.
- Maximising the impact of your work – collaboration with outside expertise, data sharing to maximise the public good of the research investment, targeting the message to the audience, providing the information and support needed to apply the recommended management. Does it pay?
- Applying an evolutionary lens to our rangeland systems to understand and predict likely management responses.
- What’s old is new again. Reusing and recycling existing datasets to gain new insights.
- Question everything – is it an outlier or a new insight?

Composition and consequences of grazing pressure in Queensland

L. I. Pahl

Department of Agriculture and Fisheries, Toowoomba, Queensland, Australia

Abstract:

Macropods (red, eastern and western grey kangaroos, euros) are the most numerous large herbivore in Queensland. During the years 2008-2021, their annual populations ranged from 17.1 to 38.4 million, compared with 9.9 to 12.1 million for cattle, 1.8 to 4.3 million for sheep and 0.7 to 1.2 million for goats. However, given the annual forage intake of average-sized cattle is 16 times that of average-sized macropods, cattle were dominant with regards to forage demand. They were responsible for between 80 and 88% of annual forage demand in Queensland, and between 69 and 98% of demand in many local government areas. On livestock properties, in both Queensland and New South Wales, it was common for macropods to be responsible for at least 20% of total forage demand. Simulated long-term livestock carrying capacity and average annual income from cattle sales both declined in proportion to the percentage of total forage demand which was macropod. For example, when proportional macropod forage demand was 20%, simulated annual income from cattle sales also declined by 20%, or around $100,000. Not surprisingly, livestock producers desire macropods to be maintained at densities much lower than those needed by the commercial macropod industry. Hence, they have competing and unresolved objectives for the management of macropods. This, combined with public expectations for the conservation and welfare of iconic kangaroos, has gridlocked the management of macropods. As such, the status quo prevails, where macropod populations rise with the rains and crash in the droughts, and the aspirations of the major stakeholders are not met.

Call to action: Stakeholders of the pastoral landscapes where macropods boom and bust need to develop strategies which better satisfy their aspirations for the ecological, economic and social outcomes of total grazing pressure.

Policy, governance, and institutional barriers and opportunities for ecosystem service markets in grazing land systems.

G. B. Witt*, R. Cotton*

*The School of Earth and Environmental Science, The University of Queensland, St Lucia, Brisbane, Australia

Abstract:

Although the idea of ecosystem service payments to incentivise the conservation of nature and other environmental values is not new, it has only recently become a reality in Australia. For example, the last decade has seen the appearance of opportunities for carbon sequestration and agricultural and grazing systems (Witt *et al*. 2011), most of which has occurred in rangeland environments (Jassim *et al*. 2022). There has been research in recent decades that attempts to understand the barriers and opportunities for the uptake of such ecosystem service payments at the landholder level (Liu *et al*. 2018). However, there is limited research into how the policy, institutional and governance arrangements may be impacting the effective and efficient development of cohesive ecosystem service payments that result in genuine and enduring environmental, social and community outcomes.

This research draws on 34 in-depth interviews with diverse experts and key stakeholders, to identify opportunities at a policy level to improve the delivery and effectiveness of environmental service and carbon markets. We identify many interrelated themes that provide clear insight into aspects of these markets that are effective and those where improvements can be made. Complexity was found to be both the most prominent and overarching theme. Complexity as it related to the multifaceted nature of these markets; where carbon is paralleling the emerging biodiversity markets, and where cost, rigour and integrity must integrate fairly with the variation across Australian landscapes. The markets also must operate on multiple levels creating implications across landholder, national and international systems in which the markets operate. Complexity also exists in the types and numbers of players who feed into these systems, with convoluted lines of responsibility, regulation and oversight. There is currently a lack of transparency within these markets resulting in trust and engagement implications.

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Managing the spread of Indian bluegrass (Bothriochloa pertusa) in the grazing lands of eastern Queensland

N.B. Spiegel*, B. Shepherd*, S.R. Buck*, W.D. Vogler*

*Department of Agriculture and Fisheries, Queensland Government, Australia

Abstract:

Indian bluegrass (*Bothriochloa pertusa*); a stoloniferous and drought-susceptible perennial grass, has naturalised in tropical Australia and is spreading across eastern Queensland by replacing preferred long-lived native and exotic tussock grasses. The aim of this paper was firstly to identify the factors responsible for *B. pertusa* expansion, and secondly to identify practical options to either manage or control its spread in native and sown pastures. Information from multiple sources was collected and synthesised. These include scientific literature, producer knowledge, expert opinion, and ecological studies. Outcomes suggest a range of factors are contributing to the spread of *B. pertusa* across eastern Queensland. Ecological attributes for competitiveness, land degradation, heavy grazing, adequate source of seed and means of spread, and climatic extremes in rainfall variability can all culminate in opportunities for *B. pertusa* to rapidly colonise in pastures. These factors also provide insights into management techniques that can slow the spread, namely [**Call to action**] avoiding over-utilisation of the pasture, maintaining high ground cover, and improving the competitiveness of existing pasture species. For pastures with highly dominant *B. pertusa*, key strategies for improved production and ecological function include [**Call to action**] reducing stocking rates, applying more rest to pasture, and incorporating new grasses and legumes into the pasture where possible. For pastures with low levels of *B. pertusa*, the best-bet options are yet to be realised but could involve a combination of prescribed fire, stocking rate management, and applying more rest to pasture.

I'm Scalded and Bare, Action Needed by YOU

Ray Thompson

Rangeland Rehabilitation, Orange East, New South Wales, Australia

Abstract:

Come on give me a chance.
I can be transformed into biodiverse native pastures.
I need your help NOW.
I can’t do it by myself.
You have over-utilised my topsoil leaving me scalded and bare.
I am a semi-arid duplex soil and I have been stripped bare and the erosion by wind and water has left me with a crust on my exposed clay subsoil.

I have heard the Waterponding technique can change my life.
Come on give it ago and change my life forever.
What! You are not up to speed with Waterponding.
Well sit down and listen closely.

Introduction

Forty-two thousand hectares of bare scaled semi-arid duplex soils in Western New South Wales have been transformed into biodiverse native pastures using the Waterponding technique which is returning clear profit to the landholder and benefits to the environment and sure has fixed my crusting problem.

Removal of native vegetation from my semi-arid duplex soil by drought or over-utilisation results in the erosion of the fine sandy loam topsoil. A crust on top of the exposed clay subsoil prevents both water penetration and seed lodgement of windblown seed.

The resulting bare areas are called scalds or claypans.

Waterponding is the holding of water at a maximum depth of 10 centimetres on the scald in horseshoe-shaped banks, each covering 0.4 ha.

Good grazing management and training for the future

Chongie and Gina Howard

Adelaide River, Northern Territory, Australia

Abstract:

In 2013 Chongie and Gina Howard moved to the Barkly Tableland to manage land (Warlmanpa Warumungu Country) where Gina grew up and is a Traditional Owner. This is her grandfather's country.

The property was on Bluebush community, backing on to the Tanami Desert. The plants/soil were a mix of coolabah swamp, red earth/sandy spinifex plains and gravel rises.

To manage the land, Gina and Chongie applied Resource Consultation Services' (RCS) grazing principles of:

- plan, monitor and manage grazing;
- time spent in each paddock is adjusted to suit the growth rate of the plant;
- stocking rate is adjusted to match carrying capacity;
- maximise stock density for minimum time; and
- use diversity of plants and animals to improve ecosystem services.

"Once we started using the RCS grazing principles, the land recovered more quickly after rainfall, there was more grass available and, as a result, the herd was more productive (increased calving rate). In the past we would run out of feed come October/November, but we found that our cattle were now holding condition during these drier months."

All employees on the property were related to Gina and had strong connections and cultural ties to the property and area. Pre-employment training programs were conducted, preparing staff for future employment. Training included stock handling, horse riding, animal health/welfare, and personal development around goal-setting, reliance and time management.

Over-sowing legumes into native pastures – adapting a technology from north-eastern Australia

G. Moore

Department of Primary Industries and Regional Development, Perth, Australia

Abstract:

A key opportunity to develop a more resilient and drought-proof feedbase in the rangelands of northern Western Australia (WA) is to take a proven technology from Queensland (Partridge *et al*. 1996) and the Northern Territory of over-sowing legumes like *Stylosanthes* species ('stylos') into native pastures. Over-sowing legumes can extend the length of the growing season (green feed) and in doing so reduce the effective length of the dry season when cattle typically lose weight. The animal production benefits are well known (Hall and Glatzle 2004) and the economics are favourable (Chudleigh *et al*. 2018; Chilcott *et al*. 2020), however there has been minimal adoption

Previous research in the north Kimberley has highlighted the importance of site selection (soil type) and that phosphorus fertiliser is required on some soils to maintain legume productivity (Holm and D'Antuono 1990). Another study showed there were >0.9 Mha of soils suitable for growing stylos in the north and central Kimberley (average annual rainfall >750 mm) (Kubicki and Beer 1975) when they were considering the potential for farms based on stylo pastures.

This project aims to: (i) work with industry and relevant government departments to clarify the approvals process; (ii) adapt the technology for conditions in northern WA (suitable soils, low P); and (iii) undertake R&D with industry to develop a reliable, cost-effective establishment package including site selection. By addressing the barriers to adoption (Chilcott *et al*. 2020) this will de-risk adoption for beef producers, while simultaneously also developing local producer champions.

How can we best tap into the knowledge base in north-eastern Australia to improve the likelihood of success of this technology in northern WA?

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Risk of agricultural plants becoming environmental weeds in the northern rangelands

G. Moore*, C. Munday, P. Barua***

*Department of Primary Industries and Regional Development, Perth, Australia
**Formerly Department of Biodiversity, Conservation and Attractions, Perth, Australia

Abstract:

Introducing non-indigenous species may improve the viability and sustainability of agricultural systems, including pastoral enterprises. However, there is clear evidence that throughout Australia some introduced species have become established in non-target areas and some have become environmental weeds (Lonsdale 1994; Low 1997; Virtue *et al*. 2004). For example: Gamba grass was introduced into the Northern Territory as a pasture grass but has subsequently become a serious weed that can greatly increase the intensity of fires (Setterfield *et al*. 2010).

A protocol for assessing the risk of agricultural plants becoming weeds of the natural environment has been developed to help achieve a balance between agricultural productivity and environmental risk (Moore *et al*. 2022). The protocol is based on the Future Farm Industries CRC weed risk protocol (Stone *et al*. 2012) but has been adapted for the rangelands of Western Australia (WA).

The environmental weed risk of a species is assessed for three regions in the pastoral zone of WA (Kimberley, Pilbara, Gascoyne-Goldfields) using a three-step process. Step 1: Whether species is permitted in WA. Step 2: A 'filter' to identify species that are not an environmental weed in similar environments in Australia or overseas, and unlikely to persist without management. Step 3. For all other species a full weed risk assessment using the protocol in the Bulletin (Moore *et al*. 2022). The Weed Risk Assessment protocol is subdivided into three sections where: (i) Invasiveness – assesses the ability of a species to spread beyond agricultural systems or grazed native vegetation into intact native vegetation; (ii) Impacts – assesses the potential detrimental impacts a species may have on intact natural ecosystems; and (iii) Potential distribution – assesses how widely adapted the species is to the novel environment based on the climate and soils.

The protocol is designed to add to the transparency, scientific rigour and consistency of information available to decision makers. Approximately 100 species have been assessed and the results (Moore *et al.* 2022) are relevant for similar environments across the northern rangelands. What safeguards are in place in your region to ensure agricultural species do not become problem weeds of the natural environment?

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Listening to Country – Collected Perspectives on Threatened Species Conservation from the WA Rangelands

A review of what's working and what's not in Australia's threatened species recovery investment programs based on in-depth and broad-ranging interviews with First Nations ranger groups from the Kimberley to the Great Victoria Desert.

S.K.G. Turisini*, C.L. Curnow*

*Rangelands NRM, Perth, Australia

Abstract:

Rangelands NRM conducted an evaluation of its threatened species program (NLP Regional Land Partnerships 2018–23). Its Bilby, Malleefowl and Night Parrot programs supported Aboriginal Ranger groups to continue, expand and commence management activities with intentions to reduce impacts of KTPs.

While the evaluation (conducted early 2023) sought to understand the extent to which contracted outputs of right way fire, feral and weed interventions were responsible for changes in species population health, it took on an expanded focus, because of interviewee responses, becoming an investigation into what are the foundational elements that drive Aboriginal land managers to achieve their Healthy Country outcomes. We then sought to answer*: What are Traditional Custodians telling us about Country that is not driven by current NRM funding models?*

The evaluation included broad-ranging interviews with ranger groups, the rangers themselves, their community Elders, their ranger coordinators and their collaborating partners, including scientists and other conservation practitioners. These included 28 Aboriginal rangers and Elders, 8 managers, 10 coordinators and 5 scientists.

A significant proportion of Australia's conservation effort is undertaken by Aboriginal rangers. During our interviews we witnessed a high degree of expert knowledge and responsibility to Country, which was a common theme across the region. By actively listening to rangers and their trusted partners, we built our awareness of their successes, aspirations, concerns and challenges. What people see as key threats to biodiversity often sit outside what is publicly funded. We present these findings and seek to address any of the *camels* in the room.

Rangelands NRM is not the voice for Aboriginal rangers. Our intention is to share perspectives gained, so that the opportunity to transform our conservation efforts is informed by the context of the Traditional Custodians. Listening to Country includes listening to those who can hear it. Are we listening?

Irrigated mosaic agriculture changing beef production in northern WA

C. Milazzo*, C. Ham*, G. Moore**

*Department of Primary Industries and Regional Development, Broome, Australia
**Department of Primary Industries and Regional Development, Perth, Australia

Abstract:

Until recently, the pastoral cattle industry in northern Western Australia has been based solely on the extensive grazing of native vegetation under 'low input' production systems. Productivity gains have stagnated due to nutritional constraints, especially of breeding animals and young growing cattle.

There is growing interest in the cultivation of high-quality fodder and forage crops under irrigation to address these performance issues. Consequently, irrigated mosaic agriculture to complement pastoral beef production has expanded from about 600 ha in 2006 to about 4200 ha in 2020, with several new developments at various stages in the planning process.

Service provision can be challenging for both government and private advisors and agribusiness. Distance, cost of service delivery, and high workforce turnover make capacity building and on-site research difficult. The Department of Primary Industries and Regional Development (DPIRD) has invested in the research and development documented in the Mosaic Agriculture Bulletin (Moore *et al.* 2021) to assist the industry by identifying the most suitable fodder species for this environment (soils, climate, farming systems) and setting production benchmarks. Guidelines are being developed to encourage best management practices, like optimising fertiliser use to balance production with environmental considerations and using integrated pest management. DPIRD actively invests in extension with the aim of encouraging the adoption of our work, with investors, producers, consultants and agribusiness.

In this paper we discuss some of the opportunities and challenges of mosaic agriculture for the northern beef industry including productivity gains, economics, barriers to adoption, and the role of government in supporting industry when there is market failure. Issues include the challenges of navigating approvals, acquiring and retaining skilled people in remote locations, the lack of supporting service industries, and environmental challenges like pest incursions and extreme weather.

How can we attract the right people to regional and remote locations, and support them to stay long-term?

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Carrying capacity estimates for the pastoral Southern Rangelands of Western Australia: review of discount factors

K.G. Ryan*, M.H. Aldrich, P.W.E. Thomas***, F. Ahmed***, P.A. Waddell***, J.E. Foster**, W.J. Fletcher***, D. Priest******

*Department of Primary Industries and Regional Development, Kununurra
**Department of Primary Industries and Regional Development, Geraldton
***Department of Primary Industries and Regional Development, Perth
****Department of Primary Industries and Regional Development, Carnarvon

Abstract:

The increasing focus on sustainable land management requires clear documentation of pastoral carrying capacities and how carrying capacity should be discounted for declining pasture condition, with updated and consistent units and a consistent categorical system.

Most of the Western Australian inventory and condition surveys and some other studies have provided estimated potential carrying capacities and discount factors for the most pastorally important pasture types; however, there are inconsistencies among publications.

The theory regarding discounts from potential carrying capacity includes a recognition that relatively more carrying capacity can be lost from highly productive pastures compared to low productivity pastures (Hennig *et al.* 2009). Pastures in good condition have, by most definitions, 100% of the potential carrying capacity. Current Carrying Capacity is discounted from 100% according to the level of condition decline.

Low productivity pastures have marginal Potential Carrying Capacity. When carrying capacity is around 35-40 ha/dse or 240-300 ha/AE, the energy required for an animal to walk to access its dietary maintenance requirement exceeds its physical feed intake capacity. The closer the pastoral value is to nil, the smaller the difference between the potential carrying capacity and the current carrying capacity.

The Department of Primary Industries and Regional Development (DPIRD) Rangelands Science team is reviewing and collating statewide information on the carrying capacity of various pastures and their condition discounts. Analysis of these data will ensure that consistent values are available for each pasture type across the southern rangelands. The revised discount factors will be applied by Rangelands Science staff to future rangeland condition assessments. Clear and updated documentation of existing carrying capacity information will improve DPIRD's capacity for the roll-out and extension activities related to risk-based standards throughout the southern rangelands. The results of the review will be available to the pastoral industry for use in land management planning.

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Holistic Development - Yawuru Gumaranganyjal (Roebuck Plains) Station

Nini Mills*

* CEO, Nyamba Buru Yawuru, Broome

ABSTRACT:

Gumaranganyjal (Roebuck Plains) Station is a viable cattle operation in the Kimberley, owned and managed by Nyamba Buru Yawuru Ltd, the operating arm of the Yawuru Prescribed Body Corporate (PBC), on behalf of the Yawuru Native Title holding community.

The PBC holds exclusive possession native title over the station comprising a unique blend of cultural, social, ecological, and economic values.

Yawuru's vision: to deliver excellence in sustainable cattle production and integrate cultural, environmental, economic, and social values to create prosperity for future Yawuru generations.

Achieving operational excellence and sustainable outcomes through the application of a holistic development model, Gumaranganyjal will be a cattle station like no other by ensuring:

- Environmental and culturally sensitive country management;
- Profitable cattle enterprise whilst ensuring cattle wellbeing and sustainable grazing practices
- Developing our people and maximising opportunities through training and education pathways.
- Future prospects aimed at new economic and social enterprise development

Yawuru utilises sophisticated technologies to ensure holistic development in practice with a partnership with ANU and the use of a multi objective land use allocation tool. A powerful planning tool for identifying the most effective allocation of land for an activity based on competing input values.

A Yawuru Indigenous Protected Area sits over cultural Jilas, nationally significant springs and wetlands, including an internationally significant Ramsar-listed wetland, all supported by a complex groundwater system connecting the landscape and flowing into Nagulagun Marine Park. The soil and pasture of the Station's marine plains provide highly productive lands for cattle grazing.

Environmental Accounting is emerging as an important tool for Environmental Management to show how landscape condition changes environmentally over time. Yawuru with partners at the Australian National University (ANU) are assessing how environmental accounts can be developed and applied to support the environmental, cultural, and economic management of Gumaranganyjal.

Yawuru commits to social development and capacity building under Yawuru ownership of the station and has seen record numbers of young Indigenous people in the Aboriginal Pastoral Academy, run through NBY's Warrmijala Murrgurlayi (Rise up to Work), which is founded in Yawuru's Mabu Liyan Framework.

This presentation will highlight Yawuru's commitment to innovation and sustainable futures underpinned by the 'quadruple bottom line'.

Natural capital: what it is, the opportunities, risks, and the pathway forward

A.P. O'Grady*, S. Stewart*, G.S. Smith*, C. Horner*

*CSIRO Environment, Hobart, Tasmania, Australia

Abstract:

Environmental change, particularly climate change, ecosystem degradation and associated biodiversity loss are now recognised as the most important risks to the global economy over the next decade. Major reviews of risks associated with climate change (Stern review) and biodiversity loss (Dasgputa review) have raised the profile of these risks in international debate and brought into sharp focus the need to manage and repair nature.

Investors, lenders, and regulators are increasingly responding to these risks by demanding a higher level of accountability from businesses. In light of this, there has been a growing focus on the concept of natural capital. In this presentation we introduce the concepts of natural capital and highlight some of recent developments in the field of natural capital accounting. We propose that accounting for nature more broadly will help unlock opportunities associated with emerging nature-based solutions, but more importantly empower land managers with the information needed to underpin an evidence-based approach to the management of our natural resources. However, in its early phases of implementation it remains challenging.

This presentation will highlight recent advances in the field of natural capital accounting and progress towards a general-purpose natural capital report that provides an approach to presenting a statement of natural capital performance, using examples spanning small and medium enterprises to large ASX listed companies, in a manner that is consistent and comparable across many sectors in the economy. This is a first necessary step towards integrated financial and environmental reporting that quantifies nature's inputs into production.

Succession the long journey

Ardie and Kacie Lord

Sutherland Station, Richmond, Queensland, Australia

Abstract:

I grew up in north-west Queensland, the fifth of six children, not believing I would have the opportunity to be on the land. Such an opportunity came at the end of the beef depression…to buy ‘Sutherland’ in conjunction with my brother James, with security from our parents.

In 1984 Kacie and I were married and moved to ‘Sutherland’, and the next five years was a baptism of fire…with three children under age three in five years of severe drought.

We decided early on that we needed to educate ourselves and grow our business.

Succession in business is a process we should review every five years. In our business we have aimed to review our roles, our vision and our goals on a regular basis. Life is a progression; from school to jackaroo or apprenticeship, to manager, to mentor. I have never viewed succession as something that happens at age 65 for example. We need to be constantly replacing ourselves in our job. Otherwise we cannot grow or have succession.

For the next generation to be able to keep stepping up, they will also need to be continually upskilling. From being able to handle cattle and maintenance, to managing people, to managing finance, marketing, property design, growing a profitable business and at the same time mentoring the next generation to grow within themselves.

At the very heart of succession is communication.

A successful succession plan requires everyone to have open, honest communication and that, as we discovered, is a learned art.

Succession is hopefully as fair as it can be, but it will often not, for so many reasons, be equal, and in that lack of equal division there will be angst.

In a family that is comfortable with communicating, that angst can be sorted in a phone call, a meeting…but so often, the opposite occurs.

Our family lives by the phrase, everything in life is just a conversation. And that is what our succession is based on.

The sum of small parts: collaborative fire management changing landscape fire regimes in north-western Australia

Bardi Jawi Rangers*, Nyul Nyul Rangers*, Yawuru Country Managers*

*On behalf of the Dampier Peninsula Fire Working Group, hosted by Rangelands NRM

Abstract:

Fire is a natural process in tropical savannas, but a regime of recurrent, extensive, severe fires was impacting communities, biodiversity, cultural and pastoral values of the Dampier Peninsula, in north-western Australia. Starting in 2016, ranger groups, Traditional Owners, pastoralists and other stakeholders began collaborating to manage fire on the Peninsula.

Since 2016, our project has reduced the extent of annual fire and high-severity fire; reduced fire frequency and severe fire frequency. The project has increased the graininess of burnt and unburnt areas, and the extent of the peninsula unburnt for at least three years. The incidence of severe fire next to monsoon vine thicket patches (which have significant cultural and biodiversity values) has decreased, and the canopy health of those patches has improved. Biodiversity benefits of an improved fire regime on the Peninsula also include key species such as Gouldian Finches and Greater Bilbies.

The landscape scale change in fire pattern helps protect lives and livelihoods of communities, outstations and businesses including pastoral properties and tourism operations from large, severe fires. The biannual group collaboration has strengthened neighbouring bonds, fostered skills development, and overall helped boost the capacity of fire managers on the Peninsula to respond to bushfires to protect lives, livelihoods and landscapes.

Despite all this, our challenge is still sustainable funding. The dominant vegetation of the Peninsula (pindan) is not yet recognised by the regulated emissions abatement program. Also, small land parcels are disadvantaged by the program’s transaction costs and interannual variability in management outcomes.

Working towards sustainable funding, our project will continue to forge ahead over the next two funded years. In expectation of future access to emerging carbon and biodiversity markets, we are developing robust biocultural monitoring around our fire management and continuing to demonstrate landscape-scale benefits of cross-tenure fire management collaboration as a model approach.

Regenerating rangelands in the Norwest with fire, grazing, rest and collaboration

K. Elezovich*, J. Macdonald**

*Country Downs Station, Broome, Australia
**Rangelands NRM, Broome, Australia

Abstract:

The Forest brothers saw the Tropical Savannah Woodlands of the Dampier Peninsula as incredible pastoral country in late 1800s, thanks to Indigenous firestick management, subsequent vegetation mosaic and abundant biodiversity – the engine of our ecosystems.

When Kurt came to Country Downs in the middle of the Peninsula it was a green desert. A legacy impact of pastoralism and a devastating cycle of bushfires left poor groundcover, bare soil and a 'scab' of green acacia repairing the fire-stricken land. This supported very little life. The biodiversity engine was a burnt-out beat-up Broome scooter.

Luckily, the agricultural mindset globally is shifting to reconnect with its roots. Our goal as stewards, and as a pastoral business, is to improve rather than degrade the foundational resource of ecosystem health – our production capacity - as biodiversity and soil health.

Soil health is the cumulative reflection of vegetation health, which is what we influence with our land use every year – namely through grazing and fire. Since 2016, the DPFWG collaboration with neighbours has been a critical first step to get bushfires in check (Wysong *et al.* 2022). Thanks to and within this, we have added storm burning for our vegetation mosaic. Integrated with balanced grazing, we have regenerated perennial groundcover, including species not seen since the 1920s, while maintaining and recruiting our higher successional woodland trees. Traditional ecological art of burning no doubt had all this and more well refined, and we still have lots to learn, but the potential is very encouraging, with grazing integrated as part of the solution.

Both fire and grazing management tools can align for biodiversity outcomes while integrating food production and business needs for modern sustainability. There are no recipes. But we can reconnect to nature's principles and laws with open minds, observation and intent to regenerate ecosystems as wholes – including ourselves.

Reference

Wysong M, Legge S, Clark A, Maier S, Bardi Jawi Rangers, Nyul Nyul Rangers, Yawuru Country Managers, Cowell S, MacKay G (2022) The sum of small parts: Changing landscape fire regimes across multiple small landholdings in north-western Australia with collaborative fire management. *International Journal of Wildland Fire* **31(2)**, 97–111. https://doi.org/10.1071/WF21118

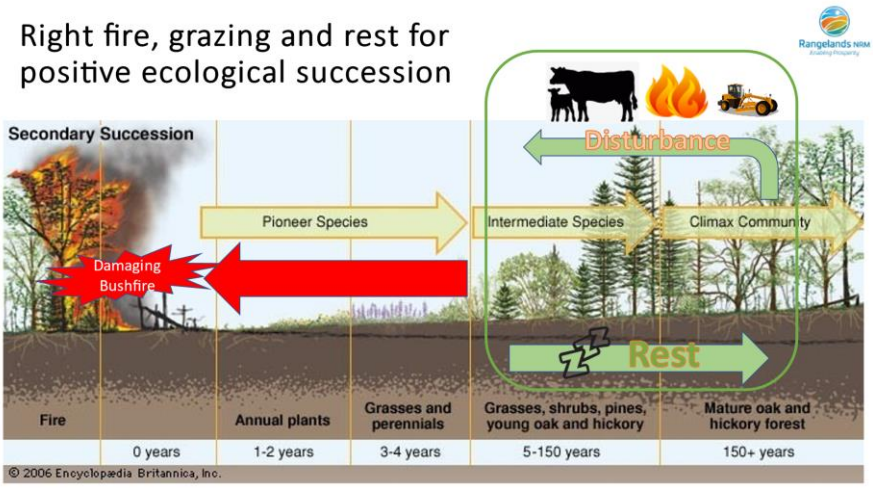

Figure 1.1 Conceptual model of ecological succession with fire and grazing.

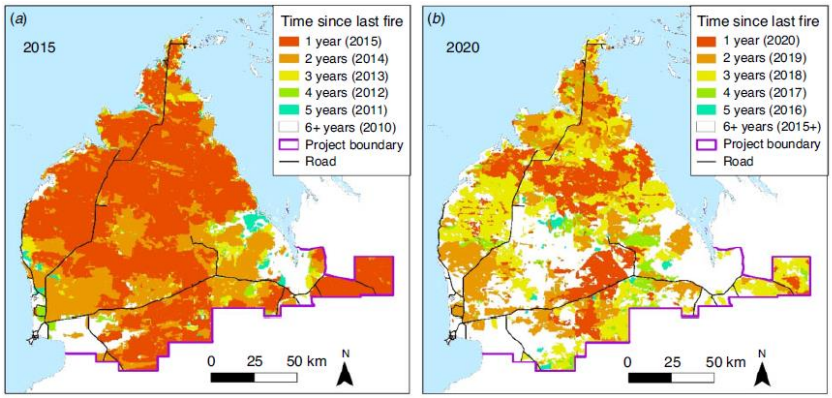

Figure 1.2 DPFWG increasing the mosaic of vegetation ages on the Dampier Peninsula 2015 to 2020 comparison (Wysong *et al.* 2022).

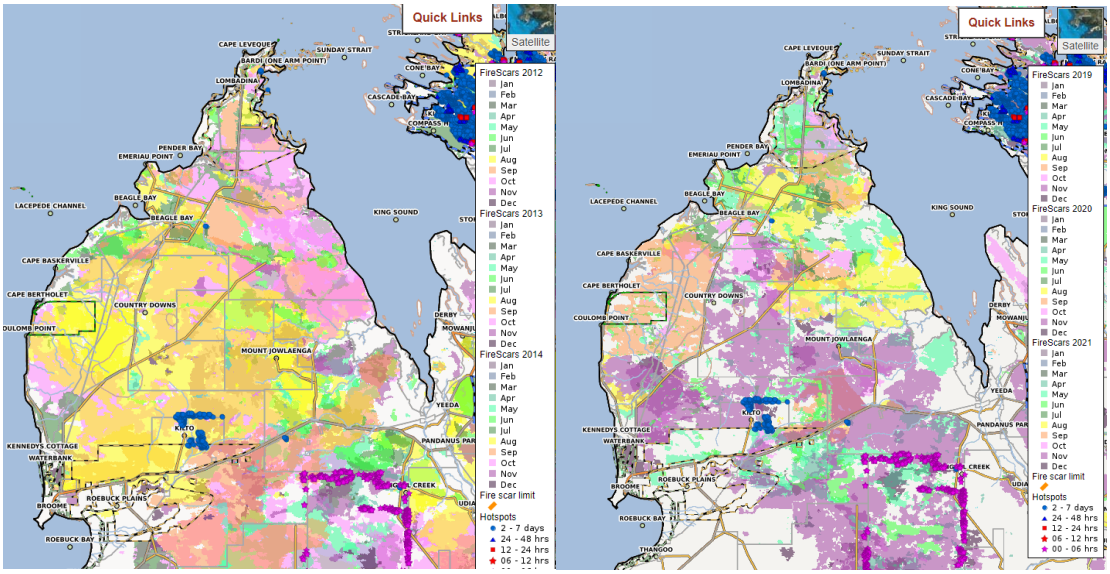

Figure 1.3 Composite fire scars showing extensive hot Aug–Oct fires 2012–2014 (left) months before any rain for vegetation/ecosystem recovery; compared to Nov–Dec storm burning (right) done with higher humidity and early monsoon rains in rotation covering most of the 169,000 ha property. Greater mosaic and unburnt area also apparent in right thanks to DPFWG collaborative approach.

Managing ‘Hillgrove’ a northern beef property – comparing 1993 to 2023 and beyond

M. Pearce

Grade 11 Student, Anglican Church Grammar School, Brisbane; and ‘Mernoo Station’ Ilfracombe, Queensland, Australia

Abstract:

This paper compares the management of a northern cattle station in 1993, with contemporary management in 2023.

The comparison is based on a paper presented at the 17th International Grassland Congress by the author’s grandfather Tom Mann in 1993. This paper profiled the then management of ‘Hillgrove’ and ‘Lochwall’, Upper Burdekin cattle stations. ‘Hillgrove’ was settled in 1861 by the Allingham family and is still under the ownership of their descendants.

Comparisons cover all aspects of the management of the property and the beef enterprise, including the land, livestock, people and finances, and marketing.

The paper highlights that while the underlying principles of sound management have remained basically the same, the practices that support those principles have changed significantly.

Likely changes over the next 30 years to 2053, during which the author may own and manage a northern livestock enterprise, are also proposed.

Reference

Mann TH (1993) Flexibility – the key to managing a northern beef property. In ‘Proceedings of the XVII International Grassland Congress 1993’. pp. 1961-1964.

Traditional Owners Taking Care of Country and Sharing Knowledge

Julie Melbourne*, Dean Mathews**

* Manager Environmental Services, Nyamba Buru Yawuru, Broome
**Assistant Manager Environmental Services, Nyamba Buru Yawuru, Broome

ABSTRACT:

Gumaranganyjal (Roebuck Plains) Station is a viable cattle operation in the Kimberley, owned and managed by Nyamba Buru Yawuru Ltd, the operating arm of the Yawuru Prescribed Body Corporate (PBC), on behalf of the Yawuru Native Title holding community.

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A Yawuru Indigenous Protected Area sits over cultural Jilas, nationally significant springs and wetlands, including an internationally significant Ramsar-listed wetland, all supported by a complex groundwater system connecting the landscape and flowing into Nagulagun Marine Park. The soil and pasture of the Station's marine plains provide highly productive lands for cattle grazing.

The interconnections across the land and sea scape will be highlighted by examining the key targets and threats identified in the IPA Plan of Management and the Monitoring and Evaluation Framework in place for managing the IPA. This adaptive management framework will be presented in relation to the key target of protecting the wetlands on RPS. The Sustainable Grazing monitoring program and drone data will also be presented in relation to the key threat of cattle impact on the cultural and ecological values of the station**.**

Finally it will present the extensive groundwater monitoring program being undertaken by Country Managers in relation to 3 critical purposes:

- To gather baseline data in compliance with the Yawuru H3 Water Licence requirements
- To monitor health of culturally important Ground Water Dependant Ecosystems;
- A broad groundwater monitoring program to measure change in groundwater levels over time.

A new data management system holding the data will enable reporting to share information and results.

This presentation will highlight Yawuru's commitment to managing the ecological and cultural values on Gumaranganyjal and to use the relevant data to inform the cattle management for holistic and sustainable management of the station.

MODELLING SchMOOdelling - What's grass got to do with it? Optimising your animal production datasets

R.A. Cowley*, G. Whish*, C. Materne**, C.L. Pettit*, K.D. McCosker*****, J.O. Carter******, D.G. Mayer***, L.I. Pahl****, B.J. Wirf***

*NT Department of Industry, Tourism and Trade, Berrimah, Australia
**NT Department of Industry, Tourism and Trade, Alice Springs, Australia
***Queensland Department of Agriculture and Fisheries, Dutton Park, Australia
****Queensland Department of Agriculture and Fisheries, Toowoomba, Australia
*****Queensland Alliance for Agriculture and Food Innovation, The University of Queensland, Gatton Campus, Australia
******Queensland Department of Environment and Science, Dutton Park, Australia

Abstract:

Pasture utilisation impacts cattle growth (Ash and Stafford Smith 1996), but the effect of utilisation on breeder performance has often been overlooked in cattle production studies. We retrospectively modelled pasture utilisation using GRASP for existing breeder herd performance datasets containing 75,000 cattle records collected between 1991 and 2022, at 60 sites from across northern Australia. Sites were located from the arid shrublands in central Australia (150–250 mm rainfall) to the tropical Eucalypt savannas of Katherine and Cape York (>900 mm rainfall). They include observational studies on commercial stations, to studies designed to measure the impacts of the provision of shade, infrastructure development, breed, supplementation, grazing system, stocking rate and utilisation on breeder performance.

Annual pasture utilisation was simulated for 350 site years and ranged between 0.5% and 113% of annual pasture growth (Figure 1.1). As an example of the influence of pasture utilisation rate on breeder performance, initial analyses found that the proportion of breeders pregnant each year declined as pasture utilisation increased. The land condition and financial implications of varying pasture utilisation in breeder operations will be extrapolated via bioeconomic modelling. Insights gained will then be used to develop breeder herd management guidelines.

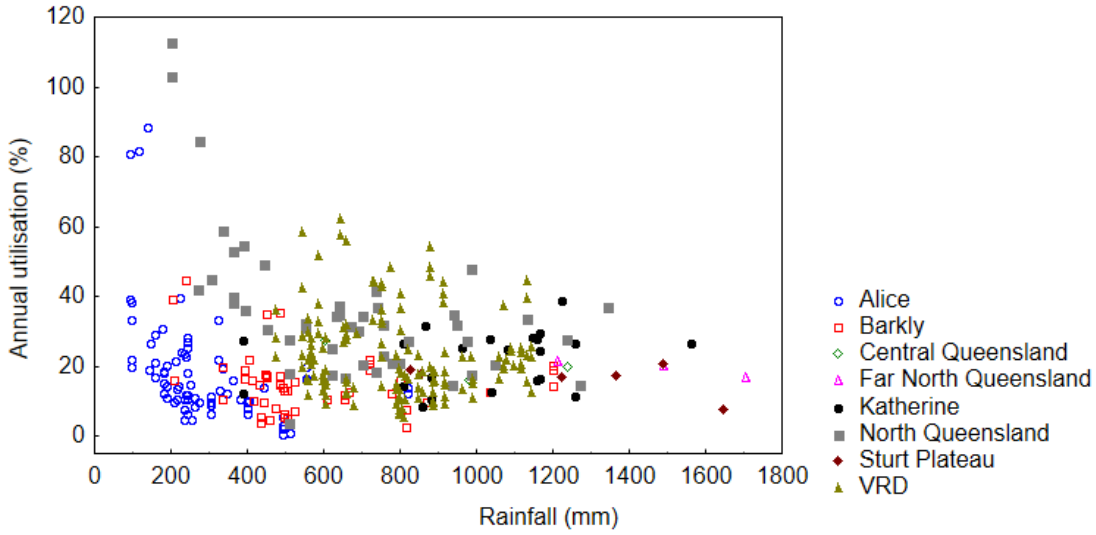

Figure 1.1 Annual pasture utilisation for each site and year versus annual rainfall by region.

This study has developed a repeatable methodology to model pasture growth and utilisation in extensive rangeland paddocks. It shows the importance of designing and reporting animal production studies in a way that facilitates the modelling of pasture utilisation as part of the environmental factors considered when analysing and interpreting animal performance.

Reference

Ash AJ, Stafford Smith DM (1996) Evaluating stocking rate impacts in rangelands: Animals don't practice what we preach. *The Rangeland Journal* **18**, 216–243. doi.org/10.1071/RJ9960216

Applying a risk risk-based approach for pastoral land management in Western Australia

R. Fletcher*, R. Sudmeyer*

*Department of Primary Industries and Regional Development, Perth, Australia

Abstract:

The Department of Primary Industries and Regional Development (DPIRD) is reforming the way it assesses pastoral land condition and the risk of condition decline with the aim of improving land condition to support strong pastoral businesses, community wellbeing and biodiversity conservation. Central to this reform is the development of the Framework for Sustainable Pastoral Management; land condition version (the Framework) (Fletcher 2022). The Framework lays out a contemporary, risk-based approach for natural resource management using internationally accepted best practice principles which includes having clear standards for assessing management outcomes.

The reforms are part of the Western Australian Government's response to an Office of the Auditor General report in 2017 (OAG 2017) that found the ecological sustainability of the WA pastoral estate was not adequately protected by the current system of monitoring and administration.

The Framework and its associated land condition standards clearly set out the basis for how DPIRD will complete future land condition assessments and will enable more consistent and objective lease and station level assessments.

The West Kimberley is the first region of the State to have quantitative land condition standards for its most productive (key) pastures developed (Fletcher *et al.* 2022). These quantitative land condition standards provide a clear description of what is, and is not, acceptable land condition for key pastures in the West Kimberley, and how land management practices could affect risk levels. DPIRD has met with industry peak bodies and West Kimberley pastoralists to discuss the new assessment approach and draft the land condition standards.

Land condition standards will be progressively developed for the remaining regions across the State's pastoral estate.

Call to action: Continue to develop condition standards for the rest of the WA pastoral estate and work with pastoralists to ensure the Framework and Standards are understood and incorporated into management decision-making.

References

Fletcher R (2022) Framework for sustainable pastoral management: Land condition version. Department of Primary Industries and Regional Development, Western Australian Government. Available at https://library.dpird.wa.gov.au/lr_publishedrpts/5/ [Verified 3 April 2023]

Fletcher R, Sudmeyer R, Ryan K, Fletcher M, Holmes K, Thomas P, Barker D, Fletcher W, Ramzi P, Penny N (2022) Pastoral land condition standards: Conceptual basis and West Kimberley region case study – Draft October 2022. Department of Primary Industries and Regional Development, Western Australian Government. Available at https://www.agric.wa.gov.au/rangelands/pastoral-land-condition-standards-%E2%80%93-western-australia [Verified 3 April 2023]

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Birds of the Outback: Unveiling the Secret Life of the Oriental Pratincole Through Local Knowledge

Grace Maglio*, Jardine MacDonald, Amanda Lilleyman*****

*Wader's Life, Broome, Australia
**Rangelands NRM, Broome, Australia
***BirdLife Australia, Darwin, Australia

Abstract:

Rangelands under pastoral use can support biodiversity and complement neighbouring ecosystems. The Oriental Pratincole is one such bird that can be found across pastoral properties in northern Australia. It is Australia's most numerous migratory shorebird (estimated 2.88 million birds recorded in 2004 at Eighty Mile Beach/Anna Plains Station). It is an insectivorous, grassland species favouring habitats modified by pastoral land use and irrigated agriculture throughout its migratory path. Arriving in time for the northern Australian wet season, the birds are known to follow locust and other insect booms in coastal and inland areas, at times in huge flocks, making this species an important ecological tool for the control of agricultural pests and nutrient cycling.

Despite the large numbers of birds, the movements of the Oriental Pratincole outside of Eighty Mile Beach are poorly known. This is partly due to the remoteness of habitat throughout northern Australia, and it is likely the agricultural community holds important knowledge about the movement of this species. This project seeks to address this knowledge gap by calling on landowners and managers in the Kimberley, Pilbara, Northern Territory, Outback, and northern Queensland regions to report sightings of the bird in a bid to gain an understanding of its movements and habits. In early 2023 a pilot study was conducted collating new and existing information.

In addition to collecting records of the Oriental Pratincole's sightings, the project hopes to expand to document the types of habitats the birds are using and the prey species they are feeding on. This information will contribute to our understanding of the bird's ecology and distribution, by raising awareness of the Oriental Pratincole among the pastoralists, station workers, Traditional Owners, and Indigenous Rangers. Ultimately, this project will help promote the conservation of this ecologically important migratory shorebird in Australia.

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Hansen B, Fuller R, Watkins D, Rogers D, Clemens R, Newman M, Woehler E, Weller D (2016) Revision of the East Asian-Australasian Flyway population estimates for 37 listed migratory shorebird species. Unpublished report for the Department of the Environment, Melbourne.

Klapste J (1977) A large concentration of oriental and Australian Pratincoles in northern Queensland. *Australian Bird Watcher* **7(2)**, 65–67. https://search.informit.org/doi/10.3316/informit.635514769329879

Queensland's Northern Gulf Grazing Land Condition Decline: 1990 - 2018

Niilo Gobius*, Kevin Shaw, Joe Rolfe*, Bernard English*,
Terry Beutel***, Dean Jones******

*Department of Agriculture and Fisheries, Mareeba, Australia
**Agricultural Consultant, Atherton, Australia
***Department of Agriculture and Fisheries, Rockhampton, Australia
****Environmental Consultant, Atherton, Australia

Abstract:

The extensive grazing industry in Queensland's Northern Gulf area has an annual turnoff in excess of A$393m based primarily on native rangelands. Land condition reflects the lands capacity to respond to rainfall and produce useful feed for livestock productivity, and in this area it has previously been reported as having declined. This paper reports on the first ongoing assessment made for Queensland rangelands.

Land condition was assessed for change (soil surface condition, pasture composition, woodland thickening, and exotic weed incidence indicators) at 250–262 sites, on 17 discreet land types, over 3 periods (2004, 2012 and 2016); and at 29 QGRAZE sites (using data from 2006–2018). Lastly, remote sensing datasets were analysed for ground cover across 23 regional land types and 29 QGRAZE sites (1990–2016).

Since 2004, we estimate the proportion of retained original carrying capacity declined from 72% to 66%. Average percentage discounts across the three rapid assessment periods for high grazing value land types were 24%, 73%, 38% and 24% for soil surface condition, pasture composition, timber thickening and weed invasion respectively. In 2004, 74% of rapid assessments were discounted due to one or more condition indicators. This increased to 80% of sites discounted in 2012 and 90% in 2016. All land types had reduced remotely-sensed ground cover, with an average value total regional ground cover loss of 4.75% between 1992 and 2015.

If trends continue it is estimated that 50% of original carrying capacity will be lost by 2046. Industry endorsed rangeland monitoring programs are required, as well as resolve from producers, community and government to respond to declining land condition and rangeland productivity trends. Modelling analysis demonstrates financial benefits from property management for improved land condition through reduced stocking rate and wet season spelling but genuine case studies are needed.

‘Climate Smart Grazing Tools’: New and innovative pasture budget

H.R. Pandeya*, G.L. Whish*, G. Fraser, J. Carter**, J. Barnetson****

*Qld Department of Agriculture & Fisheries, Brisbane, Australia
**Qld Department of Environment & Science, Brisbane, Australia

Abstract:

Rangelands in Queensland are extensively grazed by cattle, sheep and goats, and occupy over 80% of the state. Skilful stocking rate and business management is critical in coping with highly variable rainfall and associated forage supply and achieving profitable sustainable grazing enterprises. The ‘Innovative science to support climate smart grazing land management’ project aims to develop a new and innovative pasture budget tool to assist in managing the risks associated with Queensland’s variable and drought-prone climate. This forage budget tool will combine the latest developments in pasture modelling, remote sensing and climate forecasts to provide up to six-month outlooks for land managers to use.

Four targeted commercial beef properties will be visited twice a year (wet and dry season) to intensively sample soil and pasture quantity and quality. Field sampling will range from hand sampling pastures to large area sampling with uncrewed aerial vehicles (UAV). Additionally, on-ground field measurements of plant transpiration (tree and grass) and carbon assimilation rates will be achieved using a portable LI-COR 6800 instrument which may then be related to field and UAV hyperspectral imaging. Field soil and pasture samples will be collated for calibrating or validating broader model platforms including the GRASs Production (GRASP) model and machine learning modelling techniques. The repeated field measurements of pasture will also validate high-resolution hyperspectral and photogrammetric imagery captured through both UAV and optical satellite imagery to develop a new integrated system for improved pasture modelling approaches and more robust seasonal pasture budget products.

This research will provide current pasture conditions and develop forage budget information. The provision of relevant and valid forage budget information via the FORAGE online service (Zhang and Carter 2018) will increase the capacity of climate smart grazing land management and improve the long-term sustainability of the grazing industry in the rangelands of Queensland.

Reference

Zhang B, Carter J (2018) FORAGE – An online system for generating and delivering property-scale decision support information for grazing land and environmental management. *Computers and Electronics in Agriculture* **150**, 302–311.

A baton of storytelling

Amelia (Milly) Nolan

Humans of Agriculture, Geelong, Victoria, Australia

Abstract:

Fostering a future for agriculture that is sustainable, progressive, inclusive and forward-thinking requires intergenerational collaboration. Embodying the ‘next generation’, this presentation sheds light on what the ‘baton’ can look like if we are to forge a compelling future for the sector together. It doesn’t need to be bedazzled and bejewelled, but it does demand open-dialogue and vulnerability from both parties.

In an Australian society where 83% of people list their connection to agriculture as ‘distant’ or ‘non-existent’ and simultaneously 77% of farmers feel that agriculture is misrepresented in today’s media (National Farmers Federation 2017), there is an obvious and lagging void. By adapting our mindset to connecting a void with opportunity, we can not only lead the way in animal welfare, environmental stewardship, sustainability, and food security, but we can become a trusted sector that accepts learnings from previous generations, challenges the status quo in current generations and moves future generations towards the sector.

Using the art of human connection and storytelling, we can elevate the voices of those who produce, move, and consume to foster an inclusive community and embrace diversity.

One of my favourite quotes from Theodore Rosevelt is, ‘No-one cares how much you know until they know how much you care’. So how can we balance our scientific advancements with digestible storytelling?

Reference

National Farmers Federation (2017) AgDay Survey.

Greening the Chihuahuan Desert

Alejandro Carrillo

Regenerative Cattle Rancher, Chihuahua, Mexico

Abstract:

With an average precipitation of 250 mm, the Chihuahuan desert is the largest desert of North America. Reality is, it did not look like a desert based on the historical recordings from the Spanish when they arrived on these lands back in the early 1600s: They described these 'arid' lands as beautiful tall grasses full of wildlife, among them bison, deer, antelope, leopards, grizzly bears, wolves, otters and beavers. There was plenty of water and vegetation across the region that regulated the climate.

Nowadays, despite being a desert, we are getting back beautiful grasslands using livestock (mainly a combination of cows, burros and sheep) under a rational, holistic, regenerative approach, respecting the natural succession of nature: from bare ground, to weeds, to annuals, to perennials, to forbs (flowering herbs) (Figure 1.1).

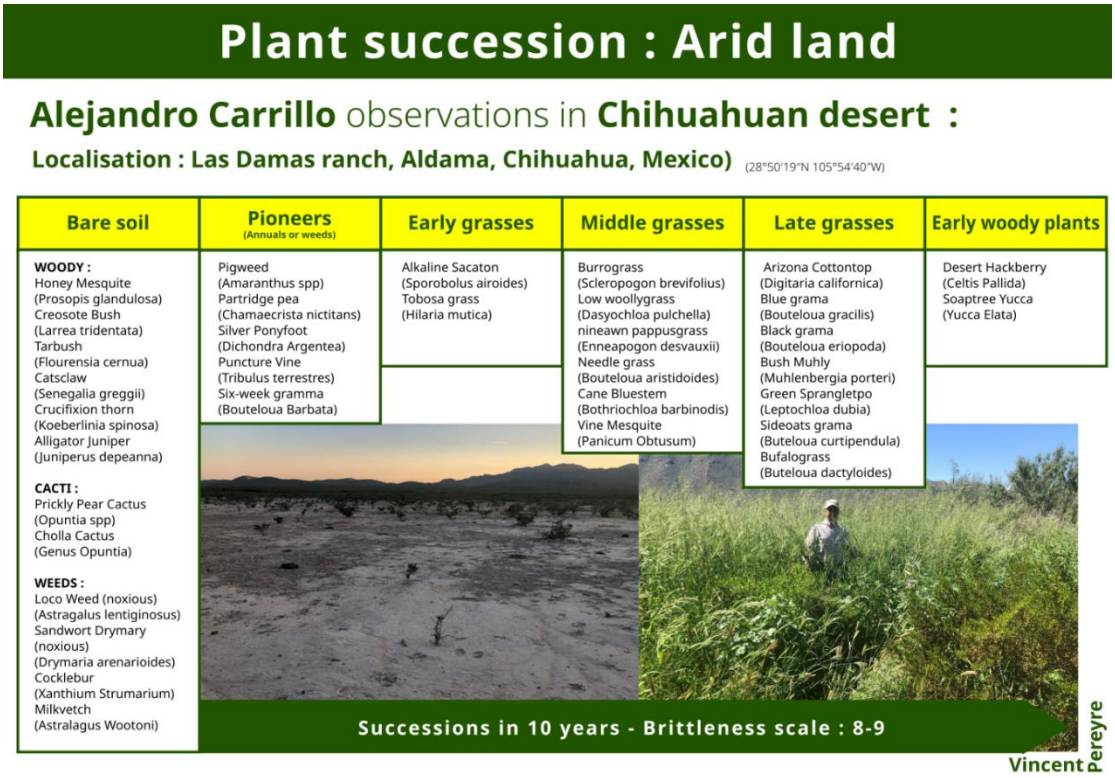

Figure 1.1 Plant succession thru regeneration.

Beyond livestock, we have an army of soil engineers working 24/7, helping us regenerate the land: dung beetles and termites. They do an incredible job of converting cow pies into feed for thousands of living organisms in the soil; making our soils more porous and fertile.

The results are impressive: we have created a micro-climate in regenerative ranches in the state of Chihuahua, Mexico. We improve not only the effective rainfall, but the amount of rainfall: we are getting between 10-20% more rainfall than conventional ranches (Figure 1.2).

Figure 1.2 Regenerative ranches getting an extra 10-20% more rainfall.

As our decisions on how to graze are made based on the well-being of our livestock, it is important to have a selection criterion in place where low performing livestock is culled often to keep a herd of healthy animals in good body condition year-around, in a way that our livestock is a driving force of regeneration, and not an impediment in the journey.

Last, how we approach our investments in time and money are critical to succeed in the regeneration of brittle environments. Areas within a ranch need to be prioritised based on its diversity, biomass, moisture, accessibility, and water availability in such a way that we will invest on the most productive areas first to get the faster return on investment at the lower risk; until we reach the more remote, less moisture, hard-to-access, more degraded areas of the ranch.

The KLC fire program: Supporting good fire management practice by supporting traditional owners

Andrew Morton*

*Kimberley Land Council, Broome

Fire management is a fundamental component of good land management practice in Australia's tropical savannahs and northern woodlands. Northern Australia has a long history of Aboriginal fire practice which has shaped the landscape and the species within.

The KLC fire program empowers Indigenous rangers and traditional owners to undertake burning practices that reinstate historic fire regimes, reducing the risk of catastrophic fires and promoting ecosystem health.

Through a combination of workshops, training, and on the ground work, the fire program facilitates the intergenerational transfer of fire-related expertise and empowers local communities to actively manage their ancestral lands.

This poster will provide an overview of the KLC fire program and outline how we support traditional owners and indigenous rangers to take ownership of their country and implement good fire management practices.