

Australian Rangeland Society 19th Biennial Conference



# **Abstracts Booklet**

The 19th Biennial Conference of the Australian Rangeland Society

**Port Augusta, South Australia**

25-28 September 2017

[www.austrangesoc.com.au](http://www.austrangesoc.com.au)

This booklet contains the abstracts for all the papers presented at the 19<sup>th</sup> Biennial Conference of the Australian Rangeland Society, held in Port Augusta 25-28 September 2017.

The abstracts are arranged in alphabetical order by the surname of the (first named) presenter.

Full papers, as submitted by authors, are available for download from the Australian Rangeland Society website - <https://www.austrangesoc.com.au/pages/19th-biennial-conference-papers-2017.html>

The mode of presentation is noted against each abstract, and the booklet concludes with an alphabetical index of authors.



**WEDNESDAY 27 SEPTEMBER 2017**

0830-0910 **WELCOME TO COUNTRY** (Stephen Atkinson) **AND OFFICIAL OPENING** (Rowan Ramsey MP)

0910-1010 **CONFERENCE KEYNOTE ADDRESS: TRANSFORMATIVE RANGELAND FUTURES: NARRATIVES AND LEARNING**  
Dr Mark Stafford Smith, *Chief Coordinating Scientist, Adaptation, CSIRO*

1010-1040 Morning Tea **Sponsor: S Kidman & Co**

**LEGACY IN THE RANGELANDS**

1040-1105 **Middleback Station—a pastoral legacy** Andrew Nicolson Snr

1105-1130 **20 Years of Ecosystem Restoration** Dr Katherine Tuft, *Arid Recovery*

1130-1230 **LIGHTNING PRESENTATIONS—SESSION 1** (see attached for order of presentations)

1230-1330 Lunch **Sponsor: Green Collar Group**

**PASTORAL INDUSTRY TRENDS IN THE SOUTHERN RANGELANDS**

**Sponsor: Primary Industries and Regions SA**

**Keynote: Growing Sustainably: The Physical and Social Capital of Pastoralism in South Australia**

Jackie Williams *Mount Barry Station;*  
*Chair Oodnadatta Marla NRM Group*

**From the ground up: fostering local ownership and building capacity in pastoral communities across the Southern Rangelands of WA**  
Kieran Massie, *Rangelands NRM*

**Assessing the economic impacts of including carbon farming in western NSW grazing enterprises**  
Prof Geoff Cockfield, *University of Southern Queensland*

**Addressing feed supply and demand through total grazing pressure management in southern Australian rangelands: key issues & opportunities** Dr Dean Revell, *Revell Science*

**Tech Tools for improving productivity, profit and pasture in the Rangelands** Murray Grey, *Glenflorrie Brahman*

1330-1515

**CHANGING FACE OF INDIGENOUS MANAGED LANDS**

**Sponsor: Bush Heritage Australia**

**Keynote: Ngaparlaru Yarta – Cultural tourism, co-management and economic opportunities on Adnyamathanha Country**

Glenise Coulthard  
*Ikara-Flinders Ranges National Park Co-management Board*

**Buffel grass management in Indigenous communities**  
Troy Bowman, *Natural Resources Alinytjara Wilurara*

**Social Return on Investment in the Rangelands: We think what we are doing is important, but does anyone else care?**  
Leah Feuerherdt, *DEWNR*

**Using FarmMaps 4D to improve management of Indigenous pastoral infrastructure** Joel Dillon, *Indigenous Land Corporation*

**Using modern technologies to inform regional infrastructure development** Geoff Deans, *OZ Minerals*

1515-1545 Afternoon tea

**COPING WITH DROUGHT**

**Sponsor: Australian Wool Innovation & Sheep Connect SA**

**Keynote: Building Drought Resilient Regions—Lessons from Central-West Queensland**

Dr David Phelps and Mr Peter Whip  
*Queensland Department of Agriculture & Fisheries (QDAF); Consultant & Grazier, Longreach*

1545-1730 **The Accidental Counsellor: more to beef extension officers than technical advice** Megan Willis, *QDAF*

**Western Queensland's Cash Drought—learning from local town business surveys to inform drought services and policy for the future** Dr Dana Kelly, *Australian National University*

**Resting strategies for recovery of pasture** Paul Jones, *QDAF*

**Ecosystem drivers in rangelands: perceptions of drought and climate change** Assoc Prof Ralph (Wal) Whalley, *University of New England*

**TRANSITIONING TO NEW INDUSTRIES**

**Sponsor: Outback Communities Authority**

**Keynote: The Leigh Creek Transition: Moving From Closed Town to Regional Hub**

Mark Sutton *Outback Communities Authority*

**Pastoralists as conservation providers—a new stewardship incentive mechanism for the South Australian rangelands** Andrew Willson, *DEWNR*

**The implications of the emerging carbon economy for the management of the rangelands** John Gavin, *Remarkable NRM*

**Assessing the impacts of opportunities from carbon farming in western NSW**  
Dr Cathy Waters, *NSW Department of Primary Industries*

**Lessons and best practice of landholder collaboration for landscape-scale conservation and production**  
Prof Graciela Metternicht, *University of NSW*

1730-2030 **RANGELANDS MUSTER** Central Oval **Sponsor: Rangeland NRM Alliance**

Poster Presentations ♦ interactive displays ♦ working dog demonstration ♦ information and sponsor stands  
Market stalls featuring local products ♦ The Western Australia Rangelands Roundtable ♦ Drones and virtual reality  
Students and Young Professionals Session: Insights from successful rangelanders ♦ cash bar and food outlets

THURSDAY 28 SEPTEMBER 2017

0730-0825 AUSTRALIAN RANGELAND SOCIETY GENERAL MEETING

LIVING WITH CLIMATE CHANGE

Sponsor: NSW Department of Primary Industries

Keynote: Living with Climate Change Dr Mark Howden *Climate Change Institute, Australian National University*

John Milne Memorial Rangeland Journal Lecture

Vegetation responses to fire history and soil properties in grazed semi-arid tropical savannah rangeland plants in a warming world  
Gabrielle Lebbink, *University of Queensland*

Rangeland plants in a warming world Assoc Prof Andy Leigh, *University of Technology Sydney*

"The Climate has always been changing": Perspectives of climate change in far west NSW  
Emily Berry, *University of NSW*

0830-1000

1000-1030 Morning Tea

NORTHERN AUSTRALIA—THE NEW FRONTIER

Sponsor: CSIRO

Keynote: What part will the rangelands play in the vision of developing Northern Australian?  
Luke Bowen *Northern Australia Development & Trade*

Plans are useless: but planning is essential. A warning and a promise for Northern development John Brisbin, *Northern Gulf Resource Management Group*

Determining the scale of opportunity for agricultural and water resource development in northern Australia Dr Ian Watson, *CSIRO*

In search of tropically adapted cattle: does size matter?  
Lester Pahl, *Department of Agriculture and Fisheries Queensland*

Simulated impacts of wet season spelling and intensive rotational grazing pressure on pasture conditions in a degraded northern Mitchell grass savanna  
Dr Robyn Cowley, *Northern Territory Department of Primary Industry and Resources*

Towards sustainable development in the Fitzroy Catchment Grey Mackay, *Rangelands NRM*

1030-1230

THREATENED SPECIES COMMISSIONER

Gregory Andrews 1030-1110  
Department of the Environment and Energy, Canberra

LIGHTNING PRESENTATIONS

SESSION 2 1110-1230  
(see attached for order of presentations)

1230-1330 Lunch

REGIONAL & COMMUNITY DEVELOPMENT

Sponsor: Outback Communities Authority

Keynote: Decentralisation and Localism—Rhetoric vs Reality  
Dr Jen Cleary  
*Chair of the Regional Development Australia Chairs' Reference Group*

Keeping people and communities at the centre of NRM in the SA Arid Lands Jodie Gregg-Smith, *SA Arid Lands NRM*

A natural partnership—conservation charity Nature Foundation SA's partnership with industry is having a positive impact on nature conservation in the SA Arid Lands  
Alex Nankivell, *Nature Foundation SA*

Bridging the divide: implications of social variations between first – and multi-generational ranchers  
Katherine Munden-Dixon, *University of California*

From LSP to ILP and all the acronyms in between—transforming an organisation Dr Gaye Mackenzie, *Rangelands NRM*

1330-1530

MONITORING AFTER ACRIIS

Keynote: Monitoring in the Australian Rangelands: Where we've come from and where we should be headed  
Ben Sparrow  
*Terrestrial Ecosystems Research Network (TERN), University of Adelaide*

Assessing land condition in a bi-polar landscape  
Robert Brandle, *SA Arid Lands NRM*

Standardised vegetation survey and monitoring data across the Australian rangelands Dr Greg Guerin, *University of Adelaide*

TERN AusCover: Delivering imagery and services to industry and landholders in the Rangelands  
Dr Peter Scarth, *Joint Remote Sensing Research Program*

VegMachine.net—big data on the Rangelands Dr Terry Beutel, *QDAF*

Establishing the health of the Lake Eyre Basin—A fishy story!  
Andrew Drysdale, *Lake Eyre Basin Community Advisory Committee*

Science is just the start—the development of the NRM Spatial Hub  
Kate Forrest, *Rangeland NRM Alliance*

1530-1600 Afternoon Tea

1600-1630 AUSTRALIAN RANGELANDS: THEIR CONTEXT IN THE WORLD'S ECONOMY Michael O'Neil, *University of Adelaide*

1630-1705 CONFERENCE RAPPOORTEURS Dr Cathy Waters & Dr Ian Watson

1705-1730 AWARDS AND CLOSE John Gavin

1830-2230 CONFERENCE DINNER The Barracks Sponsor: Department of Environment, Water & Natural Resources

## LIGHTNING PRESENTATIONS

Time is allocated for discussion and questions at the end of each themed group of presentations.

WEDNESDAY 27 SEPTEMBER 2017

### LIGHTNING—SESSION 1

1130-1150	<b>BIG PICTURES</b> <b>Ephemeral Streams and the importance of source based monitoring</b> Andrew Oswald, <i>OZ Minerals</i> <b>Why do Ecological communities stop at state borders? AusPlots and the need for consistent, national scale, surveillance monitoring</b> Emrys Leitch, <i>TERN AusPlots, The University Of Adelaide</i> <b>Groundwater: Your rights and obligations in the Far North Prescribed Wells Area</b> David Leek, <i>DEWNR</i>
1150-1215	<b>RESTORATION</b> <b>Koonamore: the TGB Osborn Vegetation Reserve; 90 years of change recorded</b> Dr Russell Sinclair, <i>The University Of Adelaide</i> <b>Long-term revegetation success of severely degraded chenopod shrublands</b> Dr Nerissa Haby, <i>Wild R&amp;D</i> <b>A novel approach to restoring bluegrass communities in the Brigalow Belt, Queensland</b> Dr Josie Kelman, <i>Enviro-dynamics</i> <b>Overview of the National Burning Project</b> Simon Wicks, <i>DEWNR</i>
1215-1230	<b>ANIMAL PRODUCTION</b> <b>How much does a cow eat? A billion dollar question for northern Australian development</b> Dr Dionne Walsh, <i>NT Department Of Primary Industry &amp; Resources</i> <b>Natural Capital Accounting for Rangelands</b> Jonathan Green, <i>Australian Indigenous Agribusiness Company</i>

THURSDAY 28 SEPTEMBER 2017

### LIGHTNING—SESSION 2

1110-1125	<b>GROWING HUMAN CAPACITY</b> <b>Community driven decision making, design and delivery by Natural Resource Management Groups in the South Australian Arid Lands</b> Louise Gavin, <i>Natural Resources SA Arid Lands, DEWNR</i> <b>Kids on country - Outback Ecology Camps at Witchelina Nature Reserve are providing Aboriginal students with opportunities for further education and employment on traditional lands</b> Caroline Nefiodovas, <i>Nature Foundation SA</i>
1125-1150	<b>LOOKING AHEAD</b> <b>Cost or quality: How are drones and new technology changing natural resource management?</b> Kylie Piper, <i>The University of Adelaide</i> <b>Rainfall and pasture information to communicate the risk of long-term drought sequences and climate awareness</b> Grant Stone, <i>Department Of Science, Information Technology And Innovation</i> <b>Investigating the value of seasonal climate forecast for beef grazing enterprises: Charters Towers case study</b> Dr Kate Reardon-Smith, <i>International Centre For Applied Climate Sciences, University of Southern Queensland</i> <b>LongPaddock 2020: Rangelands climate and pasture information portal – not just in the clouds</b> Dr Ramona Dalla Pozza, <i>Department Of Science, Information Technology And Innovation</i>
1150-1205	<b>SOIL MATTERS</b> <b>The benefits of avoiding soil organic carbon loss by wind erosion in western NSW</b> Dr Susan Orgill, <i>NSW Department Of Primary Industries</i> <b>Understanding the trade-offs and synergies between carbon farming and resilience in the rangelands of western NSW</b> Dr Annette Cowie, <i>NSW Department Of Primary Industries</i>
1205-1230	<b>MANAGING AND RESTORING RANGELAND VEGETATION</b> <b>A new way to look at leucaena in rangelands</b> Dr Terry Beutel, <i>Queensland Department of Agriculture &amp; Fisheries</i> <b>Buffel busting: pasture composition after 33 years of Cenchrus ciliaris removal in central Queensland rangelands</b> Dr Jen Silcock, <i>University Of Queensland</i> <b>Pasture biomass: a common solution for grazing profitability, carbon and drought resilience</b> Dr Steven Bray, <i>Department Of Agriculture And Fisheries Queensland</i> <b>Site selection of Melica persica for rangeland improvement by AHP and GIS (Mahidasht Sanjabi Basin, Kermanshah Province, Iran)</b> Dr Ali Ariapour, <i>Islamic Azad University, Iran</i>



## POSTER PRESENTATIONS

- 1 **Transitioning through Learning: Shark Bay Science and Research Centre**  
Ms Elisabeth McLellan, *Bush Heritage Australia*
- 2 **Uninvited guests: how some weeds of arid Australia arrived as stowaways and became widespread**  
Dr Margaret Friedel, *CSIRO Land & Water; RIEL CDU*
- 3 **Successes and challenges of delivering broadscale ecological restoration: Bounceback Program, South Australia**  
Ms Trish Mooney, *Natural Resources SA Arid Lands*
- 4 **'Pass the Parcel' - How petroleum companies are avoiding their rehabilitation responsibilities in Far SW Queensland**  
Dr Rob Savory, *RSES*
- 5 **Overview of the National Burning Project**  
Mr Simon Wicks, *Department of Environment Water and Natural Resources*
- 6 **Koonamore: the TGB Osborn Vegetation Reserve; 90 years of change recorded**  
Dr Russell Sinclair, *The University of Adelaide*
- 7 **Why do Ecological communities stop at state borders? AusPlots and the need for consistent, national scale, surveillance monitoring**  
Mr Emrys Leitch, *TERN AusPlots, University of Adelaide*
- 8 **Collaborative, Strategic and Risk-Based – A New Approach to Weed Management in Western NSW**  
Mr Paul Erkelenz, *Astrebla Agribusiness & NRM Consulting*
- 9 **Ephemeral Streams and the importance of source based monitoring**  
Mr Andrew Oswald, *OZ Minerals*
- 10 **Can greenies and graziers be friends? Profitable grazing supports reptiles in a tropical savanna rangeland**  
Mrs Heather Neilly, *James Cook University*
- 11 **Site Selection of *Melica persica* for Rangeland Improvement by AHP and GIS**  
Dr Ali Ariapour, *Islamic Azad University, Iran*
- 12 **Investigation of Chemical Essential Oil Components of *Thymus Kotschyanus* in Zagheh Area (Lorestan Province)**  
Dr Ali Ariapour, *Islamic Azad University, Iran*
- 13 **Resource Dependent Communities: Optimistic future or inevitable closure? The case of legacy mining towns in Australia's Bowen Basin**  
Professor Graciela Metternicht, *University of New South Wales*
- 14 **Developing online tools to foster cross-property collaboration for environmental action and enterprise options**  
Professor Graciela Metternicht, *University of New South Wales*



- 15 **Land degradation neutrality: a new approach to land degradation policy**  
Dr Annette Cowie, *NSW Department of Primary Industries*
- 16 **Understanding the trade-offs and synergies between carbon farming and resilience in the rangelands of western NSW**  
Dr Annette Cowie, *NSW Department of Primary Industries*
- 17 **Pursuing the World Heritage opportunity for the Flinders Ranges**  
Ms Liesl Garrett, *Department of Environment, Water and Natural Resources*
- 18 **Connect. Coordinate. Deliver: Transforming and rebranding Rangelands NRM**  
Ms Teresa Belcher, *Rangelands NRM*
- 19 **"Biteback" a model of community driven pest management in South Australia**  
Mr Greg Patrick, *SA Department of Environment, Water & Natural Resources*
- 20 **Herbage response to shrub reduction in contrasting land classes in semi-arid woodlands of western NSW**  
Mr Warren Muller, *CSIRO Land & Water*
- 21 **Groundwater: Your rights and obligations in the Far North Prescribed Wells Area**  
Mr David Leek, *SA Department of Environment Water And Natural Resources*
- 22 **Managing risk in Australian Rangelands in a Transitioning Landscape and Climate**  
Dr Jennifer Sinclair, *GreenCollar Group*
- 23 **A novel approach to restoring bluegrass communities in the Brigalow Belt, Queensland**  
Dr Josie Kelman, *Enviro-dynamics*
- 24 **Long-term revegetation success of severely degraded chenopod shrublands**  
Dr Nerissa Haby, *Wild R&D*
- 25 **Estimating an economic incentive to balance commercial grazing and tree growth and carbon storage on arid river floodplains**  
Dr Nerissa Haby, *Wild R&D*
- 26 **Natural Capital Accounting for Rangelands**  
Mr Jonathan Green, *Australian Indigenous Agribusiness Company*
- 27 **A rapid approach for the visual attribution of vegetation photo patterns across the NSW Rangelands: a data driven technique using time series earth observation**  
Mr Mike Day, *NSW Office of Environment & Heritage*
- 28 **Social acceptability of feral animal and native herbivore management in meeting TGP targets**  
Dr Katrina Sinclair, *NSW Department of Primary Industries*
- 29 **Locust and tree interactions in Australian rangelands**  
Mr Douglas Lawton, *Arizona State University*
- 30 **Flora and Fauna Communities of the Cooper-Eromanga Basin**  
Mr Trevor Hobbs, *SA Department of Environment, Water and Natural Resources*



- 31 **The use of DNA metabarcoding to study diet section in sheep**  
Dr Yohannes Alemseged, *NSW Department of Primary Industries*
- 32 **Harnessing Environmental Markets to Improve Productivity and Ecosystem Resilience in Australian Rangelands**  
Mr Dave Moore, *GreenCollar Group*
- 33 **Buffel busting: pasture composition after 33 years of *Cenchrus ciliaris* removal in central Queensland rangelands**  
Dr Jen Silcock, *University Of Queensland*
- 34 **Building grazier capacity in sustainable management of grazing lands in the Southern Gulf**  
Ms Anne Alison, *Southern Gulf NRM*
- 35 **Performance of livestock production in north Eastern Cape communal areas: a stochastic frontier analysis**  
Miss Bukho Gusha, *Agricultural Research Council*
- 36 **Effect of vegetation cover type on soil fertility in semi-arid rangelands**  
Mr Lukas Chipfupa, *Central University Of Technology, Bloemfontein, South Africa*
- 37 **Monitoring trends in grazing pressure at a regional scale**  
Ms Trudie Atkinson, *NSW Department of Primary Industries*
- 38 **Utility of Integrated Monitoring for an Evidence Based Approach to Rangeland Management in the Northern Territory**  
Dr Andrew Scott, *Department of Environment and Natural Resources*
- 39 **Key landscape function indicators determined using hyperspectral reflectance in southern Queensland grasslands**  
Mr Bruce Alchin, *University of Queensland*
- 40 **Management of commercially harvested kangaroo species in the rangelands**  
Dr Amanda McLean, *Department of Environment, Water and Natural Resources*
- 41 **Shot gun Farming in the Rangelands**  
Mr Ray Thompson, *Central West Local Land Services*
- 42 **Community driven decision making, design and delivery by Natural Resource Management Groups in the South Australian Arid Lands**  
Mrs Louise Gavin, *SA Arid Lands, DEWNR*
- 43 **Kids on Country - Outback Ecology Camps at Witchelina Nature Reserve are providing Aboriginal students with opportunities for further education and employment on traditional lands.**  
Ms Caroline Nefiodovas, *Nature Foundation SA*
- 44 **Arid river systems in South Australia - dynamics, change and variability at a landscape scale**  
Mr Henry Mancini, *Department of Environment, Water and Natural Resources*



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Dr Wendy Williams<sup>1</sup>, Dr Armando Apan<sup>2</sup>, **Mr Bruce Alchin**<sup>1</sup>

<sup>1</sup>University of Queensland, Gatton, Australia, <sup>2</sup>University of Southern Queensland, Toowoomba, Australia

## The use of DNA metabarcoding to study diet section in sheep

**Dr. Yohannes Alemseged**<sup>1</sup>, Dr. Andrew Mitchell<sup>2</sup>

<sup>1</sup>New South Wales Department of Primary Industries, Trangie, Australia, <sup>2</sup>Australian Museum Research Institute, Australian Museum, Sydney, Australia

## Building grazer capacity in sustainable management of grazing lands in the Southern Gulf.

**Ms Anne Alison**<sup>1</sup>, Ms Shari Rankin<sup>1</sup>, Mr Andrew Maclean<sup>1</sup>

<sup>1</sup>Southern Gulf NRM, Mount Isa, Australia

## Site Selection of Melica persica for Rangeland Improvement by AHP and GIS (Mahidasht Sanjabi Basin, Kermanshah Province, Iran)

**Dr. Ali Ariapour**<sup>1</sup>, Mr. Moslem Hadidi<sup>2</sup>, Miss Elahe Karami<sup>3</sup>

<sup>1</sup>Department of Range Management, Boroujerd Branch, Islamic Azad University, Borujerd, Iran, <sup>2</sup>Kermanshah Academic Center for Education, Culture and Research (ACECR), Kermanshah, Iran, <sup>3</sup>M.Sc. Student, Department of Rangeland Management, Young Researchers Club, Borujerd Branch, Islamic Azad University, Borujerd, Iran

## Investigation of Chemical Essential Oil Components of Thymus Kotschyanus in Zagheh Area (Lorestan Province)

**Dr. Ali Ariapour**<sup>1</sup>, Miss Elahe Karami<sup>2</sup>, Mr. Amir Heidari Jamshidi<sup>3</sup>

<sup>1</sup>Department Of Natural Resources, College Of Range Management, Boroujerd Branch, Islamic Azad University, Boroujerd, Boroujerd, Iran, <sup>2</sup>Department of Rangeland Management, Young Researchers Club, Boroujerd Branch, Islamic Azad University, Boroujerd, Iran, <sup>3</sup>Senior Expert of Cultivation and Crop Breeding, Jihade Agriculture Organization, Khorramabad, Iran

## Monitoring trends in grazing pressure at a regional scale

**Ms Trudie Atkinson**<sup>1</sup>, Mr Warren Smith<sup>1</sup>

<sup>1</sup>NSW Department of Primary Industries, Trangie, Australia

## Connect. Coordinate. Deliver: Transforming and rebranding Rangelands NRM

**Ms Teresa Belcher**<sup>1</sup>

<sup>1</sup>Rangelands Nrm, Como, Australia

A new way to look at leucaena in rangelands.

**Dr Terry Beutel**<sup>1</sup>, Ms Debra Corbet<sup>1</sup>, Ms Madonna Hoffman<sup>1</sup>, Mr Stuart Buck<sup>1</sup>  
<sup>1</sup>DAF, Rockhampton, Australia

VegMachine.net. Online land cover analysis for the rangelands.

**Dr Terry Beutel**<sup>1</sup>, Ms Rebecca Trevithick<sup>2</sup>, Dr Peter Scarth<sup>2</sup>, Mr Dan Tindall<sup>2</sup>  
<sup>1</sup>DAF, Rockhampton, Australia, <sup>2</sup>DSITI, Brisbane, Australia

What part will the rangelands play in the vision of developing Northern Australian?

**Mr Luke Bowen**

Buffel Grass Management in Indigenous Communities of the Alinytjara Wilurara Natural Resources Management Region and Great Victoria Desert.

**Mr Troy Bowman**<sup>1</sup>, Mrs Samantha Doudle<sup>2</sup>, **Mrs Ellen Ryan-Colton**<sup>3</sup>  
<sup>1</sup>Natural Resources Alinytjara Wilurara, Ceduna, Australia, <sup>2</sup>Spinifex Land Management, TjunTjunjara, Australia,  
<sup>3</sup>Anangu Pitjantjatjara Yankunytjatjara Land Management, Umuwa, Australia

Assessing land condition in a bi-polar landscape

**Mr Robert Brandle**<sup>1</sup>, Mr Gavin Baird<sup>1</sup>, Mr Augie Facelli<sup>1</sup>, Mr John Maconochie<sup>1</sup>, Mr David Oag<sup>1</sup>, Mr Jeff Stringer<sup>1</sup>  
<sup>1</sup>Natural Resources, SA Arid Lands, Department Of Environment, Water And Natural Resources, Port Augusta, Australia

Pasture biomass: a common solution for grazing profitability, carbon and drought resilience

**Dr Steven Bray**<sup>1</sup>, Dr David Phelps<sup>2</sup>  
<sup>1</sup>Department Of Agriculture And Fisheries Queensland, Rockhampton, Australia, <sup>2</sup>Department Of Agriculture And Fisheries Queensland, Longreach, Australia

Plans are useless: but Planning is essential. A Warning and a Promise for Northern Development

**Mr John Brisbin**<sup>1</sup>  
<sup>1</sup>Northern Gulf Resource Management Group, Georgetown, Australia, <sup>2</sup>Mitchell River Watershed Management Group, Mareeba, Australia

The ultimate transition: the role of extension in planning for future generations

**Ms Kate Brown**<sup>1</sup>  
<sup>1</sup>Department of Agriculture and Fisheries, Townsville, Australia

## Effect of vegetation cover type on soil fertility in semi-arid rangelands

**Mr Lukas Chipfupa**<sup>1</sup>

<sup>1</sup>Central University Of Technology, Bloemfontein, South Africa, Bloemfontein, South Africa, <sup>2</sup>Agricultural research Council, Pretoria, South Africa

## Decentralisation in Regional Australia: What does it really mean?

**Dr Jen Cleary**<sup>1</sup>

<sup>1</sup>Centacare Catholic Family Services Country SA, , Australia

## Assessing the economic impacts of including carbon farming in western NSW grazing enterprises

**Professor Geoff Cockfield**<sup>1</sup>, Associate Professor Tek Maraseni<sup>1</sup>, Dr Uttam Shrestha<sup>1</sup>, Ms Fiona Garland<sup>2</sup>

<sup>1</sup>University Of Southern Queensland, Toowoomba, Australia, <sup>2</sup>Local Land Services Western, Bourke, Australia

## Understanding the trade-offs and synergies between carbon farming and resilience in the rangelands of western NSW

**Dr Annette Cowie**<sup>1</sup>, Dr Cathy Waters<sup>1</sup>, Dr Susan Orgill<sup>1</sup>, Fiona Garland<sup>3</sup>, Trudie Atkinson<sup>1</sup>, Dr Deborah O'Connell<sup>2</sup>, Dr Nick Abel<sup>2</sup>, Dr Brian Walker<sup>2</sup>, Dr Nicky Grigg<sup>2</sup>, Dr Rachel Williams<sup>2</sup>

<sup>1</sup>Nsw Department Of Primary Industries, , Australia, <sup>2</sup>CSIRO, Canberra, Australia, <sup>3</sup>Local Land Services Western Region, , Australia

## Land degradation neutrality: a new approach to land degradation policy

**Dr Annette Cowie**<sup>1</sup>, Prof Barron Orr<sup>2</sup>, Prof Graciela Metternicht<sup>3</sup>

<sup>1</sup>Nsw Department Of Primary Industries, Armidale, Australia, <sup>2</sup>University of Arizona/ Belmont Forum/ UNCCD Science Policy Interface, Madrid, Spain, <sup>3</sup>University of New South Wales, Kensington, 2052

## Simulated impacts of wet season spelling and intensive rotational grazing on pasture condition in a degraded northern Mitchell grass savanna

**Dr Robyn Cowley**<sup>1</sup>, Dr Dionne Walsh<sup>1</sup>, Ms Jane Douglas<sup>1</sup>

<sup>1</sup>NT DPIR, Darwin, Australia

## LongPaddock 2020: Rangelands climate and pasture information portal – not just in the clouds.

**Dr Ramona Dalla Pozza**<sup>1</sup>, Mr Grant Stone<sup>1</sup>, Mr John Carter<sup>1</sup>, Ms April Gunning-Davis<sup>1</sup>, Mr Alan Peacock<sup>1</sup>

<sup>1</sup>Department Of Science, Information Technology And Innovation, Brisbane, Australia

## A rapid approach for the visual attribution of vegetation photo patterns across the NSW Rangelands: a data driven technique using time series earth observation

**Mr Mike Day**<sup>1</sup>, Dr Adam Roff<sup>1</sup>

<sup>1</sup>Nsw Office Of Environment & Heritage, Parramatta, Australia

Using FarmMaps 4D to improve management of Indigenous pastoral infrastructure

**Mr Joel Dillon<sup>1</sup>, Mr Peter Cunningham<sup>2</sup>**

<sup>1</sup>Indigenous Land Corporation, , Australia, <sup>2</sup>National Indigenous Pastoral Enterprises, , Australia

Establishing the Health of the Lake Eyre Basin - a Fishy Story!

**Mr Andrew Drysdale<sup>1</sup>, Dr Steve Morton**

<sup>1</sup>Lake Eyre Basin Community Advisory Committee, Toowoomba, Australia

Collaborative, Strategic and Risk-Based – A New Approach to Weed Management in Western NSW

Mr Paul Erkelenz<sup>1</sup>, **Mr David Creeper<sup>2</sup>**, Ms Jasmine Wells<sup>3</sup>, Mr Mitchell Plumbe<sup>3</sup>

<sup>1</sup>Astrebla Agribusiness & NRM Consulting, Goolwa Beach, Australia, <sup>2</sup>Western Local Land Services, Broken Hill, Australia, <sup>3</sup>Western Local Land Services, Hillston, Australia

Social Return on Investment in the Rangelands; We Think What We Are Doing is Important, But Does Anybody Else Care?

**Leah Feuerherdt<sup>1</sup>**

<sup>1</sup>Department Of Environment, Water and Natural Resources, Adelaide, Australia

Science is just the start - the development of the NRM Spatial Hub.

**Ms Kate Forrest<sup>1</sup>**, Mr Andrew Drysdale<sup>1</sup>

<sup>1</sup>Rangeland NRM Alliance, Longreach, Australia

Uninvited guests: how some weeds of arid Australia arrived as stowaways and became widespread

**Dr Margaret Friedel<sup>1</sup>**

<sup>1</sup>CSIRO Land & Water; RIEL CDU, Alice Springs, Australia

Pursuing the World Heritage opportunity for the Flinders Ranges

**Ms Liesl Garrett<sup>1</sup>**

<sup>1</sup>Department of Environment, Water and Natural Resources, Adelaide, Australia

The implications of the emerging carbon economy for the management of the rangelands

**Mr John Gavin<sup>1</sup>**

<sup>1</sup>Remarkable Nrm, Wilmington, Australia

Community driven decision making, design and delivery by Natural Resource Management Groups in the South Australian Arid Lands.

**Mrs Louise Gavin<sup>1</sup>, Ms Lelia Kamphorst<sup>1</sup>**

<sup>1</sup>SA Arid Lands, Department of Environment, Water and Natural Resources, Port Augusta, Australia

## Natural Capital Accounting for Rangelands

**Mr Jonathan Green**<sup>1</sup>

<sup>1</sup>*Australian Indigenous Agribusiness Company, Adelaide, Australia*

## Keeping people and communities at the centre of NRM in the SA Arid Lands

**Ms Jodie Gregg-Smith**<sup>1</sup>

<sup>1</sup>*DEWNR, SA Arid Lands NRM Board, Port Augusta, Australia*

## Tech Tools for Improving Productivity, Profit and Pasture in the Pastoral Rangelands

**Mr Murray Grey**<sup>1</sup>

<sup>1</sup>*Glenflorrie Station, Nanutarra, Australia, <sup>2</sup>Precision Pastoral Management Tools Project, Alice Springs, Australia*

## Standardised vegetation survey and monitoring data across the Australian rangelands from TERN AusPlots

**Dr Greg Guerin**<sup>1</sup>, Mr Ben Sparrow<sup>1</sup>, Dr Andrew Tokmakoff<sup>1</sup>, Dr Anita Smyth<sup>1</sup>, Mr Emrys Leitch<sup>1</sup>

<sup>1</sup>*Terrestrial Ecosystem Research Network, School of Biological Sciences and Environment Institute, University of Adelaide, Adelaide, Australia*

## Performance of livestock production in north Eastern Cape communal areas: a stochastic frontier analysis.

**Miss Bukho Gusha**<sup>1,2</sup>, Dr Tony Palmer<sup>1</sup>

<sup>1</sup>*Agricultural Research Council, Grahamstown, South Africa, <sup>2</sup>Rhodes University, Grahamstown, South Africa*

## Long-term revegetation success of severely degraded chenopod shrublands

**Dr Nerissa Haby**<sup>1</sup>

<sup>1</sup>*Wild R&D, Urrbrae, Australia*

## Estimating an economic incentive to balance commercial grazing and tree growth and carbon storage on arid river floodplains

**Dr Nerissa Haby**<sup>1</sup>, David Oag<sup>2</sup>, Jeffrey Stringer<sup>2</sup>

<sup>1</sup>*Wild R&D, Urrbrae, Australia, <sup>2</sup>Natural Resources - South Australian Arid Lands, Port Augusta, Australia*

## Australian Rangelands: Their time has come in the context in the World's Economy

**Jim Hancock**<sup>1</sup>

<sup>1</sup>*South Australian Centre for Economic Studies, University of Adelaide, Adelaide, Australia*

## Flora and Fauna Communities of the Cooper-Eromanga Basin

**Trevor Hobbs**<sup>1</sup>, David Armstrong<sup>1</sup>, Dale Wenham<sup>2</sup>, Scott Howell<sup>2</sup>, Jarrod Spencer<sup>2</sup>, John Maconochie<sup>1</sup>, Augie Facelli<sup>1</sup>, Rob Brandle<sup>1</sup>, Zoë Bowen<sup>3</sup>

<sup>1</sup>Department of Environment, Water and Natural Resources, Government of South Australia, Adelaide, Australia,

<sup>2</sup>Department of State Development, Government of South Australia, Adelaide, Australia, <sup>3</sup>Beach Energy Limited, Adelaide, Australia

## Living with Climate Change

**Prof Mark Howden**

## Ephemeral Streams and the importance of source based monitoring

**Mr Andrew Oswald**<sup>1</sup>, Leighton Randell<sup>1</sup>

<sup>1</sup>Oz Minerals, Parkside, Australia

## Using modern technologies to inform regional infrastructure development

**Geoff Deans**<sup>1</sup>, Mr Glen Wingfield, Mr Andrew Morley

<sup>1</sup>Oz Minerals, Parkside, Australia

## Resting strategies for recovery of pasture

**Mr Paul Jones**<sup>1</sup>

<sup>1</sup>Qld. Department Of Agricultural And Fisheries, Emerald, Australia

## Western Queensland's Cash Drought – learning from local town business surveys to inform drought assistance services and policy for the future

**Dr Dana Kelly**<sup>1</sup>, Dr David Phelps<sup>2</sup>, Rev Jenny Coombes<sup>3</sup>

<sup>1</sup>Visiting Research Fellow, Australian National University, Canberra, Australia, <sup>2</sup>Chair, Western Queensland Drought Appeal and President, Longreach Rotary, Longreach, Australia, <sup>3</sup>Minister Uniting Church and Western Queensland Drought Appeal Committee, Longreach, Australia

## A novel approach to restoring bluegrass communities in the Brigalow Belt, Queensland

**Dr Josie Kelman**<sup>1</sup>, **Mr Nev Hunt**<sup>2</sup>

<sup>1</sup>Enviro-dynamics, Hobart, Australia, <sup>2</sup>Hunt Land Management, Toowoomba, Australia

## Locust and tree interactions in Australian rangelands

**Mr. Douglas Lawton**<sup>1</sup>, Dr. Arianne Cease<sup>2</sup>, Dr. Cathy Waters<sup>2,3</sup>

<sup>1</sup>School of Life Sciences, Arizona State University, Tempe, United States, <sup>2</sup>School of Sustainability, Arizona State University, Tempe, United States, <sup>3</sup>NSW Department of Primary Industries, Trangie, Australia

## Vegetation responses to fire history and soil properties in grazed semi-arid tropical savanna

**Miss Gabrielle Lebbink<sup>1</sup>**, Dr Rod Fensham<sup>2</sup>, Dr Robyn Cowley<sup>3</sup>

<sup>1</sup>University Of Queensland, Brisbane, Australia, <sup>2</sup>Queensland Herbarium, Toowong, Australia, <sup>3</sup>Department of Primary Industries and Resources, Darwin, Australia

## Groundwater: Your rights and obligations in the Far North Prescribed Wells Area

**Mr David Leek<sup>1</sup>**, **Mr Travis Gotch<sup>1</sup>**, **Mr Lynn Brake<sup>1</sup>**

<sup>1</sup>Department Of Environment Water And Natural Resources, Adelaide, Australia

## Rangeland plants in a warming world

**Associate Professor Andy Leigh<sup>1</sup>**, Ms Ellen Curtis<sup>1</sup>

<sup>1</sup>University Of Technology Sydney, Broadway, Australia

## Why do Ecological communities stop at state borders? AusPlots and the need for consistent, national scale, surveillance monitoring.

**Mr Emrys Leitch<sup>1,2</sup>**, Mr Ben Sparrow<sup>1,2</sup>, Ms Christina Macdonald<sup>1,2</sup>, Dr Andrew Tokmakoff<sup>1,2</sup>, Dr Greg Guerin<sup>1,2</sup>, Ms Sally O'Neill<sup>1,2</sup>

<sup>1</sup>Terrestrial Ecosystem Research Network, Adelaide, Australia, <sup>2</sup>School of Biological Sciences and Environment Institute, University of Adelaide, Adelaide, Australia

## Building Relationships Towards Sustainable Development in the Fitzroy Catchment

**Mr Grey Mackay<sup>1</sup>**

<sup>1</sup>Rangelands Nrm, Broome, Australia

## From LSP to ILP and all the acronyms in between—transforming an organisation

**Dr Gaye Mackenzie<sup>1</sup>**

<sup>1</sup>Rangelands Nrm, Como, Australia

## Arid river systems in South Australia - dynamics, change and variability at a landscape scale

**Mr Henry Mancini<sup>1</sup>**

<sup>1</sup>Dept. Environment, Water & Natural Resources, Adelaide, Australia

## From the Ground-Up: Fostering local ownership and building capacity in pastoral communities across the Southern Rangelands of Western Australia

**Mr Kieran Massie<sup>1</sup>**, **Mr Kane Watson<sup>1</sup>**

<sup>1</sup>Rangelands NRM, Como, Australia

## Management of commercially harvested kangaroo species in the rangelands

**Dr Amanda Mclean**<sup>1</sup>, Mr Robert Brandle<sup>1</sup>

<sup>1</sup>*Department Of Environment, Water And Natural Resources, Port Augusta , Australia*

## Transitioning through Learning: Shark Bay Science and Research Centre

**Ms Elisabeth McLellan**<sup>1</sup>, Ms Larissa Lauder<sup>1</sup>

<sup>1</sup>*Bush Heritage Australia, Geraldton , Australia*

## Lessons and best practice of landholder collaboration for landscape-scale conservation and production

Ms Harriet Pfeiffer<sup>2</sup>, Dr Peter Ampt<sup>2</sup>, Dr Alex Baumber<sup>3</sup>, Dr Rebecca Cross<sup>2</sup>, Ms Emily Berry<sup>1</sup>, **Professor Graciela Metternicht**<sup>1</sup>

<sup>1</sup>*School of Biological, Earth and Environmental Sciences, Palaeontology, Geobiology & Earth Archives Research Centre (PANGEA), UNSW Sydney, Sydney, Australia,* <sup>2</sup>*Sydney Institute of Agriculture, School of Life and Environmental Sciences, University of Sydney, SYDNEY, Australia,* <sup>3</sup>*Faculty of Transdisciplinary Innovation, University of Technology Sydney , SYDNEY, Australia*

## “The climate has always been changing”: Perspectives of climate change in far west NSW

**Ms Emily Berry**<sup>1</sup>, **Professor Graciela Metternicht**<sup>1</sup>

<sup>1</sup>*School of Biological, Earth and Environmental Sciences, PANGEA Centre, UNSW, Sydney, Australia*

## Resource Dependent Communities: Optimistic future or inevitable closure? The case of legacy mining towns in Australia’s Bowen Basin

Ms Amanda Fotheringham<sup>1</sup>, **Professor Graciela Metternicht**<sup>1</sup>

<sup>1</sup>*University of New South Wales, School of Biological, Earth and Environmental Sciences, PANGEA Centre, Sydney, Australia*

## Developing online tools to foster cross-property collaboration for environmental action and enterprise options

**Professor GRACIELA METTERNICHT**<sup>1</sup>, Dr Peter Ampt<sup>2</sup>, Dr Alex Baumber<sup>3</sup>, Dr Rebecca Cross<sup>2</sup>, Ms Emily Berry<sup>1</sup>

<sup>1</sup>*University Of New South Wales Australia, Sydney, Australia,* <sup>2</sup>*Sydney Institute of Agriculture, School of Life and Environmental Sciences, University of Sydney, SYDNEY, Australia,* <sup>3</sup>*Faculty of Transdisciplinary Innovation, University of Technology Sydney , SYDNEY, Australia*

## SUCCESSSES AND CHALLENGES OF DELIVERING BROADSCALE ECOLOGICAL RESTORATION, BOUNCEBACK PROGRAM, SOUTH AUSTRALIA

**Ms Trish Mooney**<sup>1</sup>

<sup>1</sup>*Natural Resources Sa Arid Lands, Port Augusta, Australia*



## Harnessing Environmental Markets to Improve Productivity and Ecosystem Resilience in Australian Rangelands

Sinclair Jennifer<sup>1</sup>, Mr Dave Moore<sup>1</sup>

<sup>1</sup>*Greencollar Group, The Rocks, Australia*

## Herbage response to shrub reduction in contrasting land classes in semi-arid woodlands of W NSW

Mr Warren Muller<sup>1</sup>, Dr James Noble<sup>2</sup>, Dr Richard Greene<sup>3</sup>

<sup>1</sup>*CSIRO Land & Water, Canberra, Australia*, <sup>2</sup>*6/23 Evans Street, Mittagong, Australia*, <sup>3</sup>*FSES, ANU, Canberra, Australia*

## Bridging the Divide: Implications of Social Variations Between First- and Multi-Generational Ranchers

Phd Candidate Katherine Munden-Dixon<sup>1</sup>

<sup>1</sup>*University of California, Davis, Davis, United States*

## Kids on Country - Outback Ecology Camps at Witchelina Nature Reserve are providing Aboriginal students with opportunities for further education and employment on traditional lands.

Ms Caroline Nefiodovas<sup>1</sup>, Ms Jacquie Dealtry<sup>2</sup>

<sup>1</sup>*Nature Foundation SA, Hindmarsh, Australia*, <sup>2</sup>*Heathgate Resources, Adelaide, Australia*

## A Natural Partnership - Conservation charity Nature Foundation SA's partnership with industry is having a positive impact on nature conservation in the SA Arid Lands

Caroline Nefiodovas<sup>1</sup>, Mr Alex Nankivell<sup>1</sup>, Dr Marina Louter<sup>2</sup>

<sup>1</sup>*Nature Foundation SA, Adelaide, Australia*, <sup>2</sup>*Flinders University, Adelaide, Australia*

## Can greenies and graziers be friends? Profitable grazing supports reptiles in a tropical savanna rangeland

Mrs Heather Neilly, O'Reagain Peter, Lin Schwarzkopf, Jeremy Vanderwal

## Middleback Station - a pastoral legacy

Andrew Nicolson Snr

## The benefits of avoiding soil organic carbon loss by wind erosion in western NSW

Dr Adrian Chappell<sup>3</sup>, Dr Cathy Waters<sup>2</sup>, Dr Susan Orgill<sup>1</sup>

<sup>1</sup>*NSW Department of Primary Industries, Wagga Wagga, Australia*, <sup>2</sup>*NSW Department of Primary Industries, Trangie, Australia*, <sup>3</sup>*School of Earth and Ocean Sciences, Cardiff University, Cardiff, United Kingdom*

## In search of tropically adapted cattle: does size matter?

Dr Lester Pahl<sup>1</sup>

<sup>1</sup>*Department Of Agriculture And Fisheries Queensland, Toowoomba, Australia*

## “BITEBACK” A MODEL OF COMMUNITY DRIVEN PEST MANAGEMENT IN SOUTH AUSTRALIA

**Mr Greg Patrick**<sup>1</sup>

<sup>1</sup>*Department of Environment, Water & Natural Resources, Port Augusta, Australia*

## Building drought resilient regions: lessons from central western Queensland

**Mr Peter Whip**<sup>2</sup>, **Dr David Phelps**<sup>1</sup>

<sup>1</sup>*Department of Agriculture and Fisheries, Longreach, Australia*, <sup>2</sup>*PRW Agribusiness, Longreach, Australia*

## Cost or quality: How are drones and new technology changing natural resource management?

**Ms Kylie Piper**<sup>1</sup>

<sup>1</sup>*University of Adelaide, , Australia*

## Investigating the value of seasonal climate forecast for beef grazing enterprises: Charters Towers case study

**Dr Kate Reardon-Smith**<sup>1</sup>, Dr Duc-Anh An-Vo<sup>1</sup>, A/Prof Shahbaz Mushtaq<sup>1</sup>, Mr David Cobon<sup>1</sup>, Dr Shreevatsa Kodur<sup>2</sup>

<sup>1</sup>*International Centre For Applied Climate Sciences, University of Southern Queensland, Toowoomba, Australia*,

<sup>2</sup>*Institute for Agriculture and the Environment (Research), University of Southern Queensland, Toowoomba, Australia*

## The Western Australian Rangelands Roundtable

**Mr Rodney Safstrom**<sup>1</sup>

<sup>1</sup>*Department Of Agriculture And Food, Western Australia, South Perth, Australia*

## 'Pass the Parcel' - How petroleum companies are avoiding their rehabilitation responsibilities in Far SW Queensland.

**Dr Rob Savory**<sup>1</sup>

<sup>1</sup>*RSES, McCracken, Australia*

## TERN AusCover: Delivering Imagery and Services to Industry and Landholders in the Rangelands

**Dr Peter Scarth**<sup>1,3,5</sup>, Dr Andre (Alex) Held<sup>4,5</sup>, Dr Bek Christensen<sup>5,3</sup>, Prof Stuart Phinn<sup>1,3,5</sup>, Prof Graciela Metternicht<sup>2,5</sup>

<sup>1</sup>*Joint Remote Sensing Research Program, St Lucia, Australia*, <sup>2</sup>*University of New South Wales, Kensington, Australia*,

<sup>3</sup>*The University of Queensland, St Lucia, Australia*, <sup>4</sup>*CSIRO, Canberra, Australia*, <sup>5</sup>*TERN Auscover, St Lucia, Australia*

## Utility of Integrated Monitoring for an Evidence Based Approach to Rangeland Management in the Northern Territory

**Dr Andrew Scott**<sup>1</sup>, Mr Cameron Wallace<sup>1</sup>, Mr Laurie Tait<sup>1</sup>, Dr Henry Brink<sup>1</sup>, Mr Jason Barnetson<sup>1,2</sup>

<sup>1</sup>*Department Of Environment And Natural Resources, Alice Springs, Australia*, <sup>2</sup>*Joint Remote Sensing Research Program and the Remote Sensing Research Centre at the University of Queensland, Brisbane, Australia*

Buffel busting: pasture composition after 33 years of *Cenchrus ciliaris* removal in central Queensland rangelands

Dr Jen Silcock<sup>1</sup>, Mr Russell Fairfax<sup>2</sup>, Mr Ian Hoch<sup>2</sup>

<sup>1</sup>University Of Queensland, Brisbane, Australia, <sup>2</sup>Kerand Station, Alpha, Australia

Managing risk in Australian Rangelands in a Transitioning Landscape and Climate

Rachael Nolan<sup>2</sup>, Dr Jennifer Sinclair<sup>1</sup>

<sup>1</sup>Greencollar Group, The Rocks, Australia, <sup>2</sup>University Technology Sydney, Sydney, Australia

Social acceptability of feral animal and native herbivore management in meeting TGP targets

Dr Katrina Sinclair<sup>1,2</sup>, Dr Ron Hacker<sup>3</sup>, Dr Allan Curtis<sup>2</sup>, Ms Trudie Atkinson<sup>4</sup>

<sup>1</sup>NSW Department of Primary Industries, Wollongbar, Australia, <sup>2</sup>Graham Centre for Agricultural Innovation, Charles Sturt University, Wagga Wagga, Australia, <sup>3</sup>Ron Hacker Rangeland Consulting Services, Tenambit, Australia, <sup>4</sup>NSW Department of Primary Industries, Trangie, Australia

Koonamore: the TGB Osborn Vegetation Reserve; 90 years of change recorded

Dr Russell Sinclair<sup>1</sup>, Dr Jose Facelli<sup>1</sup>

<sup>1</sup>The University Of Adelaide, Adelaide, Australia

Monitoring in the Australian Rangelands: Where we've come from and where we should be headed.

Mr Ben Sparrow<sup>1</sup>

<sup>1</sup>TERN, School of Biological Sciences, Faculty of Sciences, The University of Adelaide, Adelaide, Australia

Transformative rangeland futures: narratives and learning

Dr Mark Stafford Smith

Rainfall and pasture information to communicate the risk of long-term drought sequences and climate awareness

Mr Grant Stone<sup>1</sup>, Mr David Ahrens<sup>1</sup>, Mr John Carter<sup>1</sup>, Mr Greg McKeon<sup>1</sup>

<sup>1</sup>Department Of Science, Information Technology And Innovation, Brisbane, Australia

The Leigh Creek Transition: Moving from Closed Town to Regional Hub

Mr Mark Sutton<sup>1</sup>

<sup>1</sup>Outback Communities Authority, Port Augusta, Australia

Shot gun Farming in the Rangelands

Mr Ray Thompson<sup>1</sup>

<sup>1</sup>Central West Local Land Services, Nyngan, Australia

## 20 Years of Ecosystem Restoration at Arid Recovery: successes, challenges and the future

**Dr Katherine Tuft**<sup>1</sup>, Katherine Moseby, John Read

<sup>1</sup>*Arid Recovery, Roxby Downs, Australia*

## How much does a cow eat? A billion dollar question for northern Australian development

**Dr Dionne Walsh**<sup>1</sup>, Mr Ian McLean<sup>2</sup>, Dr Steven Bray<sup>3</sup>, Dr Shane Blakeley

<sup>1</sup>*NT Department Of Primary Industry & Resources, Darwin, Australia*, <sup>2</sup>*Bush Agribusiness Pty Ltd, Withcott, Australia*, <sup>3</sup>*Qld Department of Agriculture & Fisheries, Rockhampton, Australia*

## Addressing feed supply and demand through total grazing pressure management in southern Australian rangelands: key issues and opportunities

Dr Cathleen Waters<sup>1</sup>, **Dr Dean Revell**<sup>2</sup>, Mr Kieran Massie<sup>3</sup>, Mr Russell Grant<sup>4</sup>, Dr Lester Pahl<sup>5</sup>, Dr Jodie Reseigh<sup>6</sup>, Ms Trudie Atkinson<sup>1</sup>

<sup>1</sup>*NSW Department of Primary Industries, Trangie, Australia*, <sup>2</sup>*Revell Science, Duncraig, Australia*, <sup>3</sup>*Rangelands NRM, Perth, Australia*, <sup>4</sup>*Local Land Service Western Region, Cobar, Australia*, <sup>5</sup>*Department of Agriculture and Fisheries, Toowoomba, Australia*, <sup>6</sup>*Rural solutions, Adelaide, Australia*, <sup>7</sup>*NSW Department of Primary Industries, Trangie, Australia*

## Assessing the impacts and opportunities from carbon farming in western NSW

**Dr Cathleen Waters**<sup>1</sup>, Dr Annette Cowie<sup>2</sup>, Dr Susan Orgill<sup>3</sup>, Ms Fiona Garland<sup>4</sup>, Dr Marja Simpson<sup>5</sup>, Dr Adrian Chappell<sup>6</sup>, Dr Keryn Paul<sup>7</sup>, Dr Geoff Cockfield<sup>8</sup>, Mr Russell Grant<sup>9</sup>

<sup>1</sup>*NSW Department Of Primary Industries, Trangie, Australia*, <sup>2</sup>*NSW Department of Primary Industries, 2351, Armidale, Australia*, <sup>3</sup>*NSW Department of Primary Industries, Wagga Wagga, Australia*, <sup>4</sup>*Local Land Service Western Region, Bourke NSW, Australia*, <sup>5</sup>*NSW Department of Primary Industries, Orange, Australia*, <sup>6</sup>*School of Earth and Ocean Sciences, Cardiff University, Cardiff, United Kingdom*, <sup>7</sup>*CSIRO, Canberra, Australia*, <sup>8</sup>*University of Southern Queensland, Toowoomba, Australia*, <sup>9</sup>*Local Land Service Western Region, Cobar, Australia*

## Determining the scale of the opportunity for agricultural and water resource development in northern Australia

**Dr Ian Watson**<sup>1</sup>, Dr Cuan Petheram<sup>1</sup>, Dr Chris Chilcott<sup>1</sup>, Dr Andrew Ash<sup>1</sup>, Dr Peter Stone<sup>1</sup>

<sup>1</sup>*Csiro, Townsville, Australia*

## Ecosystem drivers in rangelands; perceptions of drought and climate change

**Associate Professor Ralph D.B. (Wal) Whalley**<sup>1</sup>

<sup>1</sup>*University Of New England, Armidale, Australia*

## Overview of the National Burning Project

**Simon Wicks**<sup>2</sup>

<sup>1</sup>*AFAC, Melbourne, Australia*, <sup>2</sup>*Department of Environment Water and Natural Resources, Adelaide, Australia*

## Growing Sustainably: The Physical and Social Capital of Pastoralism in South Australia

**Mrs Jackie Williams**

The Accidental Counselor: more to beef extension officers than technical advice

**Mrs Megan Willis**<sup>1</sup>

<sup>1</sup>*Department Of Agriculture And Fisheries, Charters Towers, Australia*

Pastoralists as conservation providers - a new stewardship incentive mechanism for the South Australian rangelands.

**Mr Andrew Willson**<sup>1</sup>

<sup>1</sup>*Department of Environment, Water and Natural Resources, Adelaide, Australia*

# Key landscape function indicators determined using hyperspectral reflectance in southern Queensland grasslands

Dr Wendy Williams<sup>1</sup>, Dr Armando Apan<sup>2</sup>, **Mr Bruce Alchin<sup>1</sup>**

<sup>1</sup>University of Queensland, Gatton, Australia, <sup>2</sup>University of Southern Queensland, Toowoomba, Australia

## **Biography:**

*Bruce Alchin has over 40 years experience in rangelands including research, education and advisory roles. This has involved work with the Soil Conservation Service and Western Land Commission in NSW and the University of Qld (including the Rangelands Australia Centre). He has also run his own rangeland management consultancy service for 25 years.*

Multispectral measurements (e.g. Landsat) have been the conventional approach to remote assessment of rangelands. The availability of hyperspectral images at an acceptable cost to land managers has the potential to greatly enhance the delineation of ecosystem components.

The aim of this study was to assess key landscape function indices to examine their correlation with hyperspectral reflectance measurements. Four land cover types (native pasture, biocrust with native pasture, biocrust only, bare degraded soil) were analysed for landscape function indices (viz. stability, infiltration and nutrient cycling). Landscape Function Analysis (LFA) data were collected from quadrat (50 x 50 cm) and sub-quadrat (10 x 10 cm) levels, under wet and dry conditions. Hyperspectral data were collected from the quadrats with a hand-held device.

There was moderate to high accuracy of prediction for the LFA data indicators using hyperspectral data. Under both dry and wet conditions, overall quadrat spectral measurements for LFA indicator 'nutrients' produced models that had a lower prediction accuracy than sub-quadrats.

Under dry conditions, sub-quadrat regression correlations were 0.838 to 0.864 between the predicted (model) and measured (observed) values. LFA indicators in the quadrats were slightly lower in predictive ability of reflectance data compared to the sub-quadrats.

Under wet conditions, sub-quadrat prediction accuracy improved for the same LFA indicators (correlations were 0.844 to 0.877). For the quadrats, the prediction model for 'infiltration' (wet) was more accurate (83.0%) than dry (79.3%).

The LFA indicators were modelled accurately by hyperspectral reflectance of land cover features and the results indicate hyperspectral data may provide valuable support for land managers. Over the next two years new satellites will provide hyperspectral imagery. The data from this research will be used to take land management to the next level with the application of hyperspectral imagery to more accurately define land condition.

# The use of DNA metabarcoding to study diet section in sheep

Dr. Yohannes Alemseged<sup>1</sup>, Dr. Andrew Mitchell<sup>2</sup>

<sup>1</sup>New South Wales Department of Primary Industries, Trangie, Australia, <sup>2</sup>Australian Museum Research Institute, Australian Museum, Sydney, Australia

## **Biography:**

*Yohannes Alemseged is Rangelands Research Officer (NSW Department of Primary Industries, Trangie) with 15 years' experience in rangeland research. He has BSc. in Agriculture (AA University), MAppSc. in Arid land management (UNSW) and PhD. in pasture agronomy and ecology (UNSW). His work has focussed on managing natural resources in the semi-arid rangelands, including: managing climate variability and developing stocking decision tools, controlling invasive native scrub (INS) and regeneration of native perennial grasses, evaluating the impact of grazing management on ground cover, developing grazing management strategies for non-traditional sheep breeds and rangeland goats and understanding the influence of grazing pressure changes on soil organic carbon.*

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Australian Museum Research Institute, Australian Museum, 6 College Street, Sydney, NSW 2010, Australia

Reports indicate that potential differences exist in diet selection and grazing behavior between Merino and Dorper sheep in that Merinos do travel longer distance to find food than Dorpers. Moreover, it is suggested Dorper sheep select diet containing about 90% of the available feed in a given area, while Merino sheep select only between 60 and 65%. The diets of Dorper and Merino sheep, grazing in adjacent paddocks, were compared using a DNA metabarcoding approach. The method combines DNA based identification (DNA barcoding) and high-throughput DNA sequencing to determine the DNA sequences present in dung samples. Twenty four Dorper and Merino dung samples had fragments of the *rbcl* and *ITS2* gene sequenced. After undertaking quality control on the over 1.1 million sequences, 20-100 unique haplotypes per sample were obtained. In total 90 species were identified; but many sequences could not be exactly matched to one plant species because either insufficient resolving power or no exact match in the Barcode of Life Data system (BOLD) was found. However there were more species found in Dorper dung (26) than in Merino dung (15). At family-level identification was possible for all sequences recovered from all samples and Dorper dung contained six plant families not found in Merino dung while no families were unique to Merino dung. The study confirmed that Dorpers are the more generalist feeders than Merinos.

## Building grazer capacity in sustainable management of grazing lands in the Southern Gulf.

Ms Anne Alison<sup>1</sup>, Ms Shari Rankin<sup>1</sup>, Mr Andrew Maclean<sup>1</sup>

<sup>1</sup>*Southern Gulf NRM, Mount Isa, Australia*

### **Biography:**

Anne Alison, with a life-long involvement in the beef industry, has a passion for agriculture and how it can complement excellent natural resource management. After a childhood spent on a dairy/beef farm, she worked within the beef industry in both corporate and private sectors, including thirteen years in the northern Australia pastoral industry. Anne has also managed a national second-tier grain co-operative, establishing value-added export markets in Japan; and convened Grains Research Expos.

Anne has managed natural resource management projects for Capricornia Catchments, a sub-region of Fitzroy Basin Association, Central Queensland; Barkly Landcare, Northern Territory; and most recently Southern Gulf NRM, Queensland. Her NRM volunteer roles include being foundation member, initiator or member of: Landcare groups in three states; regional Landcare committees; NSW Farming for the Future State Advisory Committee; inaugural chair of a NSW Regional Vegetation committee; and has convened conservation farming field days/expos.

The sustainability of a rangeland's native pasture resource is critical to the environment and the ability of the northern pastoral industry to thrive. A healthy pasture base protects soil and water and recovers more quickly from drought. It yields an economic dividend, with the carrying capacity of good condition pastures much higher than degraded pastures.

Healthy, productive and resilient grazing lands in Queensland's Southern Gulf region are being supported by an integrated program, Pasture Partners, funded by the Australian Government, and involving collaboration with the Futurebeef team in the Queensland Department of Agriculture and Fisheries.

The project aims to promote and increase adoption rates of grazing land best practice management in the region through: demonstration of grazing land best management practices; testing of innovative tools and practices (such as utilising the Stocktake Plus app); customisation of relevant research and extension methods for the Southern Gulf; support for graziers to understand existing resource condition and develop management strategies to address these; and skills and capacity building activities.

Pasture Partners is supporting graziers to establish monitoring sites to systematically monitor the condition of their land using the Land Condition Guide published by Southern Gulf NRM during 2016. The Guide draws upon many years of research and practical experience in the cattle industry and Queensland agriculture research, providing a simple way of consistently assessing pasture condition. It allows graziers to track land condition over time and to benchmark their pastures with others in the region.

The data provided by the monitoring sites across the Southern Gulf region is providing information about current land condition and guide future investment and activities, from paddock level through to a regional level.

Pasture Partners encourages graziers to adopt established grazing land best management practices and have beneficial outcomes for the rangeland environment and the grazing industry.



# Site Selection of *Melica persica* for Rangeland Improvement by AHP and GIS (Mahidasht Sanjabi Basin, Kermanshah Province, Iran)

Dr. Ali Ariapour<sup>1</sup>, Mr. Moslem Hadidi<sup>2</sup>, Miss Elahe Karami<sup>3</sup>

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## **Biography:**

*He is editor-in-chief of Rangeland Journal from 2008 till now. Also director-in-chief of IAUB Press form 2008 till now. He is Member of the board of directors of Iranian Range Management Society. He is former member of the Society of Range Management, USA. He is author/co-author of 9 books, 10 projects, 39 journal articles, 65 national and international conference paper as oral and poster presentation in some country include: China, India, Japan, Italy, Indonesia, Thailand, Romania, Singapore, Malaysia, Philippine. 42 and 38 MSc. Thesis supported by him as supervisor and advisor respectively. He was awarded the 2011 national Award for writing a book about Medicinal, Industrial and Aromatic Plants of Rangeland and Forest. In some years was awarded the Award by the university. He spent sabbatical opportunity in UPM Malaysia for six month in GIS and RS section.*

Site selection based on suitability is difficult according to many factors in nature. Site selection exactly, fast and low cost for rangeland improvement by some species by new technique such as RS and GIS is very important. Increasing of palatable species for livestock is one of the rangeland improvement aims. Seedling, to sow shrub or sowing of palatable species need to fit places in rangeland based on their ecological needs such as; climatic, edaphic and topographic factors. Integration of Analytical Hieratical Process (AHP) and GIS can help to find best, quick and cheapest ways for selection of area to improvement by I classes plants. Attentive to native *Melica persica* and create a type of plants in the Mahidasht Sanjabi basin and also palatable class one as a decrease species, this study was conducted to find a good place to propagate in 2014. The Mahidasht Sanjabi rangeland under study is located in Kermanshah and Javanrod township city in Kermanshah province (46° 21' 55" to 47° 22' 20" E and 34° 00' 20" to 34° 53' 25" N) comprises of 269900-hectares of which 46.06% of sub basin Gharasoo that it is 11.04 percent (579350-hectares) of Karkhe basin too. Result show that suitability categories of region fall in four main sections that most of the area is not suite to growth of the specie. Suitability revealed that 32396.59 hectares (12.10%) was classified in the S1 suitability category, 53597 hectares (20.02%) in S2, 86736.5 (32.39%) in S3 and 268262 hectares (99.39%) was placed in non-suitability (NS) category. This research pointed out that most of the region is not suite to growth the species.

# Investigation of Chemical Essential Oil Components of *Thymus Kotschyanus* in Zagheh Area (Lorestan Province)

Dr. Ali Ariapour<sup>1</sup>, Miss Elahe Karami<sup>2</sup>, Mr. Amir Heidari Jamshidi<sup>3</sup>

<sup>1</sup>Department Of Natural Resources, College Of Range Management, Boroujerd Branch, Islamic Azad University, Boroujerd, Boroujerd, Iran, <sup>2</sup>Department of Rangeland Management, Young Researchers Club, Boroujerd Branch, Islamic Azad University, Boroujerd, Iran, <sup>3</sup>Senior Expert of Cultivation and Crop Breeding, Jihade Agriculture Organization, Khorramabad, Iran

## **Biography:**

*Dr Ali Ariapour is an Iranian who as young man studied range and watershed management culminating in a Bachelor of Science degree. He has a PhD in Rangeland Science from IA University, Science and Research Branch, Iran. He is editor-in-chief of Journal of Rangeland Science from 2008 until now and also director-in-chief of IAUB Press since 2008. He is Member of the board of directors of Iranian Range Management Society and a former member of the Society of Range Management, USA. Aromatic Plants of Rangeland and Forest. In some years was recognized with an Award by the university.*

The flora of the Middle East is estimated at 15,000 species. The use of medicinal and aromatic plants, herbs and species in the region has a long history and forms an important part of a number of cultures. Traditional medicine still plays a major role in health care systems, despite the availability of modern medicine (Heywood, 1999). Medicinal and aromatic plants constitute the basis of primary health care for the majority of the population in Asia and are a critical source of income for rural populations. The book, Canon of Medicine (Al-Ghanoon) by Avicenna has been used by the European scientific community for more than 600 years. The works of Avicenna and Razes, another famous scientist have been translated into various languages (Mosaddegh and Naghibi, 2003). Lamiaceae family has about 200 genuses and 4000 species, of which one is *Thymus*. The majority species in the family have essence and uses for medicinal, nutritional, toiletry and health industry purposes. The genus includes many species in Iran. According to components retention volume, retention time, Kovats retention index and mass spectrum and comparing those to standard components results show that there are 52 components in essence that formed 78/87% of all essences. Most of the components in the species were Thymol (32/77%), Gamma-terpinene (8/43%), Carvacrol (5/61%), Borneol (4/35%) and Cynol (4/35%). Researchers in previous studies have previously pointed out that weather is one of the most important affecting to essential oil in medicinal plants, this study has confirmed this. Weather can change number of components and percent of each components of essence in different species, because each species growth in different environmental factors which cause on number of endocrine glands in lower and upper of leaves.

## Monitoring trends in grazing pressure at a regional scale

Ms Trudie Atkinson<sup>1</sup>, Mr Warren Smith<sup>1</sup>

<sup>1</sup>NSW Department of Primary Industries, Trangie, Australia

### **Biography:**

Trudie Atkinson Employed by NSW DPI, Development Officer (Slopes & Rangelands)

Trudie is a specialist with more than 15 years' experience in the management of livestock and the natural resource base in rangeland contexts. She has a strong interest in working with extensive livestock industries and their producers to implement current best practices that deliver productivity and resource condition outcomes. She has established relationships with the extensive livestock industries and their producers. Trudie has coordinated the establishment and management of large-scale participatory research sites that demonstrate the benefits of adopting TGP management practices. She has delivered Tactical Grazing Management training to more than 150 rangeland producers. Her expertise is recognised by her continued funding to facilitate producers groups in a co-learning environment that has successfully led to changes in management practice.

Managing total grazing pressure (TGP) requires an understanding of changes in the densities of populations of managed domestic livestock and unmanaged native and feral herbivores at a regional scale to enable adaptive management. While livestock numbers are routinely collected by industry and trends in kangaroo populations assessed largely for conservation purposes there is limited information on the combination of this data, which represents a gap in our ability to assess regional trends. Information about regional TGP trends will inform property scale grazing management and investment into TGP management practices. In addition, it will also inform policy decisions and investment in TGP management incentive programs, including those aimed at achieving regional ground cover targets.

This paper provides a combined assessment of aggregated changes in grazing pressure from sheep, cattle, goats and kangaroos in western NSW. For the period 2006-2016, annual population numbers for each of the four species are reported and the data analysed to describe the nature and extent of the changes in populations. Trends have been classified as stationary or non-stationary and the direction of change as increasing or decreasing. The results are reported for key bioregions, which experience varying influences on grazing pressure, to enable a comparison between sub regions. The identified trends and changes in grazing pressure are discussed providing insights into current regional TGP and the management challenges that need to be faced.

# Connect. Coordinate. Deliver: Transforming and rebranding Rangelands NRM

**Ms Teresa Belcher<sup>1</sup>**

<sup>1</sup>Rangelands Nrm, Como, Australia

## **Biography:**

*Teresa is a science communicator with over 20 years' experience communicating science and engineering research and projects. Her initial university qualifications are biology, environmental science and environmental management, supplemented by a Masters in scientific communication from the ANU. Since 2010, she's been back living in her hometown of Perth, after working in Canberra, Switzerland and the UK for 17 years. Teresa has a wide range of experience in corporate communication, public relations, journalism, web design and maintenance, new media, event management and training in both the public and private sectors. Her current role is the Communications Manager for Rangelands NRM, which allows her to combine her background and interest in the environment with her skills in communicating.*

Over the past three years, Rangelands NRM has transitioned from its role in delivering localised environmental projects and building individual land management capacity to holistic (triple-bottom-line) coordinated programs. We are increasingly being valued for our unique position as a neutral facilitator in the WA rangelands region.

To make any kind of difference working in the expansive WA rangelands, we need to think landscape-scale. And, if we work together, we can achieve better results.

Everyone ultimately has the same problems, but maybe different ways or ideas on how to deal with them. If we get people together to talk about this, and agree on key things that need to be worked on and the approach, then we have a better chance at making a difference.

This poster outlines the new Rangelands NRM philosophy of Connect > Coordinate > Deliver.

As a 'backbone' organisation, Rangelands NRM helps maintain overall strategic coherence and coordinates and manages the day-to-day operations and implementation of work, including stakeholder engagement, communications, data collection and analysis, and other responsibilities.

Rangelands NRM is a not-for-profit, non-political and neutral organisation working towards better WA rangelands. We connect people and projects so that real solutions can develop. We coordinate effort and resources so that the maximum results are achieved on the ground. We work with organisations to deliver on ground results. We believe if we work together, we can achieve better results.

## A new way to look at leucaena in rangelands.

Dr Terry Beutel<sup>1</sup>, Ms Debra Corbet<sup>1</sup>, Ms Madonna Hoffman<sup>1</sup>, Mr Stuart Buck<sup>1</sup>

<sup>1</sup>DAF, Rockhampton, Australia

Lightning Session 2, Central Oval - Gibber Room, September 28, 2017, 11:10 AM - 12:30 PM

### **Biography:**

*Terry Beutel has worked in the Australian Rangelands for 25 years, chasing lizards, pitfall trapping ants and growing out soil cores, before he saw the light and realised that satellite data was delivered right to his desk. He has worked with the Queensland Department of Agriculture and Fisheries since 2001 on a range of projects, but largely focused on the use of remote sensing products to inform rangeland stakeholders about the state of their landscape.*

Leucaena is a forage crop with demonstrated potential to dramatically improve beef production across substantial parts of the world's grazing lands. This study documents a novel approach to quantify cultivated rangeland leucaena coverage across 350 000 km<sup>2</sup> of Queensland's primary leucaena growing area. The method uses high resolution aerial and satellite imagery, can provide efficient estimates of total leucaena coverage, and also supports other analyses such as comparison of actual with potential distribution, and estimation of the statistical power of the sample size.

While no prior estimate of leucaena coverage has focused on exactly the same area used in this study, our estimate (123 500 ± 31 200 Ha) appears substantially lower than previous efforts based on similar areas. However, this is the most in depth study to date on the topic, and additional validation during the survey suggests the method is unlikely to overlook leucaena where it is actually present. On this basis, it seems likely that there is less cultivated rangeland leucaena than previously thought in Queensland and Australia.

# VegMachine.net. Online land cover analysis for the rangelands.

Dr Terry Beutel<sup>1</sup>, Ms Rebecca Trevithick<sup>2</sup>, Dr Peter Scarth<sup>2</sup>, Mr Dan Tindall<sup>2</sup>

<sup>1</sup>DAF, Rockhampton, Australia, <sup>2</sup>DSITI, Brisbane, Australia

Monitoring after ACRIS, Central Oval - Spinifex Room, September 28, 2017, 1:30 PM - 3:30 PM

## **Biography:**

*Terry Beutel has worked in the Australian Rangelands for 25 years, chasing lizards, pitfall trapping ants and growing out soil cores, before he saw the light and realised that satellite data was delivered right to his desk. He has worked with the Queensland Department of Agriculture and Fisheries since 2001 on a range of projects, but largely focused on the use of remote sensing products to inform rangeland stakeholders about the state of their landscape.*

VegMachine.net is an online land cover monitoring tool funded by the Fitzroy Basin Association (FBA). The tool focuses primarily on Queensland, but has functionality for much of Australia's rangelands. The website went live in July 2016 and recently logged the 1000th user session. Users can view seven different seasonal time series of cover products across the landscape and interactively interrogate and graph ground cover change in six different on-the-fly and email delivered reports. Results can then be exported for use in other software.

To date, users have generated over 400 VegMachine® FORAGE ground cover reports which provide paddock-by-paddock, landtype-by-landtype analysis of ground cover change from 1990 to the present. Detailed help is available in multiple formats, including website popups and a dedicated YouTube channel. The web application was designed for two main user groups; technically equipped RD&E personnel including those servicing land manager clients, and a subset of the grazier community willing to operate the service themselves. Initial rollout of the application focused primarily on training events for government agency, private consultancy and natural resource management (NRM) staff in regional Queensland. These users form the core of the current user base.

In this paper, we outline the development of VegMachine.net. We demonstrate the primary functionality of the website, provide an overview of user experience including a case study and discuss major learnings and future directions.

# Northern Australia: the new frontier

Luke Bowen<sup>1</sup>

*Northern Australia Development & Trade, Darwin NT 0801*

Australia's North is close to 50% of the continent's landmass yet it holds only 5% of the population. Northern Australia sits within a sphere capturing half the world's population and an increasing share of the economic and strategic power. Almost all of the entire Northern Australia region is rangeland therefore the rangelands are at the heart of our nation's connection with this dynamic region.

It is fair to say that for most Australians, the North is somewhat of a mystery; with prevailing knowledge perhaps informed by the front pages of newspapers, tourism ads and the odd current affairs program focussed on the latest contentious or sensitive issue. Unfortunately much of what is perceived and known bares little relationship to the reality - a fact not aided by the slim representation from Northern Australia in our national parliament.

It is clear that the accepted time scale for human habitation in Australia and Northern Australia keeps getting pushed back, by 15,000 years most recently. What a fascinating time lapse it would be to see the last 65,000 years roll out on the big screen!

While it may be interesting to reflect on what we think it may have been like once upon a time and debate the pros and cons of the impacts of the last 150 odd years, the challenges and opportunities of today cannot be isolated and siloed. The rangelands of Northern Australia must be viewed within the wider national and international context, including the role Northern Australia will play in the future prosperity and security of our nation.

# Buffel Grass Management in Indigenous Communities of the Alinytjara Wilurara Natural Resources Management Region and Great Victoria Desert.

Mr Troy Bowman<sup>1</sup>, Mrs Samantha Doudle<sup>2</sup>, Mrs Ellen Ryan-Colton<sup>3</sup>

<sup>1</sup>Natural Resources Alinytjara Wilurara , Ceduna, Australia, <sup>2</sup>Spinifex Land Management, TjunTjunjara, Australia, <sup>3</sup>Anangu Pitjantjatjara Yankunytjatjara Land Management, Umuwa, Australia

## **Biography:**

*Following completion of a Bachelor of Environmental Management in 2004, Troy has gained extensive project management and practical experience in carrying out surveillance and control of a variety of pest plants and animals in agricultural and environmental systems.*

*Most recently, Troy managed a three year project funded by the Native Vegetation Council as the South Australian buffel grass operations coordinator. Key components of the project included the design and implementation of field trial and demonstrations sites, development of a best practice management guide, set-up and coordination of a strategic response team, delivery of annual roadside surveys, identification of priority infestations for control and provision of technical advice to a variety of local and interstate stakeholders.*

*Currently Troy works on various projects as an NRM/Biosecurity Consultant with Rural Solutions SA and Coordinates Buffel Grass Management in the Alinytjara Wilurara Natural Resources Management Region.*

Buffel grass has been recognised as one of the greatest threats to biodiversity in South Australia's arid and semi-arid rangelands. It has the capacity to transform ecosystems through habitat loss, competition with native plants and alteration of natural fire regimes. Buffel grass is increasingly impacting on the culture, health and safety of Indigenous communities and new approaches to the management of this devastating weed are being employed.

Advances gained from South Australian research and development have resulted in the application of new control options, increasing the efficiency and effectiveness of herbicide application. The emergence of new technologies has resulted in the use of drones and user friendly platforms for the mapping of buffel grass infestations in Indigenous communities and throughout SA's arid rangelands.

Building the capacity of Indigenous communities through both formal and informal training is a key focus of the Alinytjara Wilurara Natural Resources Management Board. Anangu Pitjantjatjara Yankunytjatjara Land Management and Spinifex Land Management. Training provided includes the use of herbicides, mapping equipment and a range of other land management tools, with a southern desert ranger forum planned in 2017 to provide an opportunity for indigenous rangers from SA, NT and WA to learn from the experiences of fellow rangers and traditional owners.

In addition, 'healthy country planning' is being used to develop achievable management objectives for a range of cultural and environmental issue, such as weed management. This planning process has a strong emphasis on traditional owner engagement.

A focus on building the capacity of Indigenous communities has seen a changing face of Indigenous managed lands. New and innovative ways of effectively managing buffel grass are being employed to improve the condition of country and manage the threats posed to the environment and culture in Australia's rangelands.



## Assessing land condition in a bi-polar landscape

Mr Robert Brandle<sup>1</sup>, Mr Gavin Baird<sup>1</sup>, Mr Augie Facelli<sup>1</sup>, Mr John Maconochie<sup>1</sup>, Mr David Oag<sup>1</sup>, Mr Jeff Stringer<sup>1</sup>

<sup>1</sup>Natural Resources, SA Arid Lands, Department Of Environment, Water And Natural Resources, Port Augusta, Australia

Monitoring after ACRIS, Central Oval - Spinifex Room, September 28, 2017, 1:30 PM - 3:30 PM

### **Biography:**

*Rob currently works as Manager, Scientific Services for the Natural Resources, SA Arid Lands region based in Port Augusta. This role provides scientific support and advice to the Pastoral Management, Biosecurity, Kangaroo Management, Sustainable Industries, Public Land Management and Community Engagement Programs in the region. He has over 25 years experience in wildlife research and biological surveys, often involving the South Australian arid ecosystems. More recently he has focussed on developing methods to assess and monitor management effectiveness and the impacts of native and feral herbivores on native vegetation resources.*

Reliable assessment of resource condition is a critical tool for managing and regulating the sustainable use of biological resources in the rangelands. Accepted approaches rely on comparisons with real or conceptual benchmarks characterised by low levels of disturbance. This approach works well in areas and systems that have been intensively studied and show predictable patterns of response to the important drivers of change. Where these factors are consistent, simple to measure indicators that reliably track change can be used as surrogates for the system, some of which can be scaled up and monitored using remote sensing.

Problems with these approaches for resource condition regulators arise for the following reasons:

1. resourcing to obtain the knowledge and understanding needed to define benchmarks and their condition indicators for all the land systems and component vegetation communities;
2. historic damage that has transitioned areas into irreversibly degraded condition states that are unlikely to return to benchmark states without expensive reconstruction;
3. unpredictable dynamic (bi-polar) landscapes that make useful benchmarks impossible to define, which is the case for most arid vegetation communities where the presence and abundance of even the long-lived species at any location can vary significantly in response to climate cycles.

To overcome these issues, the South Australian Pastoral Unit is developing a non-benchmark reliant, rapid assessment method that focuses on the herbivore utilisation of longer-lived perennial shrubs and trees, their age structure and relative palatability. All data, including physical disturbance indicators and site descriptors are collected within a 10-minute sample period to enable multiple sites to be sampled across a pastoral lease. Data collection can be interpreted by non-scientists and a site frequency approach to data analysis enables data to be logically presented.

# Pasture biomass: a common solution for grazing profitability, carbon and drought resilience

Dr Steven Bray<sup>1</sup>, Dr David Phelps<sup>2</sup>

<sup>1</sup>Department Of Agriculture And Fisheries Queensland, Rockhampton, Australia, <sup>2</sup>Department Of Agriculture And Fisheries Queensland, Longreach, Australia

Lightning Session 2, Central Oval - Gibber Room, September 28, 2017, 11:10 AM - 12:30 PM

## **Biography:**

*Based in Rockhampton, Steven undertakes applied research and supports extension in the grazing industry of northern Australia. Steven research has included linking together business profitability with pasture condition and management, carbon and greenhouse gas emissions.*

Many issues impact the sustainability and profitability of extensive grazing industries and the associated environment. The magnitude of the impacts result in State and Territory, National and global policy responses. Four current issues generating a significant policy response include:

- Pastoral profitability and business debt servicing
- Drought resilience
- Off-property water quality (Great Barrier Reef and other inland waterways)
- Carbon and greenhouse gas emissions.

A potential common solution for these policy issues is retaining pasture biomass, particularly in northern Australian grazing land with persistently low ground cover and low pasture biomass.

A Mitchell grasslands case study was used to assess the implications of improved grazing management. Mitchell grasslands cover over 40 million ha in Queensland and the Northern Territory. Data was examined from the Toorak grazing trial which operated for 26 years (Orr and Phelps 2013).

On average across highly variable seasons, the sustainably grazed 30%-utilisation paddock had 0.63 t CO<sub>2</sub>e per ha higher carbon stocks than the unsustainable 50%-utilisation paddock. Assuming a property size of 102,000 ha, this equates to an average sequestration 64,260 t CO<sub>2</sub>e per property, or 9,555,000 t CO<sub>2</sub>e for this one bioregion in northern Australia.

30%-utilisation of pasture at the end of summer was sustainable for pasture health, drought resilience and economics. Modelling of financial returns indicated that 50%-utilisation had slightly higher short-term (1-2 year) returns, highlighting a conundrum for business decision making that is focused on 'maximising' short-term grazing income to enable farm-debt repayments.

Could payments to retain biomass based on a sustainable utilisation level induce graziers to achieve multiple co-benefits?

Orr, D.M., and Phelps, D.G. (2013) Impacts of level of utilisation by grazing on an *Astrelba* (Mitchell grass) grassland in north-western Queensland between 1984 and 2010. 1. Herbage mass and population dynamics of *Astrelba* spp. *The Rangeland Journal* 35, 1-15.

# Plans are useless: but Planning is essential. A Warning and a Promise for Northern Development

Mr John Brisbin<sup>1</sup>

<sup>1</sup>Northern Gulf Resource Management Group, Georgetown, Australia, <sup>2</sup>Mitchell River Watershed Management Group, Mareeba, Australia

## **Biography:**

*John is an advocate of planning that connects with a complex world. He arrived in Australia 25 years ago as a political refugee from the United States and has been at the frontiers of distributed knowledge systems ever since. He reached the edge of digital systems in 1999 and started looking for more robust tools for crafting social change. In 2001 he completed a MAppSci in Complex Systems and Organisational Development and immediately put the theories to use as coordination of the Arid Land Environment Centre in Alice Springs. In 2005 he was recruited to the Northern Territory NRM Board as their first Executive Officer and responsible to implementation of the first NRM Plan for the Territory. In 2007 he dipped back into the Semantic Web, and in 2016 was elected as Chair of the Northern Gulf Resource Management Group, centered on Georgetown, Far North QLD.*

Will Northern Development be driven by fake news and alt-right conspiracies?

Civic process internationally is now dominated by actors who claim "there is no alternative" to their chosen worldview. Leaders insist we must make painful trade-offs instead of insisting that we work together to co-create new forms of mutual benefit. And vast segments of reality are privatised. Data is the property of powerful interests who weaponise the facts to support their specific viewpoint.

We think of regional development and national policy in Australia as being immune to virulent strains of coercive power-politics as seen overseas. But listen to a day of Parliamentary sittings and you will find strong evidence that Australia's political and corporate culture is deteriorating rapidly.

Decisions for Northern Development are being taken in this dysfunctional civic context, and we are the worse for it. This paper argues for a planning-centric approach that leverages our strongest collective abilities.

Humans possess an extraordinary capacity to cooperatively manifest new realities. Our innate intelligence can be deployed in our common interest, but to do so will demand a significant maturation of our plan-making processes. Regional Natural Resource Management (NRM) and planning provide a foundation on which to build this discourse.

Planning, the verb, the consensual activity, is the ideal way to achieve fair, just, and healthy development. In the North we have an unprecedented opportunity to realise the benefits of a planning culture. Let's do it.

# The ultimate transition: the role of extension in planning for future generations

**Ms Kate Brown<sup>1</sup>**

<sup>1</sup>*Department of Agriculture and Fisheries, Townsville, Australia*

## ***Biography:***

*Kate Brown has spent the last five years working for the Queensland Department of Agriculture and Fisheries providing extension support to graziers in the Burdekin Rangelands. She provides assistance with many aspects of the beef business but particularly enjoys working in the areas of grazing land management, succession, property planning and adopting new technology.*

A grazing business is a complex system involving several players and often multiple generations. The DAF Grazing BMP and Extension Support project in the Burdekin catchment provides a mechanism to familiarise all members of the business with a multitude of support tools and the opportunity to document learnings for future generations. Despite many graziers undertaking valuable projects to improve their business, property or herd it could also be noted how easy it is to avoid the topic of planning the transition to future generations. After all, failure to plan is planning to fail. Most graziers can tell you about their plans for infrastructure development; so, why plan property improvement, or plan for drought, but fail to plan for transition? Extension support is helping graziers manage their business and meet the needs of the people within the business by starting the succession conversation.

# Effect of vegetation cover type on soil fertility in semi-arid rangelands

**Mr Lukas Chipfupa<sup>1</sup>**

<sup>1</sup>Central University Of Technology, Bloemfontein, South Africa, Bloemfontein, South Africa, <sup>2</sup>Agricultural research Council, Pretoria, South Africa

## **Biography:**

*Mr Lukas Chipfupa was born on the 8th of June 1981 in Zimbabwe. His highest qualification to date is an MSc degree in Agriculture, where he looked at the effect of weather variability on growth potential of Afrikaner cattle breed in Matebeleland South of Zimbabwe. He is currently based in South Africa in Free State province, in a small town called Koffiefontein. He is also currently studying for a PhD qualification looking at rangeland analysis; particularly effects of invasive species on rangeland productivity and soil ecology.*

Effect of vegetation cover type on soil fertility in semi-arid rangelands

Lukas Chipfupa<sup>1</sup>#, Florence V Nherera-Chokuda<sup>2</sup> and Pieter J Fourie<sup>1</sup>

## **Abstract**

Degradation of natural rangelands affect ecosystem services in fragile environments. The creeping prickly pear (*Opuntia humifusa*) is invading the Nama Karoo Biome of the western South Africa and affecting herbaceous plant structures. Species mortality and loss of ephemerals, geophytes, C3 and C4 grasses and chamaephytes due to invasive creepers has effects on soil fertility and net productivity of the rangeland. The aim of the study was to determine the relationship between soil nutrients and associated herbaceous cover in a rangeland invaded by creeping cactus. A rangeland of 400 ha in the semi-arid region of the western South Africa with lime rich soils was stratified based on herbaceous vegetation cover. Treatments were i) creeping cactus (CC) ii) dwarf shrubs (DS) and iii) grass (GR). Three quadrats (25 m x 25 m) were randomly selected per treatment. Within the quadrat, one vegetated subplot and adjacent bare area were selected. Soil samples (0 – 30 cm deep) were randomly collected per subplot. Soils were analyzed for organic matter, C, N, P, K, Ca and Mg using wet soluble extract method. About 50% of rangeland was covered by large old colonies of *O. humifusa*. Grasses covered less than 20% and the rest were dwarf shrubs interspaced by small (<10 cm) cactus colonies and bare ground. Mg, Ca and K differed ( $P < 0.001$ ), creeping cactus (900:223:101 mg/kg), dwarf shrubs (500:195:70 mg/kg) and grass (720:158:55 mg/kg). Soil C was about 3% and did not vary with vegetation cover. Organic matter ranged between 3-6% and was higher under CC. Although *Opuntia* spp. seems to be the major challenge on rangelands, beneficial attributes higher carbon sequestration, soil cover and nutrients are critical in reducing the carbon footprint.

# Decentralisation in Regional Australia: What does it really mean?

Dr Jen Cleary<sup>1</sup>

<sup>1</sup>*Centacare Catholic Family Services Country SA, , Australia*

Regional & Community Development in the Rangelands, Central Oval - Gibber Room, September 28, 2017,  
1:30 PM - 3:30 PM

Amidst change and decline of regional, rural and remote (RRR) communities globally, policy makers have struggled to agree on the nature of policy settings to sustain such communities. In Australia too, regional development policy has long been highly problematic for policy makers (of whatever political persuasion). Various approaches have been tried over the past 100 years with very limited success in driving sustainable economic growth in RRR Australia. As a result, a high level of political risk has come to be associated with regional policy initiatives aimed at redressing decline or promoting socio-economic growth. This in itself, has become an important driver in determining policy approaches to RRR Australia. Australia has tended to look externally for 'tried and true' approaches to regional development as a means of mitigating this risk. For the most part, such approaches have come from the experiences of the Organisation for Economic Co-operation and Development (OECD) countries.

Increasingly, there is a policy trend across OECD countries towards more decentralised, 'localist' approaches to regional development. The expectation is that regions will mobilise local assets and resources with a view to capitalising on specific, localised competitive advantages. Such policies can be seen for example in the European Union Commission's policy stance on smart, sustainable and inclusive economies. Australia has also largely followed this path. The challenge for Australia in adopting such approaches however, is that they are usually not nuanced in terms of our demography, geography, history of settlement patterns or economic base.

A further challenge lies in how the concept of 'decentralisation' itself is understood and subsequently mobilised as policy. For example, recent focus at the national scale has centred on the notion of moving government departments to regional Australia, and this is being termed 'decentralisation.' One could argue that this is a concerted and genuine effort to promote regional growth, by devolving the bureaucracy of government to regional areas where local conditions are better understood and thus decision-making could be more effective. Conversely, a counter argument could be made that 'localism' 'decentralisation' and the like, are simply a mechanism through which political risk can be effectively devolved and thus managed. Put succinctly, if local people, acting in a representative fashion, make their own strategic decisions, then the responsibility for the success or failure of such decisions and strategy outcomes stops with them.

The major question to be asked then, is whether what we are seeing in the current regional policy rhetoric is a form of 'top down' regionalism, driven by the State for political purpose, or whether it is a fuller, more inclusive form of regionalisation, aimed at benefitting regions. Importantly, how will we know the difference?

This presentation will examine the concept of 'decentralisation' in the context of both 'regionalism' and 'regionalisation' and discuss the reality of both approaches and what this means for RRR Australia.

# Assessing the economic impacts of including carbon farming in western NSW grazing enterprises

**Professor Geoff Cockfield<sup>1</sup>**, Dr Cathy Waters<sup>3</sup>, Dr Uttam Shrestha<sup>1</sup>, Ms Fiona Garland<sup>2</sup>

<sup>1</sup>University Of Southern Queensland, Toowoomba, Australia, <sup>2</sup>Local Land Services Western, Bourke, Australia, <sup>3</sup>NSW Department of Primary Industries

## **Biography:**

*Geoff Cockfield is the Research Leader of the Sustainable Agricultural Environments Group at the University of Southern Queensland. He worked in agricultural industries and rural journalism before starting an academic career. His base discipline is public policy, specializing in environmental and agricultural policy and environmental economics. He has conducted research on structural adjustment in agriculture, deregulation of agricultural industries, carbon emissions and sequestration in agricultural enterprises and farmer decision-making.*

Emissions Reduction Fund (ERF) auctions have been used to secure agreements to sequester or retain carbon in vegetation on agricultural properties. There are at least 115 projects, covering 1.8 million ha in the Cobar Penneplain and Mulga Lands of NSW, with the main contracted methodologies being avoided deforestation (AD) and human induced regeneration (HIR). The Government has invested ~\$590m in these projects but benefits and costs, especially opportunity costs, to landholders, are uncertain or unknown. This paper is part of a study using bio-economic modelling to quantify the trade-offs between pastoral enterprises and carbon farming at both farm and regional scales. For this paper, the net present values (NPV) of a combined Dorper sheep and goat harvesting business over 25 years, with and without a sequestration project, were estimated. We then estimated the time (years) until the opportunity costs of having a sequestration project started to accumulate. The longer the time frame, the more favourable it is to have a project.

Results from this case study suggest that early payments based on a price of >\$10/tonne for carbon sequestration, carbon accumulation of >8 t/ha, would make a project an attractive proposition to include in a mixed grazing enterprise, even with a significant increase in meat prices or a modest increase in carrying capacity. We conclude with an outline of the limitations of this preliminary work and set out the steps to extend and deepen the study.

# Understanding the trade-offs and synergies between carbon farming and resilience in the rangelands of western NSW

Dr Annette Cowie<sup>1</sup>, Dr Cathy Waters<sup>1</sup>, Dr Susan Orgill<sup>1</sup>, Fiona Garland<sup>3</sup>, Trudie Atkinson<sup>1</sup>, Dr Deborah O'Connell<sup>2</sup>, Dr Nick Abel<sup>2</sup>, Dr Brian Walker<sup>2</sup>, Dr Nicky Grigg<sup>2</sup>, Dr Rachel Williams<sup>2</sup>

<sup>1</sup>Nsw Department Of Primary Industries, , Australia, <sup>2</sup>CSIRO, Canberra, Australia, <sup>3</sup>Local Land Services Western Region , , Australia

Lightning Session 2, Central Oval - Gibber Room, September 28, 2017, 11:10 AM - 12:30 PM

## **Biography:**

*Annette Cowie is Principal Research Scientist, Climate in NSW Department of Primary Industries (NSW DPI). Annette is the Land Degradation advisor on the Scientific and Technical Advisory Panel of the Global Environment Facility. She also leads the International Energy Agency Bioenergy research group Climate Change Effects of Biomass and Bioenergy Systems. Annette has a background in plant and soil science, with particular interest in sustainable resource management, and indicators of sustainability. Her recent research has focussed on GHG accounting for the land sector, soil carbon dynamics, life cycle assessment of bioenergy and biochar systems, and methods for assessment of resilience of agro-ecosystems.*

The project “Assessing the impacts and opportunities from carbon farming in western NSW” aims to enhance the environmental, social and economic outcomes from carbon farming activities undertaken through the Emissions Reduction Fund in the rangelands of western NSW. The project is using RAPTA (the Resilience, Adaptation Pathways and Transformation Assessment) framework to guide assessment of the resilience of current management and alternative land use strategies involving carbon farming. RAPTA is a framework tool that guides the application of resilience concepts to resource management planning, using a structured participatory approach. RAPTA encourages a systems view, identifying critical linkages in the social-ecological system that become the focus of system assessment and development of management plans.

New data on the environmental and economic impacts of carbon farming as well as abatement potential will be generated from the current research project. This will then be combined with expert knowledge and published information to devise a farm-level system description. Through stakeholder workshops we will validate and refine the system descriptions and identify key driving variables, likely shocks and risks, and proximity to thresholds of concern, including likely impacts of climate change. Utilising the Multi-Criteria Analysis Shell for Spatial Decision Support (MCAS-S) as a spatial framework, we will evaluate the capacity of the system to continue to meet stakeholders’ goals, and consider the need for adaptation or transformation. Thus, RAPTA will be used to undertake a holistic assessment of social, biophysical and economic impacts of carbon farming activities and improve understanding of the trade-offs and synergies between carbon farming and conventional pastoral management. This project demonstrates this method, based on RAPTA, as a process for the identification of practices that deliver environmental, social and economic sustainability for local communities in response to system shocks, which can underpin development of regional and local adaptation plans.



# Land degradation neutrality: a new approach to land degradation policy

Dr Annette Cowie<sup>1</sup>, Prof Barron Orr<sup>2</sup>, Prof Graciela Metternicht<sup>3</sup>

<sup>1</sup>Nsw Department Of Primary Industries, Armidale, Australia, <sup>2</sup>University of Arizona/ Belmont Forum/ UNCCD Science Policy Interface, Madrid, Spain, <sup>3</sup>University of New South Wales, Kensington, 2052

## **Biography:**

*Annette Cowie is Principal Research Scientist, Climate in NSW Department of Primary Industries (NSW DPI). Annette is the Land Degradation advisor on the Scientific and Technical Advisory Panel of the Global Environment Facility. She also leads the International Energy Agency Bioenergy research group Climate Change Effects of Biomass and Bioenergy Systems. Annette has a background in plant and soil science, with particular interest in sustainable resource management, and indicators of sustainability. Her recent research has focussed on GHG accounting for the land sector, soil carbon dynamics, life cycle assessment of bioenergy and biochar systems, and methods for assessment of resilience of agro-ecosystems.*

The health and productivity of global land resources is declining while demand for land resources is increasing. The aim of the land degradation neutrality (LDN) initiative is to maintain or enhance the the land resource base – that is, the stocks of natural capital associated with land resources, and the ecosystem services that flow from them. The goal is to maximize provisioning services (food, materials, fuel) while enhancing the resilience of land resources and the communities that depend on them. LDN is central to the global 2030 Agenda for Sustainable Development.

The “Scientific Conceptual Framework for Land Degradation Neutrality” has been developed to provide a scientific approach to planning, implementing and monitoring LDN. The Science-Policy Interface of the United Nations Convention to Combat Desertification (UNCCD) led the development of the conceptual framework, drawing in expertise from a range of diverse disciplines.

The LDN conceptual framework focuses on the goal of LDN and the supporting processes required to deliver this goal, including biophysical and socio-economic aspects, and their interactions. Pursuit of LDN requires effort to avoid further net loss of the land-based natural capital relative to a reference state, or baseline. Planning for neutrality involves projecting the likely cumulative impacts of land use and land management decisions, then counterbalancing anticipated losses with measures to achieve equivalent gains, within individual land types (where land type is defined by land potential). Actions to achieve LDN include sustainable land management practices that avoid or reduce degradation, coupled with efforts to reverse degradation through restoration or rehabilitation of degraded land. The response hierarchy of Avoid > Reduce > Reverse land degradation articulates the priorities in planning LDN interventions. The implementation of LDN is managed at the landscape level, while achievement is assessed at national level. Over 100 countries have committed to LDN targets.

# Simulated impacts of wet season spelling and intensive rotational grazing on pasture condition in a degraded northern Mitchell grass savanna

Dr Robyn Cowley<sup>1</sup>, Dr Dionne Walsh<sup>1</sup>, Ms Jane Douglas<sup>1</sup>

<sup>1</sup>NT DPIR, Darwin, Australia

Oral Presentation - Northern Australia - the new frontier

## **Biography:**

*Dr Robyn Cowley has been with the Northern Territory Department of Primary Industry since 2000 working on grazing systems, fire management, carrying capacity and climate impacts.*

The northern Australian pastoral industry is intensifying development and grazing systems to facilitate greater productivity and capital value. A three year field trial in the Barkly region of the Northern Territory (Beetaloo) comparing intensive rotational grazing (IRG) combined with wet season spelling (WSS) to set stocking (SS) at similar average annual stocking rates (SR) and paddock sizes, found no change in pasture condition in either grazing system.

Given the short duration of the trial we used GRASP to simulate how the intensified grazing system might influence pasture condition in the longer term (30 years) comparing: 1) continuous SS; 2) SS with an annual 3 month WSS; and 3) annual WSS with IRG; for a range of graze dates, climate windows, starting pasture conditions and SR. SR that facilitated pasture recovery in drier climate windows or from C condition pastures were 2/3 of safe SR in wetter climate windows or B condition pastures. Adding WSS to SS facilitated faster pasture recovery times at higher safe SR. For WSS + IRG, if any of the grazes were during the growing season, the SR that promoted pasture recovery was one to two thirds less than the safe SR when grazing occurred only during the dry season. Dry season IRG + WSS had higher safe SR and shorter recovery times than the Grazing Land Management (GLM) derived carrying capacity with continuous grazing, or SS + WSS.

This study suggests that WSS + IRG may be a useful tool to enhance recovery of degraded grasslands. However, recovery timeframes were still in the order of decades and any wet season IRG should be avoided or carefully managed to prevent further pasture condition decline.

## LongPaddock 2020: Rangelands climate and pasture information portal – not just in the clouds.

Dr Ramona Dalla Pozza<sup>1</sup>, Mr Grant Stone<sup>1</sup>, Mr John Carter<sup>1</sup>, Ms April Gunning-Davis<sup>1</sup>, Mr Alan Peacock<sup>1</sup>

<sup>1</sup>Department Of Science, Information Technology And Innovation, Brisbane, Australia

Lightning Session 2, Central Oval - Gibber Room, September 28, 2017, 11:10 AM - 12:30 PM

### *Biography:*

Ramona Dalla Pozza is Science Leader for the Grazing Lands Systems group within DSITI (Department of Science, Information Technology and Innovation) based at the Ecosciences Precinct in Brisbane.

Ramona has an Environmental Management degree and a PhD in Geomorphology (awarded in 2007). Over the last 14 years Ramona has worked as a scientist with both the Federal and Queensland governments in climate impacts on natural resource systems, palaeoclimate, climate change, fluvial and coastal geomorphology and biosecurity.

Ramona is currently leading the provision of climate change data to support the Queensland Climate Adaptation Strategy and leading DSITI's contribution to the Queensland Drought Mitigation Centre – research aimed to improve primary producers drought preparedness.

The LongPaddock website <https://www.longpaddock.qld.gov.au/> is a Queensland Government initiative that has served rangelands scientists and land managers since 1995. For over 22 years LongPaddock has provided climate and pasture information on a state and national basis with greater than 300,000 users and 3 million visits since late 2011. The current LongPaddock website is a valuable repository of information for rangelands applications, but is becoming increasingly outdated in terms of how information and data are available to users. Information delivery has fundamentally changed over the last 20 years and the current LongPaddock website is limited by its old technology infrastructure.

The Queensland Government has supported and recognised the need for a modern, innovative platform from which to deliver climate and land management information to stakeholders, to improve primary producer's resilience to extreme climate variability. To meet the changing demands of its users, LongPaddock needs to transition from a basic website to a dynamic information portal – a collection of information and services to maximise productivity and maintain resource condition, tailored to rangelands users.

The LongPaddock 2020 project is a key communication vehicle for the new Queensland Drought Mitigation Centre which is a collaboration between Department of Agriculture and Fisheries, Department of Science, Information Technology and Innovation and the University of Southern Queensland funded under the Drought and Climate Adaptation Program. The changes to the website and major products will be a considered incremental process – released to users progressively. A recent survey revealed that over 90% of LongPaddock users were either very satisfied or satisfied with the current website. Therefore, the detailed information that has been traditionally offered will not change, though the new site will deliver an enhanced user experience and improved data accessibility.

# A rapid approach for the visual attribution of vegetation photo patterns across the NSW Rangelands: a data driven technique using time series earth observation

**Mr Mike Day<sup>1</sup>**, Dr Adam Roff<sup>1</sup>

<sup>1</sup>Nsw Office Of Environment & Heritage, Parramatta, Australia

## **Biography:**

*Mike is a Senior Scientist at the NSW Office of Environment and Heritage. He specialises in spatial and remote sensing analysis as part of the Science Division's native vegetation mapping team. He particularly enjoys the programming and automation of big data spatial processing. Mike also lectures in spatial science at the Australian Catholic University. His undergraduate and post-graduate research explored the application of hyperspectral imagery for soil mapping.*

A spatially consistent record of vegetation type is essential for managing and monitoring rangelands effectively, particularly at the regional scale. Aerial or satellite imagery at a high spatial resolution provides excellent visual detail but a visual extraction of relevant vegetation type is still a laborious and often infeasible task across such large extents. The New South Wales (NSW) Office of Environment and Heritage have utilised automated feature extraction and classification to map Vegetation Photo Patterns (VPP) using a time-series of SPOT-5 satellite images. This data driven approach was used to rapidly classify the NSW rangelands into broad structural vegetation types. The approach used the mean spectral response of SPOT-5 satellite imagery for six dates over eight years. Image pre-processing included a red-green index, noise reduction and the use of SPOT-5 derived foliage projected cover. Feature recognition was used to delineate homogeneous patches of vegetation and an automated classification algorithm (isodata) was used to classify the patches into consistent classes. Each class was assigned to a VPP and then visually assessed using 2.5m pan sharpened imagery, with correction made at finer scales where necessary. This automated classification of western rangelands made mapping VPP's faster and more efficient than similar mapping conducted in other areas of the state. The rangeland's reflective soils, relatively low incidence of cloud cover and flat terrain proved ideal for time-series remote sensing. This study has implications for the mapping of rangelands in other parts of Australia, particularly with the recent launch of the Sentinel 2 satellite platform that offers free high resolution time series imagery.

# Using FarmMaps 4D to improve management of Indigenous pastoral infrastructure

Mr Joel Dillon<sup>1</sup>, Mr Peter Cunningham<sup>2</sup>

<sup>1</sup>Indigenous Land Corporation, , Australia, <sup>2</sup>National Indigenous Pastoral Enterprises, , Australia

## Oral Presentation- Changing Face of Indigenous Managed Lands

### **Biography:**

*Joel Dillon has 11 years' experience in spatial sciences. He has served as the SA (2012-2014) and National (2014-2016) chair of the Surveying and Spatial Science Young Professionals committees. Since 2009 Joel has managed the Indigenous Land Corporation (ILC)'s GIS services providing mapping and analysis products to support land management including the pastoral operations of the ILC's subsidiary, National Indigenous Pastoral Enterprises.*

The Indigenous Land Corporation (ILC) assists Aboriginal and Torres Strait Islander people to acquire and manage land to achieve economic, environmental, social, and cultural benefits.

To support this the ILC maintains a spatial database of property infrastructure information, including property layout, fencing, water points, and other features, for more than 160 Indigenous and ILC-held properties across Australia. The quality and consistency of this information varies depending on information availability and managers, limited access to the information on remote properties or ability to improve it.

To address these issues, the ILC, through its wholly owned subsidiary the Australian Indigenous Agribusiness Company (AIA) [formerly National Indigenous Pastoral Enterprises (NIPE)] , started a project in 2016 to develop detailed property infrastructure information using its in-house Indigenous mapping capability, starting with fifteen NIPE-managed properties.

The FarmMap 4D (FM4D) online application [formerly known as the NRM Spatial Hub] was used to deliver information to the remote property managers. Managers can use FM4D to dynamically view and overlay map layers, and generate maps and reports, to support more effective land management and planning. This single source of information is accessed by project managers, contractors, and property managers alike.

But how did the ILC develop its property information, how is the ILC using the FM4D, and what are the ILC's plans for the future? Moreover, how is this project improving the ability of the ILC and AIA to deliver benefits to Indigenous people?

# Establishing the Health of the Lake Eyre Basin - a Fishy Story!

Mr Andrew Drysdale<sup>1</sup>, Dr Steve Morton

<sup>1</sup>Lake Eyre Basin Community Advisory Committee, Toowoomba, Australia

## Oral Presentation - Monitoring after ACRIS

### **Biography:**

*Andrew was born and raised in South West Queensland in the Charleville/Augathella district. He gained a degree in Applied Science (Rural Technology) from the then Queensland Agriculture College at Gatton. Later, Andrew completed a Graduate Diploma in Property Studies.*

*With his brother, Andrew purchased a mulga property outside of Charleville which he owned and operated for 16 years. Throughout the eighties and early nineties Andrew was involved in local, state and national primary industry peak bodies.*

*In 2000 Andrew became the Executive Officer for the Queensland Murray Darling Committee and in 2006 took up the role of CEO to the Queensland Regional NRM Groups Collective.*

*Along with being the CEO of the Queensland Regional NRM Groups Collective, Andrew Chairs the Rangelands NRM Groups Alliance and the Lake Eyre Basin Ministerial Forum Community Advisory Committee.*

The Lake Eyre Basin is among the world's largest internally draining river basins, and supports values of national and international significance. In 2000, the Australian, Queensland and South Australian governments signed the Lake Eyre Basin Intergovernmental Agreement (joined by the Northern Territory in 2004) to promote sustainable management of the Basin's water resources and river systems, and especially to minimise cross-border downstream impacts. Under the Agreement, the condition of the Basin's watercourses and catchments is assessed every 10 years. By the Rangelands Conference the State of the Basin Condition Assessment Report 2016 will have been released.

Data collected under the Lake Eyre Basin Rivers Assessment programme indicate that riverine fish communities are in good condition, although exotic fishes are more widespread than previously known. Waterbirds demonstrate relative stability over the period 1983-2015, despite being locally variable in response to streamflow. Current threats to water resources and riverine ecosystems appear relatively low and mostly concentrated at waterholes.

It is challenging to find indicators that can be relatively simple to measure, that cover most if not all the region, have previously been monitored and evaluated, and can be extrapolated to reflect a range of condition determinants. The scientists in the room adopted the position that indicators must be supported by robust data; non-scientists argued that to ignore more subjective information could exclude powerful observations. Much discussion occurred about capturing economic, cultural and social indicators.

The story that I share will outline the assessment processes as well as outcomes, including marrying science with stories and including the community in the development of a Report with a more convincing picture. Maybe we can't yet establish how far we are down the track from 'transition to transformation', but we now have the capacity to allow for such assessment in future years.

# Collaborative, Strategic and Risk-Based – A New Approach to Weed Management in Western NSW

Mr Paul Erkelenz<sup>1</sup>, Mr David Creeper<sup>2</sup>, Ms Jasmine Wells<sup>3</sup>, Mr Mitchell Plumbe<sup>3</sup>

<sup>1</sup>Astrebla Agribusiness & NRM Consulting, Goolwa Beach, Australia, <sup>2</sup>Western Local Land Services, Broken Hill, Australia,

<sup>3</sup>Western Local Land Services, Hillston, Australia

## Poster presentation

### **Biography:**

*David is based at the Broken Hill Office and has been in his current role as Manager for Biosecurity and Emergency Services since 2014.*

*Prior to joining the WLLS, David worked for Lachlan CMA as biodiversity and native vegetation coordinator based at Forbes. He has had extensive experience in local and state government in SA, mainly in pest management servicing the Mid North and Yorke Peninsula.*

*David grew up on a small dairy farm south of Adelaide at Yundi.*

Weeds pose a major biosecurity risk in western NSW. The actual and potential impacts on agriculture, biodiversity, natural environments, cultural sites and human health are significant.

Regulation of weeds in NSW has changed. In line with the recommendations of the Review of Weeds Management in NSW 2014, a new Biosecurity Act 2015 has replaced the former Noxious Weeds Act 1993. These reforms support a regional approach to the planning and management of weeds, as a first step to managing them more strategically and efficiently. A shared approach is an underlying theme throughout the new legislation.

The Western Regional Strategic Weed Management Plan 2017-2022 was developed collaboratively with input from a range of stakeholders including local government, state government agencies, primary producer groups, aboriginal representative bodies and weed management and Landcare groups. Along with the advice of technical experts and experienced regional stakeholders, the nationally accepted NSW Weed Risk Management system was used to identify which weed species would be priority for management in the region, the control objectives for each species and any legal requirements.

The new Biosecurity Act 2015 introduces a number of regulatory innovations which will support the implementation of the plan, including a tenure-neutral approach, the introduction of a General Biosecurity Duty and new regulatory tools that will provide more flexibility for both land managers and regulators. The plan is not solely regulation focussed; a number of other strategies including awareness raising, research, development and extension and bio-control release programs are also supported.

With the Western Local Land Services Region sharing boundaries with four other NSW Local Land Services regions and three other states (including six separate NRM regions), there is real potential for both cross border collaboration and conflict on weed management. Opportunities for collaboration with adjoining regions can be realised and solutions to conflict developed.

# Social Return on Investment in the Rangelands; We Think What We Are Doing is Important, But Does Anybody Else Care?

Leah Feuerherdt<sup>1</sup>, Stuart Peevor<sup>2</sup>, Michael Clinch<sup>3</sup>, Tim Moore<sup>1,4</sup>

<sup>1</sup>Natural Resources Alinytjara Wilurara, Department of Environment, Water and Natural Resources, <sup>2</sup>EIB Consulting,

<sup>3</sup>Anangu Pitjantjatjara Yankunytjatjara (APY) Pastoral, <sup>4</sup>Biodiverse Carbon Conservation

## Oral Presentation - Changing Face of Indigenous Managed Lands

Social Return on Investment (SROI) is an internationally recognised methodology used to measure and value the impact of programs. Like a traditional cost-benefit analysis, SROI examines economic outcomes, but also includes the social, environmental and cultural outcomes created by the investment. These outcomes are evaluated against their cost, using financial proxies to estimate their relative value. SROI is particularly valuable in the indigenous natural resource management context, because of the strong 'value' or importance of non-economic (particularly cultural) costs and benefits.

The Alinytjara Wilurara Natural Resources Management Board (AW NRMB) undertook a study of the economic, social, environmental and cultural impacts of large feral herbivores in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands, in the far northwest of South Australia. Camels, donkeys and horses present significant impacts for the community in terms of vehicle collisions, community health, damage to infrastructure and water pollution. With the costs incurred by pest animals in the APY lands valued at \$4.2m and possible benefits valued at \$140,000, the study found that there was a net cost impact of approximately \$4m. This study also found significant cultural impacts of pest animals, which requires further analysis.

Future investment models that consider a broad range of costs and benefits, are considered appropriate for Australian rangelands, particularly Indigenous-owned land.



## Science is just the start - the development of the NRM Spatial Hub.

**Ms Kate Forrest**<sup>1</sup>, Mr Andrew Drysdale<sup>1</sup>

<sup>1</sup>Rangeland NRM Alliance, Longreach, Australia

### Oral Presentation - Monitoring after ACRIS

#### ***Biography:***

*Kate Forrest works as the coordinator for the Rangeland NRM Alliance. She works with the Alliance Chair, Andrew Drysdale, the fourteen regional NRM body and a range of partners to improve the profile and programs to support Natural Resource Management in the rangelands.*

*Kate will speak today about the transition of access to spatial information via the NRM Spatial Hub and the transformation it offers for rangeland monitoring and decision making.*

The NRM Spatial Hub (The Hub) is world leading on-line mapping technology that is revolutionising Australian rangeland monitoring and management. The Hub began as a dispersed multitude of government and non-government GIS systems, satellite information, maps and datasets across the country and the people and institutions who managed these. Its development brings together the world's largest archive of satellite data, mapping and analysis capabilities accessible to land managers.

The identification of the need for improving monitoring for NRM interventions by the Rangelands NRM Alliance coincided with increasing demand from land managers to better map and monitor their management decisions. This provided impetus for the development of the partnerships that lead to this tool developing. It required a huge number of partners, some serious coordination and considerable flexibility in how we went about getting the end result land managers wanted. The NRM Spatial Hub project brought together the funding partners, the technical staff for data interaction, extension staff to provide opportunities to work with the end users to ensure that the Hub provided the information in a format they would use.

The development of this tool from the initial idea to develop a collaborative national project which resulted in the technology that is now being applied by a number of industries demonstrates the rangelands can trigger transitions of science via collaboration. The first stage ran for 2 years with an overwhelming level of uptake by Rangeland managers. To further develop the capacity for delivery the initial investors have self funded further delivery and the development of a business plan for expansion.

# Uninvited guests: how some weeds of arid Australia arrived as stowaways and became widespread

**Dr Margaret Friedel<sup>1</sup>**

<sup>1</sup>CSIRO Land & Water; RIEL CDU, Alice Springs, Australia

## Poster Presentation

### ***Biography:***

*Marg is an Honorary Fellow with CSIRO Land & Water and an Adjunct Professorial Research Fellow at the Research Institute for the Environment & Livelihoods at Charles Darwin University in Alice Springs. She joined CSIRO Alice Springs in 1974 to research the ecology and management of arid Australian rangelands and, over many years, explored the theory and practice of range assessment, rangeland rehabilitation, impact of tourism on rangelands, community-based solutions for land use planning, managing contention surrounding pasture plants and the development of appropriate policy directions. She was Officer-in-Charge of the Alice Springs laboratory from 2002 to 2009. Since retirement in 2010, she has contributed to various boards and committees and she continues to publish on arid land ecology, including invasive plants and fire management. She remains an enthusiastic member of the Australian Rangeland Society since first joining in 1975.*

In the 19th and 20th centuries, numerous plant species were deliberately introduced into Australia for use in crops, pastures, gardens and horticulture, while others arrived by chance. Many subsequently escaped and became weedy. Of the 54 weed species of natural environments of arid and semi-arid Australia that are considered here, 22 were intentionally introduced, 24 were accidentally introduced and eight were probably introduced both accidentally and intentionally. Recent new introductions are few, due to pre-border, border and post-border protections, but many current arid zone weeds continue to spread.

## Pursuing the World Heritage opportunity for the Flinders Ranges

**Ms Liesl Garrett<sup>1</sup>**

<sup>1</sup>*Department of Environment, Water and Natural Resources, Adelaide, Australia*

Over 600 million years old, the Flinders Ranges is one of Australia's magnificent landscapes. This diverse landscape is world-renowned for its wealth of natural, cultural, historic and scenic values making it an iconic tourism destination with outstanding visitor experiences.

Particularly extraordinary are the fossils and geology of the Flinders Ranges, which display the history of our planet and the evolution of life on Earth. Some of this critical evidence spans more than 300 million years and includes the world's finest example of the Ediacaran explosion of life, when the earliest forms of animal life evolved. It is these outstanding geological and palaeontological forms within the Flinders Ranges that make it an important site to pursue for World Heritage Listing.

Pursuing World Heritage Listing for the Flinders Ranges provides an exciting opportunity to recognise this site on a global scale, to celebrate these outstanding values and create economic benefits for the region.

# The implications of the emerging carbon economy for the management of the rangelands

**Mr John Gavin<sup>1</sup>**

<sup>1</sup>*Remarkable NRM, Wilmington, Australia*

## Oral Presentation - Transitioning to New Industries

### ***Biography:***

*John has over 20 years' experience in natural resource management and is well regarded for his broad knowledge of Rangelands NRM related issues. He operates his own business specializing in natural resource management services and solutions supporting a number of regional NRM bodies, Government agencies and private organisations and businesses across Australia with strategic planning and project development.*

*John has previously been involved with carbon project development with a specific focus on the Australian rangelands. He has an extensive understanding of the implications of the carbon economy for the Rangelands producers and industries and continues to provide associated advice and extension services across Australia.*

*Additionally, John applies his practical background in weed and feral animal, water resource and soils management to work with communities to undertake NRM projects at a local scale.*

Improving rangelands land management provides the single largest Green House Gas (GHG) sequestration opportunity in Australian agriculture with the potential to sequester 100 million tonnes (Mt) of CO<sub>2</sub>e per year for 40 years (CSIRO, 2009). Improved herd management could lead to an additional 20% reduction in GHG emissions with an 80% reduction possible by 2050.

54% of all registered carbon projects in July 2017, totalling over 370 projects, are rangelands based projects. Forward contracts for sale of Australian Carbon Credit Units (ACCU's) through the Emissions Reduction Fund (ERF) from across the rangelands will see 271 projects deliver more than 139.5 Mt CO<sub>2</sub>e of emissions either avoided or sequestered over the next 10 years, with over 13.3 Mt CO<sub>2</sub>e already delivered. This is 73.8% of the total abatement contracted across all sectors, nationally.

Estimates of the full value of rangelands based ACCUs that have been sold or are contracted for sale over the next 7–10 years (based on the published average price of the first 5 ERF auctions) indicate a value of approximately \$1.65 billion. This compares favourably with the \$1.1 billion committed by the Australian Government over 7 years to the National Landcare Program for delivery across the entire country.

The emergence of the carbon economy provides a once in a generation opportunity for landholders. The alternative income can be used to develop infrastructure and improve land management in a pastoral economy dealing with increasing challenges to profitability. However, this new industry brings many challenges for land managers and regulators with potential conflicting outcomes between traditional pastoral practices and carbon sequestration projects.

# Community driven decision making, design and delivery by Natural Resource Management Groups in the South Australian Arid Lands.

Mrs Louise Gavin<sup>1</sup>, Ms Lelia Kamphorst<sup>1</sup>

<sup>1</sup>SA Arid Lands, Department of Environment, Water and Natural Resources, Port Augusta, Australia

## Lightning and Poster Presentation

### **Biography:**

*Louise has worked in the SA Arid Lands in Natural Resource Management for the past 10 years in various community engagement roles ranging from Landcare coordinator to volunteer program coordinator. Louise has worked with Progress Associations, Schools, Adelaide-based and rural-based volunteer groups, pastoralists, Aboriginal groups and other Government organisations, to link people with opportunities for funding and project development. In 2014, Louise was an environmental mentor in the Solomon Islands for a small, remote community group where she lived a traditional life in the local village, assisting with processes and governance to stop logging companies and improve local understanding of unsustainable logging practices. Louise has also lived and worked in the rangelands of NSW and the NT as a primary school teacher, including 4 years with the Alice Springs School Of The Air.*

In the South Australian Arid Lands, community has been placed at the centre of decision making and project design to bring relevant support, content and opportunities around Natural Resource Management (NRM) out into the region. The main drivers of this adaptable approach are the NRM District Groups which are comprised of local land managers who bring a range of backgrounds and expertise to their representation of the community (pastoralism, Aboriginal heritage, tourism and conservation).

Working with and through the Groups, community members work with the support of engagement staff to plan, organise and deliver projects relevant to their local NRM needs.

Input from the wider community is sought through a range of mediums from phone and email surveys by group members to one on one discussions.

Through group priorities involving a desire to access information and opportunities for community to come together and learn; two NRM Groups have hosted Field Day events and another group has hosted a day focussed specifically on the best practice management of feral cats amongst other initiatives.

The leadership and ownership of planning by community groups in the form of NRM Groups and their members has led to tailored events, activities and discussions. Successful elements of these have been attributed to a consideration of the social capital and opportunity provided by regional rural events, appropriate timing as far as the community is concerned, diversity of relevant and requested content and a consideration of local context.

The work of District Groups and the manner in which they are conducting their planning shows the shared commitment to community focussed decision making, design and delivery around NRM which is increasingly relevant in the face of constant change, whilst recognising the need to build resilience in our landscapes and people.

# Natural Capital Accounting for Rangelands

Mr Jonathan Green<sup>1</sup>

<sup>1</sup>*Australian Indigenous Agribusiness Company, Adelaide, Australia*

## Lightning Presentation

### **Biography:**

*Jonathan has over 20 years experience in managing environment and sustainability projects. This includes work as a field ecologist in outback SA and NT. Jonathan currently oversees a range of innovative projects that seek to support Indigenous people to benefit from the Indigenous land estate.*

The 'Natural Capital Accounting for Rangelands' project seeks to demonstrate how integrated ecological and financial accounts can guide rangelands beef producers in improving productivity through sustainable grazing. Each year the pastoral industry contributes hundreds of millions of dollars to regional northern economies through grazing cattle over northern Australia's vast rangelands. Much of these rangelands are relatively intact, providing habitat for important plant and animal communities and providing extensive regulatory services. Although rangelands can be grazed sustainably through Grazing Land Management practice, overgrazing remains a major threat to the rangelands and the beef industry.

The Australian Indigenous Agribusiness Company (AIAC) a subsidiary of the Indigenous Land Corporation, directly supports indigenous landholders contributing to the industry by managing 70,000+ head of cattle on indigenous held land. AIAC also recognises the potential for joint management pastoral enterprises over vastly greater areas of indigenous held land. A key element in their success will be indigenous oversight of sustainable grazing practice, through a combination of quantitative and qualitative monitoring, and transparent ecological accounting. This project demonstrates how tried and tested rangeland management techniques such as grazing land management, rangeland condition monitoring and remote sensing can be combined with the international system of environmental economic accounting (SEEA) to quantify the potential long term economic impact of mid-term grazing management decisions. The presentation will document how these complementary methods can be combined in formats suitable for practical rangeland managers using technologies such as the FarmMap4D property management planning platform. The project is supported by Australian Government funding and is a collaboration between the ILC's AIAC, the Northern Territory Department of Primary Industries and Resources, FarmMap4D, and My Farm Shop.

# Keeping people and communities at the centre of NRM in the SA Arid Lands

Ms Jodie Gregg-Smith<sup>1</sup>

<sup>1</sup>DEWNR, SA Arid Lands NRM Board, Port Augusta, Australia

## Oral Presentation - Regional & Community Development in the Rangelands

### **Biography:**

*As Manager for Partnerships and Community Engagement (PACE) with the SA Arid Lands Jodie leads the work of connecting the people, science, policy, partners and the SA Arid Lands NRM Board's Strategic Plan to develop joint investment and shared responsibility across the community in NRM across the SA Arid Lands. With a background in social policy, regional and community development, strategy and program management Jodie is a passionate advocate for regional SA. With most of her 23-year public sector career being based in regional South Australia, Jodie sees communities as the experts of their own needs and issues and is a fervent believer and practitioner in the Better Together and Reforming Democracy policy platforms that have brought the South Australian community to the table when it comes to planning, deciding and influencing government on issues that impact them.*

The South Australian Arid Lands Natural Resources Management Region spans over 50% of SA with approximately 10 000 people (2% of the SA population) sparsely occupying over 500 000 square kilometres. Critical industries and globally iconic landscapes characterise the region with remote and isolated communities sparsely positioned, each of which are in the view of the SA Arid Lands NRM Board, critical to the conversations on managing the Arid Lands landscapes, lifestyles and livelihoods. Pastoralism, Tourism, Mining and Exploration contribute significantly to state and national economies.

In considering how people and communities would remain central to the influence the SA Arid Lands NRM Board seeks to have, IT has invested in a model that acknowledges the challenges of funding and time limitations and the tyranny of distance balanced with the critical need to value and include its community in every way possible to encourage participation in NRM.

A team of multi-disciplinary Community Engagement Officers, within the Partnerships and Community Engagement (PACE) Team each take responsibility for one of 6 NRM districts within the region and in doing so, play a key role as a conduit between the Board, program managers and the community. Supporting community in NRM extension, school and education programs, community events, Aboriginal partnerships, the leadership of district NRM groups, grant programs, action planning, cross regional collaboration and volunteering form the core business of the PACE team.

Placing people at the centre, and deciding, designing and delivering on NRM priorities, projects and plans together, grows the NRM community and develops community capacity. This enhanced community capacity will far outlive the political and financial cycles that often lead to a model of 'reinventing wheels' in regional service delivery and capacity building and stop-start successes in community endeavour.

Investment in community development, education and self-governance whereby communities see themselves more prominently involved in local decision making and influence needs to remain foundational to regional and outback investment, thereby 'future proofing' regions that will inevitably face change and transition, whether intentionally imposed or as a result of the boom bust cycle of the rangelands.

# Tech Tools for Improving Productivity, Profit and Pasture in the Pastoral Rangelands

**Mr Murray Grey**<sup>1</sup>

<sup>1</sup>Glenflorrie Station, Nanutarra, Australia, <sup>2</sup>Precision Pastoral Management Tools Project, Alice Springs, Australia

## Oral Presentation – Pastoral Industry Trends in the Southern Rangelands

### **Biography:**

*I am part of a family owned and operated beef production business based in the West Pilbara on Glenflorrie Station. My family has been in the pastoral game for 5 generations from the Kimberleys to the Goldfields and everywhere in between. Since returning to the station from boarding school in 2002 I have been involved in various industry committees including a stint on the Northern Australia Beef Research Council and a member of the Industry Systems and Food Safety and Marketing sub-committees to the Cattle Council of Australia. I was also a member of the Youth in Beef organizing committee responsible for the establishment of the Greame Acton Mentoring program. I currently live and work with my wife Adele, daughter Odelia and son Jack on a backgrounding property near Regans Ford in the Central West which we have purchased as an expansion of our northern operations.*

In the last 20 years there has been a huge surge in development of technological tools to improve the business of producing protein in Australia. While in the early stages this was mostly confined to the cropping sectors, more and more we are seeing the livestock industry embracing technology and the benefits it brings to business bottom lines. Unfortunately, the remote pastoral industry has been behind the eight-ball due to a combination of harsh conditions, limited access to online service and very low adoption rates, amongst other things. Tech companies have been quite successful in building hardware capable of withstanding the extremes of Australia's hostile climate and gradually, ever so gradually, regional Australia is joining the 21st century in its access to the World Wide Web at speeds not totally reminiscent of a slow-motion replay. That leaves adoption...

There are now tools available to the pastoral industry that can not only save time and money, but that can also identify inefficiencies, minimize unnecessary production losses and monitor pasture condition and availability to better manage our grazing ecosystems. The PPMS (Precision Pastoral Management System) is a software system based online via a cloud based network. It draws on multiple data products that are customized to each property. The RLMS (Remote Livestock Management System) collects live weight data and also an auto-drafting option, while pasture production is collected via satellite. Data is streamed back to the PPMS via the telemetry unit. This system is used to maximise animal productivity while minimizing overgrazing and land system degradation. The telemetry units also support other cost saving tools like Tank Level Sensors, Digital Rain Gauges, Remote Start/Stop function for motors and many more .



# Standardised vegetation survey and monitoring data across the Australian rangelands from TERN AusPlots

Dr Greg Guerin<sup>1</sup>, Mr Ben Sparrow<sup>1</sup>, Dr Andrew Tokmakoff<sup>1</sup>, Dr Anita Smyth<sup>1</sup>, Mr Emrys Leitch<sup>1</sup>

<sup>1</sup>Terrestrial Ecosystem Research Network, School of Biological Sciences and Environment Institute, University of Adelaide, Adelaide, Australia

## Oral Presentation - Monitoring after ACRIS

### **Biography:**

*Greg is an ecologist with expertise in community ecology, vegetation science and plant diversity. Greg provides analysis and synthesis support to the TERN AusPlots team and is also Transect Leader for the TREND monitoring network in South Australia. Recent research has included mapping regional biodiversity, exploring ecological climate sensitivity and interpreting continental patterns of vegetation structure and composition.*

Robust ecosystem monitoring to report on condition and trajectory in rangelands requires precise and objective measurements of indicators linked to climate and disturbance regimes. TERN AusPlots provides systematic monitoring data at continental scale, enabling comparisons of metrics like vegetation cover and structure or species diversity. Here we present the first collated AusPlots dataset and overview the sampling of environments (e.g. a rainfall gradient of 129–1437 mm Mean Annual Precipitation) and vegetation. Over 3,000 vascular plant taxa in 22 major vegetation types including savanna, eucalypt woodland, chenopod shrubland and grassland have been recorded in these 442 field plots. The core field module of AusPlots is a point intercept survey, which records substrate, plant species, growth form and height at each of 1010 intercepts located along 10 transects arranged in a grid within 1 ha plots. Comprehensive plant species diversity is also recorded through systematic vouchering and formal identification, making the data robust to identification error and taxonomic change. Standardised and quantitative data combined with open access data publication via AEKOS, plus a broad spatial scope, make this a useful dataset for applications such as analysis of vegetation cover (by species, growth form or fractional cover) and species composition modelling. The data are already being used to validate remotely sensed information, including fractional cover products and estimates of tree and forest cover in drylands based on visual interpretation of satellite imagery. Data are available in raw as well as more processed or summarised formats.

# Performance of livestock production in north Eastern Cape communal areas: a stochastic frontier analysis.

Miss Bukho Gusha<sup>1,2</sup>, Dr Tony Palmer<sup>1</sup>

<sup>1</sup>Agricultural Research Council, Grahamstown, South Africa, <sup>2</sup>Rhodes University, Grahamstown, South Africa

## Poster Presentation

### **Biography:**

*Bukho Gusha is a 2nd year PhD student at Rhodes University in South Africa. She holds a BSc in Livestock and Pasture Science, Msc Science in Rangeland ecology both from the University of Fort Hare, South Africa. She is currently working on Livestock water productivity for her PhD, which deals with improving rural livelihoods in the Semi-arid rangelands in South Africa.*

Livestock sector is a fast growing agricultural sub sector worldwide. Approximately 37% and 25% of the gross value of the agricultural sector in East and Southern Africa is contributed by the livestock production. Livestock supply many different products and services, making a significant contribution to rural livelihoods and to the variety of social and economic roles for the world's poor. Level of technical inefficiency shows inability of an individual to attain the highest possible outputs in a given inputs used. Technical efficiency analysis has mostly been used in integrated farming with limited focus on livestock production. Therefore, a study assessing the performance of livestock total household production and technical efficiency of livestock communal farmers was conducted with the aim of understanding the variation of efficiency in different households. A structured questionnaire was developed for each village to gather information pertaining livestock use and contribution to rural livelihoods. The results were analysed using a stochastic frontiers analysis to test the maximum likelihood estimate and technical production efficiency for each household. The maximum likelihood estimates results showed that the coefficients for productive factor (capital) is positive except for labour, which had a negative coefficient. Labour had a negative coefficient (-0.279), which suggests that its increase would increase the outputs derived from livestock into a positive value. The mean level of technical efficiency for the sampled households (n=120) was 0.49, which suggests that on average, the sampled households could only achieve about 49% of the potential maximum outputs from a given number of production inputs (labour and capital). The results also revealed that 26 % of the household had abandoned livestock farming (n= 32). In conclusion, there is a need for knowledge about market information so that we can reduce the livestock water footprint in the village.

# Long-term revegetation success of severely degraded chenopod shrublands

Dr Nerissa Haby<sup>1</sup>

<sup>1</sup>Wild R&D, Urrbrae, Australia

Lightning and Poster Presentation

## **Biography:**

*Nerissa is an experienced ecologist with an interest in resource selection and range dynamics, but who is often inspired by the challenges of sustainable natural resource management in a dynamic system, and the restoration of degraded communities.*

The restoration of severely degraded vegetation communities is often said to require mechanical intervention. However, the degree of intervention required, and its capacity to successfully restore areas of bare (scalded) soil and high weed cover into functioning chenopod shrubland, is unknown. After 11 years following mechanical intervention and direct seeding, the abundance and cover of species was compared across disturbed and undisturbed microtopographic zones using one-way repeated measures ANOVAs and pairwise t tests. Along Contour Seeder rip lines, recruitment of perennial species was greatest in the furrow (e.g. direct seeded:  $F_{2,78} = 27.15$ ,  $p < 0.001$ ; wild-sourced:  $F_{2,78} = 13.19$ ,  $p < 0.001$ ), and annual (and short-lived perennial) species equal to, or greater, on the flat (wild-sourced species:  $F_{2,98} = 43.91$ ,  $p < 0.001$ ). These trends often coincided with species life-history strategy, but not always (e.g. the perennial *A. stipitata* illustrated the annual trend;  $F_{2,78} = 7.71$ ,  $p < 0.001$ ). Furthermore, trends could be driven by recruitment patterns in one or more demographic phase. For example, the perennial trends in *A. vesicaria* and *S. fibulifera* abundance appeared to be driven by the recruitment of reproductive plants ( $F_{2,48} = 15.57$ ,  $p < 0.001$ ), or seedlings ( $F_{2,36} = 5.24$ ,  $p = 0.010$ ), respectively. These results indicate the functional benefits of mechanical intervention vary between species. The perennial and annual trends detected along Contour Seeder rip lines were less apparent along Camel Pitter rip lines where both perennial and annual species benefited from the initial disturbance. Overall, mechanical intervention has facilitated the patchy recruitment of a *M. pyramidata* over *A. vesicaria* low shrubland, including a number of perennial and annual chenopods, indicating an early stage of recovery. Continued restoration may be facilitated by reducing browse by Macropod species on established plants.

# Estimating an economic incentive to balance commercial grazing and tree growth and carbon storage on arid river floodplains

Dr Nerissa Haby<sup>1</sup>, David Oag<sup>2</sup>, Jeffrey Stringer<sup>2</sup>

<sup>1</sup>Wild R&D, Urrbrae, Australia, <sup>2</sup>Natural Resources - South Australian Arid Lands, Port Augusta, Australia

## Poster Presentation

### **Biography:**

*Nerissa is an experienced ecologist with an interest in resource selection and range dynamics, but who is often inspired by the challenges of sustainable natural resource management in a dynamic system, and the restoration of degraded communities.*

Eucalyptus coolabah is the dominant riparian tree throughout arid eastern and central Australia. In this system, E. coolabah is dependent on the unpredictable availability of soil water moisture in every stage of its life cycle, in which case, the exposure of seedlings and saplings to herbivory may be either inconsequential or critical for growth and development. This investigation aimed to: i) determine the relationship between cattle densities and herbivory on E. coolabah, ii) estimate the potential loss of profit associated with reducing cattle densities, and given E. coolabah can be sparse in the landscape, iii) identify useful indicator species in the understorey to monitor cattle browse on E. coolabah. In this case study, limiting browse to 15% of E. coolabah would require reducing cattle densities to 0.91 head km<sup>-2</sup> in the third year of a dry phase (at a loss of \$131.23 km<sup>-2</sup>), and 0.88 head km<sup>-2</sup> in the fourth year (at \$30.34 km<sup>-2</sup>). To support these stocking densities, the relative palatability of 22 species were identified for use in a monitoring program. Offsetting the potential loss in profit associated with recommended management actions may increase confidence in pastoralists to reduce cattle densities earlier than is currently practiced.

# Australian Rangelands: Their time has come in the context in the World's Economy

**Jim Hancock**<sup>1</sup>

<sup>1</sup>South Australian Centre for Economic Studies, University of Adelaide, Adelaide, Australia

**Oral Presentation - Australian Rangelands: their Context in the World's Economy**

## ***Biography:***

*Jim Hancock is Deputy Director at the SA Centre for Economic Studies. He has 25 years of experience in applied economic and statistical analysis, both at SACES and prior to that working as an economist and then manager in South Australian Treasury.*

*At SACES he has been project manager for assignments in a range of areas, including macroeconomic performance and growth, cost-benefit analysis, econometric analysis of labour market programmes, environmental evaluations, competition policy, program evaluations, regulatory issues and public finance. At Treasury his work covered a range of areas including macroeconomic monitoring and forecasting, tax policy issues, evaluation methodologies and market structure issues. He has also been lecturer for public finance in the School of Economics at University of Adelaide.*

There are two driving forces for regional development in the rangelands.

The first is internal as the Australian and South Australian economies transition to new opportunities, new industries, new activities supported by new and emerging technologies with a particular emphasis on South Australia. The second driver of change is the emergence of the Chinese economy, its path to growth and the potential impacts this may have on the economic uses of our rangelands.

# Flora and Fauna Communities of the Cooper-Eromanga Basin

Trevor Hobbs<sup>1</sup>, David Armstrong<sup>1</sup>, Dale Wenham<sup>2</sup>, Scott Howell<sup>2</sup>, Jarrod Spencer<sup>2</sup>, John Maconochie<sup>1</sup>, Augie Facelli<sup>1</sup>, Rob Brandle<sup>1</sup>, Zoë Bowen<sup>3</sup>

<sup>1</sup>Department of Environment, Water and Natural Resources, Government of South Australia, Adelaide, Australia,

<sup>2</sup>Department of State Development, Government of South Australia, Adelaide, Australia, <sup>3</sup>Beach Energy Limited, Adelaide, Australia

## Poster Presentation

### **Biography:**

*Trevor Hobbs is an ecologist and modeller of temperate and rangeland landscapes of Australia with over 30 years of experience in SA Government and CSIRO. His work has involved the analysis of biological, environmental, economic and cultural information to develop knowledge and spatial models of landscape processes, the distribution of native species and ecosystems, primary productivity, carbon sequestration, and agricultural and industry economics. This research has influenced environmental monitoring methodologies, natural resource management, biodiversity conservation, sustainable production systems, regional industry development and climate change adaptation. He is the lead author on many scientific reports and journal papers on environmental monitoring, primary production, arid lands ecology, woody crops, carbon sequestration, industry development, natural resource management and remote sensing of the environment.*

This study describes and maps the native flora and fauna communities of the Cooper-Eromanga Basin of South Australia. In past decades, regional conservation planning and environmental assessments by natural resource managers and energy industries were constrained by the lack of consistent and spatial information on the biodiversity assets of the region. Prior to this work, vegetation mapping and ecosystem information were unavailable for large portions of the region (54,000 km<sup>2</sup>), especially within Strzelecki Desert and Cooper Creek channel country. During 2016-17, this study collated biological and environmental information from government and industry sources, identified gaps in existing information, conducted new surveys in priority landscapes, analysed relationships between flora and fauna and their environment, identified dominant ecosystems (i.e. vegetation and landscapes) and their associated flora and fauna species, mapped the distribution of ecosystems, and identified areas with highest risk of disturbance (including conservation-listed species under federal and state legislation).

The new information and spatial tools created by this study significantly improves our understanding regional biodiversity for conservation planning and natural resource management decisions, and facilitates more efficient and scientifically-robust environmental assessments of petroleum/geothermal or pastoral development activities, and vegetation clearance/offset proposals in the region. Future environmental assessment, monitoring and reporting activities under legislative, regulatory and policy requirements can now be based on more reliable information on the flora and fauna communities of the Cooper-Eromanga Basin of South Australia.

# Living with Climate Change

Prof Mark Howden

## Oral Presentation - Living with Climate Change

The climate is changing and more change is in store. Projections of temperature change and CO<sub>2</sub> increase are robust whilst rainfall changes remain uncertain (and in many locations increasingly uncertain over time) even in terms of direction. The response to CO<sub>2</sub> increase in terms of plant growth and soil water relations is potentially large and positive but also uncertain. These changes will impact on almost all parts of rangeland systems including pasture and livestock production, feed budgeting and safe carrying capacity, fire, soil C, biomass C, heat stress and biodiversity. There is increasing focus on developing a practical and effective array of adaptation responses and these are the frontline approach to living with climate change. The evolution of science has been largely appropriate to help with this goal: moving from conceptual frameworks to quantitative analysis; from climate change impacts analyses to concrete adaptation and mitigation responses; from single-component studies to integrated responses.

# Ephemeral Streams and the importance of source based monitoring

Mr Andrew Oswald<sup>1</sup>, Leighton Randell<sup>1</sup>

<sup>1</sup>*Oz Minerals, Parkside, Australia*

## Lightning and Poster Presentation

OZ Minerals owns and operates two projects in the South Australian arid land region; Prominent Hill and Carrapateena. The projects are surrounded by highly ephemeral creek systems. The creek systems typically only flow for a few days a year, if at all, following intermittent rainfall. Once flow ceases the creeks/streams become a series of disconnected waterholes of varying size, most of which dry out within a number weeks or months. The quality of the water in these systems is highly variable both between individual rainfall/flow events as well between the type of flow that is occurring in a single event; high flow, base flow, nil flow.

Surface water monitoring techniques such as grab samples from streams after flow events and static rising stage samplers are problematic due to the opportunistic nature of the monitoring, the differences in flow response of the creeks to rainfall events and the change in water quality in the streams over time. The results obtained from sampling reflect the water quality from that particular flow event and as such cannot be easily compared to other events to determine ongoing trends and potential impact for compliance.

Due to this high degree of variability, traditional surface water quality monitoring techniques as applied to perennial or temperate rivers, are not effective and the guideline values, developed based on estuarine or marine waters, are no longer appropriate for ephemeral creek systems. The more ephemeral the stream the more difficult it becomes to successfully undertake these monitoring techniques and the less likely that the guideline values are appropriate.

A proposed source based approach and lead indicator reporting will give early warning signs of change in these environments while providing a clearer and more meaningful target for compliance and regulation.



# Using modern technologies to inform regional infrastructure development

Geoff Deans<sup>1</sup>, Mr Glen Wingfield, Mr Andrew Morley

<sup>1</sup>Oz Minerals, Parkside, Australia

## Oral Presentation - Changing Face of Indigenous Managed Lands

### **Biography:**

*Glen Wingfield the deputy chairperson of the Kokatha Aboriginal Corporation. Glen has an extensive history working 'on country' with the Kokatha Community and with resource developers.*

*Andrew Morley the Kokatha Aboriginal Corporation Anthropologist. Andrew has worked with Aboriginal groups throughout Australia for over a decade with multiple resource project developments.*

In order to support the development of and sustain the operations of the OZ Minerals Carrapateena Mine the infrastructure of roads, powerlines, communications assets and borefields need to be developed. Historically the process and seeking alignment for 'regional infrastructure' can create negative impacts to relationships, cultural heritage and the environment. Often the values, needs and knowledge are not incorporated in the design and placement of these assets early enough in the process.

It was understood from the outset of the Carrapateena Project that infrastructure development will create impacts. By applying a new approach OZ Minerals and Kokatha Aboriginal Corporation have partnered to develop an improved heritage survey methodology for infrastructure placement. A combination of Drone technology, high resolution aerial imagery and traditional heritage survey methods was used to identify the constraints and opportunities critical to getting the 'best result for all parties'. This process resulted in greater involvement of all stakeholders, saw improved data capture and storage and has proven to be efficient and cost effective.

The overall process has given OZ Minerals and Kokatha Aboriginal Corporation a greater understanding of the surrounding environments making it possible to work to promote and protect the rights and interest of all parties during the development of the regional infrastructure to support the Carrapateena Project.

# Resting strategies for recovery of pasture

**Mr Paul Jones<sup>1</sup>, Ms Carly Johnstone<sup>2</sup>**

<sup>1</sup>Qld. Department Of Agricultural And Fisheries, Emerald, Australia, <sup>2</sup>Qld. Department Of Agricultural And Fisheries, Biloela, Australia

## Oral Presentation - Coping with Drought

### ***Biography:***

*Paul Jones has had a 28-year research and development career with Queensland Government working in southwest, central and northern Queensland. He has done research and development work on woody weed management, rangeland monitoring, native pasture grazing trials, long term carrying capacity, grazing systems and wet season spelling.*

Reduced condition of pasture and soil is common in pasture communities across northern Australia where desirable perennial grasses are the cornerstone for profitable and sustainable beef production. Resting pasture from grazing over the summer growing season is a key grazing land management recommendation. Trials to quantify the response of native pastures to differing resting regimes were conducted. Two sites with poor condition grazing land in priority pasture communities in central and north Queensland, Australia were studied. Detailed recordings were made on plant lifecycles, pasture attributes and soil seed banks.

The recovery of 3P (palatable, perennial, productive) grasses appears to be limited by a small viable seedbank. Resting management to achieve pasture recovery will require time frames in the order of 10 years before there will be an obvious impact on land condition and productivity. A moderate stocking rate when grazing is necessary for these improvements to accrue. During drought, adjusting stock numbers to the amount of forage available is critical to avoid reducing land condition and further prolonging recovery. Other essential management includes stocking around long-term carrying capacity, and avoiding high grazing pressure on the paddocks around the rested paddock.

## Drought: rain... cash... population... resilience

Dr Dana Kelly<sup>1</sup>, Dr David Phelps<sup>2</sup>, Rev Jenny Coombes<sup>3</sup>

<sup>1</sup>Visiting Research Fellow, Australian National University, Canberra, Australia, <sup>2</sup>Chair, Western Queensland Drought Appeal and President, Longreach Rotary, Longreach, Australia, <sup>3</sup>Minister Uniting Church and Western Queensland Drought Appeal Committee, Longreach, Australia

### Oral Presentation - Coping with Drought

#### **Biography:**

*As President of the International Rangelands Continuing Committee, Dana is helping promote the idea of an International Year of Rangelands and Pastoralists. She supervises Master's and PhD thesis, is Project Manager for Toowoomba Landcare, and undertakes evaluation projects in agriculture as her consultancy business.*

*Dana has a strong theoretical background in social sciences, complemented with over 20 years practical experience in social change, agricultural extension, environmental education and natural resource management. Dana has developed and coordinated courses in rangeland management, protected area management and water planning at the University of Queensland and International Water Centre.*

*Prior to her PhD, Dana was the Queensland state-wide Coordinator for Extension for weeds and feral animals as well a National Parks Interpretation Officer with the Queensland government. She has also worked for conservation groups, managed eco-tourism lodges and run her own cattle property in southeast Queensland.*

Towns in central western Queensland are especially exposed to the risks of drought, with approximately half of the businesses directly linked to agriculture. This paper reports on surveys undertaken in 2015 and 2017 of town business.

A significant reduction in turnover is reported by businesses in the region's largest town, Longreach. Populations have declined sharply over the past four years, partly due to itinerant agricultural workers leaving the region.

Townsppeople are major contributors to social cohesion and resilience in rural and regional communities. Declining grazier incomes have led to reduced spending in town businesses as well as a negative spiral of declining population and declining services, resulting in lower social resilience in rural and remote communities.

Policy makers have four options: do nothing; understand the local context; support local capacities; and/or transform. Transformation of governance arrangements is crucial if social resilience is to be restored.

Drought assistance can contribute to developing more resilient communities. Recommendations include fostering innovation and changing the roles and responsibilities in collaboration between government and local organisations.

# A novel approach to restoring bluegrass communities in the Brigalow Belt, Queensland

Dr Josie Kelman<sup>1</sup>, Mr Nev Hunt<sup>2</sup>

<sup>1</sup>Enviro-dynamics, Hobart, Australia, <sup>2</sup>Hunt Land Management, Toowoomba, Australia

## Lightning and Poster Presentation

### **Biography:**

*Josie has specialist skills in monitoring and evaluation with a PhD in Environmental Management. Her thesis focused on evaluation of management effectiveness in protected areas. Josie has lectured in Ecology, Integrated Landscape Management and Experimental Techniques. She has worked as a private consultant conducting botanical surveys, forest carbon assessments and providing technical advice and implementing monitoring and evaluation of biological resources.*

*Josie has worked in the environmental field for over 15 years in a range of technical and management roles. This has included regional natural resource management, threatened species management, private land conservation, vegetation mapping and survey. In what is perhaps an unusual blend of skills Josie has strong technical scientific knowledge combined with considerable experience in community consultation and extension. Part of the purpose of her business Enviro-dynamics is to meld these skills together so that science communication is integral to the research and consultancy projects undertaken.*

Tussock grasslands are one of Australia's most threatened vegetation communities and are under-represented in the National Reserve Network. Many of the Bluegrass grassland remnants in Queensland's Brigalow Belt Bioregion are small and fragmented, surrounded by cleared agricultural land. The pre-clearing tussock grasslands in *Dicantheum* dominated communities show some movement back towards original condition when left un-disturbed for long periods (>80 years), providing nearby seed sources exist. Regeneration techniques have shown that this process can be accelerated especially when fire is used as a management tool. The cost of seed however remains a limiting factor to the viability of re-seeding areas. The extensive mining in Central Queensland and the Darling Downs region has provided an unexpected opportunity through the legislative offset process to trial restoration techniques and lift condition of historical grassland sites. Our recent trial used a unique approach to seed harvesting and re-sowing. Seed was harvested from local sites in good condition using a mechanical harvester. The seed and vegetative matter was packed into 5kg lots and mixed with fertiliser. The ground was prepared by ploughing and the collected material was sprayed onto the disturbed soil, from a cannon mounted on a tanker. A high success rate was demonstrated within one growing season when the site was compared to adjacent untreated areas ( $p < 0.1$ ). *Dicantheum sericium* became dominant across the treated area. The species richness is lower than benchmark reference sites but shows potential for increasing the speed of recovery for these areas which were once bluegrass communities.

# Locust and tree interactions in Australian rangelands

Mr. Douglas Lawton<sup>1</sup>, Dr. Arianne Cease<sup>2</sup>, Dr. Cathy Waters<sup>2,3</sup>

<sup>1</sup>School of Life Sciences, Arizona State University, Tempe, United States, <sup>2</sup>School of Sustainability, Arizona State University, Tempe, United States, <sup>3</sup>NSW Department of Primary Industries, Trangie, Australia

## Poster Presentation

### **Biography:**

*Douglas Lawton is an Environmental Life Sciences PhD student who started in 2016 at Arizona State University, Tempe, Arizona (USA). He comes from North Carolina where he obtained his B.S in biology from The University of North Carolina at Greensboro. He is interested how landscape features of the Australian rangeland impact distribution, abundance, and migration of locusts. He will link this landscape ecology research to socioeconomic factors coupling communities and ecosystems with the overall goal of seeking sustainable solutions to locust plagues in Australia and around the world.*

Locust outbreaks remain a major challenge to sustainable agriculture globally, including Australia. Locust swarms link people and ecosystems through time and space. Failing to account for these dynamic linkages imposes costs on future and distant people. Recent research in China demonstrated that livestock overgrazing promotes Mongolian locust outbreaks in an unexpected way - by lowering plant nitrogen content due to soil degradation. This understanding creates new opportunities to account for these linkages and develop new management strategies. In Australia, locusts tend to originate in rangelands then migrate to cropping areas. Therefore, it is critical for research and management to occur at a landscape scale. Anecdotally, Australian plague locusts (APL) became a problem in the same time frame as New South Wales lost 67% of its pre-existing forests. Early research showed that locusts were not found within tree stands. However, the spatial extent to which locusts avoid trees, and the mechanisms underpinning this relationship are unknown. In Trangie, NSW we measured APL abundance across a tree stand to grassland gradient. We have four hypotheses: 1) trees are 'islands of fertility' and result in grasses with too high protein levels for locusts, 2) locusts have decreased threat of predation in open grasslands, 3) open grasslands are warmer and locusts prefer high temperatures, and 4) locusts are repelled by shade. We found that APL were most abundant in open grasslands as compared to tree stands, as expected. Interestingly, locusts had low relative abundances even within 20 meters of trees stands. We are still testing the mechanisms, but preliminary results suggest that increasing tree cover in rangelands may assist in keeping locusts at bay. Further work is needed to understand the interactions between locusts and tree stands at statewide spatial scales. This research is supported by National Science Foundation DEB-1313693 and CHE-1313958.

# Vegetation responses to fire history and soil properties in grazed semi-arid tropical savanna

Miss Gabrielle Lebbink<sup>1</sup>, Dr Rod Fensham<sup>2</sup>, Dr Robyn Cowley<sup>3</sup>

<sup>1</sup>University Of Queensland, Brisbane, Australia, <sup>2</sup>Queensland Herbarium, Toowong, Australia, <sup>3</sup>Department of Primary Industries and Resources, Darwin, Australia

## Oral Presentation - Living with Climate Change

### **Biography:**

*I started at the University of Queensland directly after year 12 in a nutrition degree, but soon realised that this was not for me and instead pursued ecology, which was a much better fit. At the end of my undergraduate I was unsure whether I wanted to do honours, so took 6 months off. I spent a lot of this time in the Australian arid zone, helping an honours student with his research and national parks with their surveys. I also did some volunteering with my now supervisor, Rod Fensham. It was during this time that I realised I wanted to pursue a research career and decided to go ahead with honours. I had a great honours year and loved working in Australia's rangelands. So much so that I straight away applied to do a PhD, and am now working on an invasive grass species in northern Australian rangelands.*

A long term (1993-2016) fire experiment in the grazed semi-arid savanna of the Northern Territory, was used to investigate the relative impacts of soil properties and fire history on vegetation composition and diversity in grassland and woodland habitats. Subtle variation in soil texture influenced vegetation composition and abundance independently of fire variables and was generally a more important control on floristic patterns. Irrespective of fire interval or season, fire promotes greater diversity in the understorey through its positive influence on ephemeral grasses, forbs and legumes. These findings suggest fire has a modest and temporary influence on understorey floristic patterns and fire regimes may therefore be manipulated for other management imperatives without substantial impacts on botanical values in tropical savannas. This also suggests that some savanna flora may be relatively resilient to a predicted future climate of more severe fire weather.

# Groundwater: Your rights and obligations in the Far North Prescribed Wells Area

Mr David Leek<sup>1</sup>, Mr Travis Gotch<sup>1</sup>, Mr Lynn Brake<sup>1</sup>

<sup>1</sup>Department Of Environment Water and Natural Resources, Adelaide, Australia

## Lightning and Poster Presentation

### **Biography:**

*Travis Gotch has been working on the Great Artesian Basin Mound Springs for over 20 years in a range of roles ranging from scientific surveys, research and practical protection. This professional interest in the GAB springs has led to his current role which includes all elements of the compliance function; education, willing compliance and assisted compliance to protect these unique ecosystems.*

The 10 year grace period to allow for pastoralists to prepare for the water licence condition requiring closed delivery systems for stock water within the Far North Prescribed Wells Area (FNPWA) comes to an end on the 16th of February 2019. Parallel to this, a review of artesian well condition in the FNPWA has shown that 50% of wells are at a moderate or greater chance of failure within the next 5 years. This impacts on a pastoralist's ability to comply with their license conditions especially in regard to closed delivery systems. Significant improvements in our understanding of groundwater resources within the FNPWA have occurred over the past 10 years and this new knowledge is needed to shape water management in the region. This presentation will detail the rights and obligations of groundwater use in the pastoral industry, it will look at defining what is meant by good practice and judicious water use and we will inform the audience on the latest knowledge of the resource and the implications of this for the pastoral industry.

# Rangeland plants in a warming world

**Associate Professor Andy Leigh<sup>1</sup>**, Ms Ellen Curtis<sup>1</sup>

<sup>1</sup>University Of Technology Sydney, Broadway, Australia

## Oral Presentation - Living with Climate Change

### **Biography:**

*Assoc. Prof. Andy Leigh is a researcher in plant ecology at the University of Technology Sydney (UTS), with a strong interest in how plants cope with extreme high temperatures, particularly in Australia's semi-arid and arid regions. In 2013, Andy established a partnership with the Friends of the Australian Arid Lands Botanic Gardens (AALBG) and the Port Augusta City Council to carry out research at the AALBG. Through this collaborative partnership, the UTS Research Facility was established on site, where researchers from Andy's lab have been investigating how different plant species respond to heat stress. Andy's other areas of research include mistletoes, animal-plant interactions and leaf structure. She also teaches undergraduate ecology, running undergraduate field trips of >3,000 km to introduce students to the ecology, issues and stakeholders of the Australian landscape beyond the city.*

Australia's rangeland vegetation is a vital asset to this country. Australian rangeland plants often grow in extremely nutrient-poor soils, cope with highly variable rainfall, and are predominantly evergreen (less so in the northern regions). Recent years has seen Australia's climate records being broken almost yearly, with high temperature extremes being increasingly more frequent and intense. To be maintained on a plant and to remain healthy for several seasons, the leaves of our rangeland species must be able to withstand critically high temperatures. Until now, heat stress tolerance of Australian arid and semi-arid land plants has not been investigated.

This presentation will highlight our research into how different rangeland plant species respond to heat stress and their ability to adjust their heat tolerance threshold seasonally. We measured thermal tolerance thresholds for 47 species growing under comparable conditions at the Australian Arid Lands Botanic Gardens in summer, winter and spring. Species were grouped according to their natural growth preferences for particular micro-habitat conditions with respect to water availability. We found that plant heat tolerance varied widely, not only among species, but also through time and space. In a given season, heat tolerance thresholds varied by up to 10 °C among species. We also found clear seasonal differences, with average thresholds increasing by 5°C from winter to summer. Regardless of seasonal effects, plants genetically adapted to more readily accessible water had significantly lower thermal tolerance thresholds than species naturally occurring in local micro-habitats where water availability is more restricted or short-lived. These results suggest that the ability of species to adjust their heat tolerance threshold is somewhat genetically constrained and relates to the conditions of their native habitat. These findings have implications for predicting how different rangeland species will respond to increasing frequency and intensity of heat waves.



## Why do Ecological communities stop at state borders? AusPlots and the need for consistent, national scale, surveillance monitoring.

Mr Emrys Leitch<sup>1,2</sup>, Mr Ben Sparrow<sup>1,2</sup>, Ms Christina Macdonald<sup>1,2</sup>, Dr Andrew Tokmakoff<sup>1,2</sup>, Dr Greg Guerin<sup>1,2</sup>, Ms Sally O'Neill<sup>1,2</sup>

<sup>1</sup>Terrestrial Ecosystem Research Network, Adelaide, Australia, <sup>2</sup>School of Biological Sciences and Environment Institute, University of Adelaide, Adelaide, Australia

### Lightning and Poster Presentation

#### **Biography:**

*Emrys studied at the University of Adelaide and has a passion for arid ecosystems. He has worked extensively in the arid and semi-arid zone across Australia. Emrys is interested in understanding how landscape processes including fire, grazing and invasive species affect vegetation communities. Emrys has a broad range of skills and experience and is a firm believer in the intuitive responses that come from on-ground experience and from working closely with local land managers.*

With 6 years of consistent surveillance monitoring across Australia's rangelands and with increasing temporal depth, TERN AusPlots stands positioned to fill a range of knowledge gaps. AusPlots data infrastructure has been able to be used to document changes starting with local landholders through to changes at a national scale. Collaboration at all levels of government, as well as with the private sector has been critical to the success of the program thus far. The freely accessible nature of the data has also been a cornerstone of the program. Much more needs to be done, including the implementation of the nationally agreed methods of woodland, condition and fauna monitoring. There are many opportunities for further analysis of the data and samples which will help to drive effective responses to ecological challenges across the Rangelands.

# Building Relationships Towards Sustainable Development in the Fitzroy Catchment

**Mr Grey Mackay<sup>1</sup>**

<sup>1</sup>*Rangelands NRM, Broome, Australia*

**Oral Presentation - Northern Australia - the new frontier**

## ***Biography:***

*Grey is the Kimberley Program Manager with Rangelands NRM and moved to Broome in 2012. Grey previously worked with Greening Australia as National Partnership Manager and South West Program Manager. Prior to this he was the WA Business Development manager with a spatial company (GIS, Satellite Imagery, Surveying) working with all the miners in WA's North West. With this merging of business and environment, Grey is not only passionate about the Kimberley, he is well suited to the world of NRM and finding a balance between social, environment and economic needs in the region.*

Development is not a new word for the Fitzroy Catchment in the Kimberley region of Western Australia. However, it is currently the focus of an enormous level of interest and investment driven primarily by the State and Federal Governments development papers, with significant diversity and different agendas with respect to pastoral, environmental and indigenous groups.

Rangelands NRM is facilitating opportunities to make the most from these initiatives and ensure the programs follow a sustainable pathway that is grounded in best practice environmental stewardship, is respectful and inclusive with community, and pursues sustainable and appropriate economic developments. History has demonstrated that significant investment alone will not bring about sustainable change to the region. Only through an inclusive, triple-bottom-line approach will we see lasting positive change that is driven and supported by community.

Our approach is to use a networking ☒ problem solving ☒ coordinated program to assist stakeholders along a journey. We bring an openness to discuss the issues, without having the answers or driving the direction of discussions. Together, the group is developing a framework and facilitating the creation of a body who can navigate environment, social and economic needs. We are using a 'collective impact' strategy to seek shared commitment through understanding of a collective goal between participating stakeholders. This encourages the pooling of resources, tasks and objectives across multiple stakeholders to change the disposition of a complex system towards resilient, sustainable and hopefully flourishing outcomes.

# From LSP to ILP and all the acronyms in between—transforming an organisation

Dr Gaye Mackenzie<sup>1</sup>

<sup>1</sup>Rangelands NRM, Como, Australia

## Oral Presentation - Regional & Community Development in the Rangelands

### **Biography:**

*Gaye joined Rangelands NRM in October 2010 but prior to that had been providing monitoring and evaluation and communications support as a consultant for several years. She has extensive experience in social research, evaluation and project management across a diverse range of areas. Gaye has a BA in sociology and politics and a PhD in sociology and is passionate about the 'people' side of NRM, especially finding ways that people and groups can work together to achieve more than they could on their own. She commenced the position of Chief Executive Officer in January 2014.*

How does an NRM group transform from being a relatively simple project/contract delivery organisation—a conduit of government funds, a 'funding bucket'—to an organisation that provides holistic program development and delivery which has problem solving and innovation at its centre? All with a sociologist as a CEO?

Join Gaye to hear about the journey that Rangelands NRM WA has taken over the last three years to transform the way it sees itself, how others see it and how we do things. To make any kind of difference working in the expansive WA rangelands, we need to think landscape and as soon as we do that we need to think across tenure. People need to be empowered to look after their own patch and they also need to work together in a strategic way to ensure efforts are sustainable.

Gaye will briefly explore the theories and concepts that have helped shape the thinking behind the transformation. Also, perhaps more importantly, she will demonstrate how by being guided by a set of values rather than a set of rules has enabled the organisation to have the freedom to learn and adapt—a process which has resulted in deep learning for staff and those who we have worked closely with. It is a journey that has taken us from priority areas to LSP to LSC to CI and finally to ILP.

Rangelands NRM is a not-for-profit, non-political and neutral organisation working towards better WA rangelands. We connect people and projects so that real solutions can develop. We coordinate effort and resources so that the maximum results are achieved on the ground. We work with organisations to deliver on ground results. We believe if we work together, we can achieve better results.

# Arid river systems in South Australia - dynamics, change and variability at a landscape scale

Mr Henry Mancini<sup>1</sup>

<sup>1</sup>Dept. Environment, Water & Natural Resources, Adelaide, Australia

## Poster Presentation

### **Biography:**

*Henry Mancini works as a Project Officer for Natural Resources SA Arid Lands (Department of Environment, Water & Natural Resources). Based in Adelaide, Henry has worked in the arid lands of South Australia for the past 10 years on projects in the Gawler Ranges, Flinders Ranges and the extensive arid river systems of far north SA, including the Cooper Creek; Diamantina-Warburton Rivers and the Neales-Peake River catchments. He has a keen interest in understanding the dynamics and biophysical attributes of these highly variable and complex aquatic ecosystems and to translate this theory to inform the business enterprises operating in the region and the various community groups interested in these unique natural environments.*

Arid river systems in far north South Australia are vast relatively intact systems that include the Cooper Creek; Diamantina-Warburton Rivers; the Macumba River; and the Neales-Peake River catchments. These systems support a resilient cattle grazing industry. These systems have unregulated flow regimes with minimal water extraction and are significant examples, on a global scale, of intermittent, low gradient dryland rivers. The annual variability patterns in flow contributes to the Diamantina River and Cooper Creek having one of the most variable flow regimes of large rivers in the world. The South Australian reaches of the Cooper and Diamantina have very high environmental value with Coongie Lakes and Goyder Lagoon often being the focus of large waterbird numbers. An understanding of the dynamics and biophysical attributes of these highly variable and complex aquatic ecosystems is important as there is a paucity of knowledge in terms of understanding the ecological function and the key drivers and processes influencing these systems, such as salinity and flow regimes. This limits the capacity of natural resource managers to identify and manage key aquatic refuges in the catchment and to monitor changes in flow volumes that could occur from climate change scenarios and upstream water regulation, including water extraction, land-use changes and infrastructure development affecting flooding patterns. An examination of the natural features and key influences on these arid zone rivers, will be provided. This includes their unique flora and fauna; the flooding and flow regimes that are influenced from local and Queensland monsoonal rains; management implications including pest animals and plants; salinity gradients affecting vegetation distribution and extent; connectivity of catchment rivers, creeks and floodplains that influence fish distribution; Aboriginal people and their connection to country; and the main industries including mining and pastoralism. There will be a focus on the Diamantina River catchment in SA.

# From the Ground-Up: Fostering local ownership and building capacity in pastoral communities across the Southern Rangelands of Western Australia

Mr Kieran Massie<sup>1</sup>, Mr Kane Watson<sup>1</sup>

<sup>1</sup>Rangelands NRM, Como, Australia

## Oral Presentation – Pastoral Industry Trends in the Southern Rangelands

### **Biography:**

*Kieran is Program Manager (Southern Rangelands) and has a strong background in regional development through the planning and coordination of regional infrastructure and services. Whilst in the public service, he was actively involved in assisting the growth of resilient communities through economic diversification, capacity building and skills transfer. Kieran has a keen appreciation of the complex challenges and opportunities across the Southern Rangelands region, which he gained while undertaking his Master's thesis on Changing Land Use in the Murchison Rangelands in 2010.*

In the southern rangelands of Western Australia there are real opportunities to drive sustainable pastoral production and adoption of improved land management practices.

By adopting a systems-based approach driven by the pastoral industry with aligned support from government agencies, financial institutions and NGOs, Rangelands NRM is supporting targeted landscape interventions to increase confidence in the regenerative capacity of the landscape.

No single land management practice stands by itself. Practices like understanding carrying capacity, placement of watering points and management of total grazing pressure are all interlinked across the complex and diverse rangelands system. Sustainable grazing management within a changing landscape requires judgement about how to fit practices together in the specific circumstances of properties, land systems and regions.

We believe a region's greatest asset is its people. By recognising and promoting the local knowledge of land managers and complementing this knowledge with technical expertise and support at appropriate junctures, barriers to the development of sustainable pastoral production can be identified for further enquiry through shared learnings.

This process of enquiry informs the development of on-ground 'trials' and the introduction of alternative approaches to pastoral land management. Once established, a continuous improvement approach is adopted where land managers share learnings and adapt their management strategies where appropriate. Ultimately, the approach bolsters the confidence of pastoralists in applying, adapting and improving current best practices, and in evolving new practices leading to locally-owned and tailored landscape interventions.

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# Management of commercially harvested kangaroo species in the rangelands

Dr Amanda Mclean<sup>1</sup>, Mr Robert Brandle<sup>1</sup>

<sup>1</sup>Department Of Environment, Water And Natural Resources, Port Augusta, Australia

## Poster Presentation

### **Biography:**

*Amanda McLean completed her PhD at The University of Adelaide during 2015 on the conservation biology of the endangered sandhill dunnart (*Sminthopsis psammophila*). During her PhD she developed a fascination with dryland mammals and their conservation. Amanda recently became the kangaroo ecologist/ policy officer for DEWNR, based in Port Augusta, and has been amazed at the complexity of kangaroo management.*

Kangaroos are amongst the few native mammals to have increased in abundance since European settlement, and are now found in large numbers across the rangelands. The high number of kangaroos relates to an increase in water points for stock and ongoing dingo control, posing a unique challenge to pastoral and conservation land managers. Government regulation of kangaroo management follows two models, commercial and non-commercial. The commercial harvest supports a national meat and skin industry and in South Australia is limited to harvest regions covering 63% of the State. Non-commercial population reduction occurs through granting of destruction permits in areas where kangaroos are causing property or environmental damage. Kangaroo populations are estimated for the harvest zone based on annual aerial count surveys and used to determine sustainable harvest quotas for harvest sub-regions. Quotas represent fixed proportions of the previous year's estimated population, up to a 20% for Red Kangaroos, or 15% for Western Grey Kangaroos and Euros. In recent years kangaroo numbers have been climbing, peaking at 4.7 million in 2016, the highest since surveys began in 1978. Despite this, harvest rates have been falling, bottoming out at under 100 thousand during 2016, the lowest since 1984. This equates to the commercial industry taking only 15-20% of the available quota each year (<4% of the estimated population). This low harvest is also reflected in an increase in wildlife destruction permit applications by land managers to destroy over-abundant kangaroos. We present an overview of current management practices for kangaroos in the rangelands and suggest there is a need to develop a framework that involves all key stakeholder groups to support the role of the commercial industry in kangaroo management.

# Transitioning through Learning: Shark Bay Science and Research Centre

Ms Elisabeth McLellan<sup>1</sup>, Ms Larissa Lauder<sup>1</sup>

<sup>1</sup>*Bush Heritage Australia, Geraldton, Australia*

## Poster Presentation

### **Biography:**

*Elisabeth McLellan is an ecologist with over 30 years of experience in national and international contexts. After studying in South Africa and Western Australia, she began her ecological career focusing on eucalypt woodland and threatened species conservation in the Western Australian Wheatbelt. Elisabeth has also worked overseas on large mammal conservation and illegal wildlife trade, before returning to Western Australia and joining Bush Heritage Australia as the Healthy Landscapes Manager – Western Rangelands. In this position, Elisabeth has oversight of three Bush Heritage Reserves in the Mid-west region of WA – all pastoral leases in various stages of being transitioned into conservation reserves.*

The Rangelands community and industries are in a state of transition that will lead to major changes in how rangelands are appreciated, used, managed and governed. Hamelin Station Reserve, a 202,644 hectare property directly adjacent to Hamelin Pool in the Shark Bay World Heritage Area, Western Australia, is a working example of this transition. In 2015, Bush Heritage Australia purchased Hamelin Station Reserve to safeguard the cultural and natural values of this unique landscape forever. In addition to transitioning the property from its former land-use of stock grazing to conservation, Bush Heritage plans to aid regional development, scientific research and appreciation of the World Heritage Area and the rangelands, through its future plans for the Reserve.

Shark Bay is remarkable. It meets all four 'natural' criteria for World Heritage listing: exceptional natural beauty, ecological and biological processes, outstanding examples of stages in Earth's history, and biodiversity.

Shark Bay's marine and terrestrial wonders already attract researchers from across the globe, but inadequate facilities and a lack of resources mean their visits are brief. This is a missed opportunity. Bush Heritage proposes to create The Shark Bay Science & Research Centre, a world-class facility on the edge of Hamelin Pool that will draw scientists from across the globe. The centre will also offer sustainable and educational tourism opportunities, so that visitors who pass through Shark Bay can learn about the cultural and natural values of the region.

The planning and creation of this facility will be a shared venture, involving the Traditional Owners of Shark Bay, all levels of government, researchers, scientific institutions, Bush Heritage supporters and members of the Shark Bay community.

# Lessons and best practice of landholder collaboration for landscape-scale conservation and production

Ms Harriet Pfeiffer<sup>2</sup>, Dr Peter Ampt<sup>2</sup>, Dr Alex Baumber<sup>3</sup>, Dr Rebecca Cross<sup>2</sup>, Ms Emily Berry<sup>1</sup>, **Professor Graciela Metternicht**<sup>1</sup>

<sup>1</sup>*School of Biological, Earth and Environmental Sciences, Palaeontology, Geobiology & Earth Archives Research Centre (PANGEA), UNSW Sydney, Australia,* <sup>2</sup>*Sydney Institute of Agriculture, School of Life and Environmental Sciences, University of Sydney, Australia,* <sup>3</sup>*Faculty of Transdisciplinary Innovation, University of Technology Sydney, Australia*

## Oral Presentation - Transitioning to New Industries

### **Biography:**

*Graciela Metternicht is a Professor of Environmental Geography in the School of Biological, Earth and Environmental Sciences, University of New South Wales. She is a member of the Science-Policy Interface of the UN Convention to Combat Desertification, the College of Experts of the Australian Research Council, and the IUCN Dryland Ecosystem Specialist Group. Her research interest is primarily in the fields of environmental geography, with a focus on geospatial technologies and their application in environmental management (mapping and monitoring, sustainable land management, land degradation, indicators, ecosystem services) and sustainability. Prior to joining UNSW, Professor Metternicht was Regional Coordinator of Early Warning and Assessment of the United Nations Environment Programme (UNEP). Previous academic appointments include Head of Discipline and Professor of Geospatial Systems and Environmental Management at the School of Natural and Built Environments of the UniSA, and Professor of Spatial Sciences at Curtin University of Technology.*

Tensions between production and natural resource management objectives, often perceived as mutually opposing, are increasing as technological, political, social changes and climatic variability continue to shape Australian rural landscapes. This paper explores enablers and barriers for landholder collaboration to bridge this gap, and to facilitate transitioning to new industries. Through key informant interviews we identified nine central themes that need be considered for enhanced understanding of the complexities and contextual nature of landholder collaboration. These include models of collaboration; the role of government and funding; the role of industry; the role of education; marketing strategies; the importance of social cohesion; community involvement; succession of collaboration; and integrating production and conservation. Social analysis of key informants provided lessons to address barriers for achieving desired outcomes within past and present models of landholder collaboration.

Our findings suggest that when transitioning to new industries on a landscape-based scale:

- a) A one-size-fits-all approach to collaboration is inappropriate due to the highly contextualised nature of elements that make or break attempts to collaborate.
- b) The complexity of the topic affects the role of government and industry on the effectiveness and potential of outcomes generated through collaboration.
- c) Education and communication through common language are key enabling factors for the success of cohesive landholder groups.

Potential enablers to collaboration between actors at the landscape scale included: social cohesion and generation of relationships based on trust, as was the role of whole community involvement in providing support structures and generating environments conducive to effective collaboration. Themes of ownership, leadership and motivation fuelled by common interest were highlighted as key stabilising factors that contributed to the resilience of groups to survive internal and external shocks. Finally, models that demonstrated the integration of production and conservation initiatives were suggested as providing the best chance for successful cross-property collaboration.



# “The climate has always been changing”: Perspectives of climate change in far west NSW

Ms Emily Berry<sup>1</sup>, Professor Graciela Metternicht<sup>1</sup>

<sup>1</sup>*School of Biological, Earth and Environmental Sciences, PANGEA Centre, UNSW, Sydney, Australia*

## Oral Presentation - Living with Climate Change

### **Biography:**

*In 2016, Emily completed a Master of Philosophy (Environmental Management) at UNSW, focussing on perceptions of land degradation globally through the United Nations and locally in the far west region of NSW. She is now working on several research projects: facilitating collaboration between landholders (UNSW and USyd); assessing indigenous engagement by Local Land Services (USyd); and exploring the social benefits of conservation on private land (Foundation for National Parks & Wildlife). Emily has previous qualifications and experience in environmental management and communications, and would like to spend more time in the bush.*

While scientific studies and literature link anthropogenic climate change to land degradation as a cause and consequence, the connection may not be so clear for local rangelands communities. We interviewed 18 stakeholders in the far west of New South Wales about their perspectives on environmental issues and sustainable land management. Few participants were concerned about the potential effects of climate change on the region. By perceiving widespread changes over a long time frame, industrialised human impacts are seen as minimal and of little impact in comparison to the idea of a natural climatic cycle. Nonetheless, there were multiple observations of confusing or unexpected current climatic patterns, although their observers were unwilling to attribute their cause to climate change.

Many participants described their rangeland management styles as adaptive to climatic fluctuations, regardless of the reasons for its variations, suggesting that ‘believing in’ climate change is unnecessary for land managers in this region to respond appropriately to its threats. Many also expressed willingness to partake in climate-based initiatives, if given private incentives. Sustainability was seen as pragmatic, resourceful and mainstream, with intergenerational concerns being a strong motivator for sustainable land management. Such results signify a need to better understand local land managers’ perspectives in the design and implementation of climate change adaptation and mitigation strategies.

# Resource Dependent Communities: Optimistic future or inevitable closure? The case of legacy mining towns in Australia's Bowen Basin

Ms Amanda Fotheringham<sup>1</sup>, Professor Graciela Metternicht<sup>1</sup>

<sup>1</sup>University of New South Wales, School of Biological, Earth and Environmental Sciences, PANGEA Centre, Sydney, Australia

## Poster Presentation

### **Biography:**

*Graciela Metternicht is a Professor of Environmental Geography in the School of Biological, Earth and Environmental Sciences, University of New South Wales. She is a member of the Science-Policy Interface of the UN Convention to Combat Desertification, the College of Experts of the Australian Research Council, and the IUCN Dryland Ecosystem Specialist Group. Her research interest is primarily in the fields of environmental geography, with a focus on geospatial technologies and their application in environmental management (mapping and monitoring, sustainable land management, land degradation, indicators, ecosystem services) and sustainability.*

*Prior to joining UNSW, Professor Metternicht was Regional Coordinator of Early Warning and Assessment of the United Nations Environment Programme (UNEP). Previous academic appointments include Head of Discipline and Professor of Geospatial Systems and Environmental Management at the School of Natural and Built Environments of the UniSA, and Professor of Spatial Sciences at Curtin University of Technology.*

The Australian resources boom of the 60's resulted in an increase in mining activities throughout the nation and the creation of over 20 new towns to service the companies' operations. Dotted in remote areas of Australia's vast landscape remnants of these towns can still be seen 50 years on. Some of these towns haven't fared well, seeing their closure coincide with that of the mines. This has resulted in a number of ghost towns that have long been forgotten and buried deep in the archives of Australian mining legacies. This poster shares a strategy towards promoting the long-term sustainability and viability of remaining resource dependent towns using the Bowen Basin as case study. We conducted research to identify strategies with potential for sustainability of resource-dependent communities through comparative case study analysis of three towns (located in Australia, Sweden, and Canada) that experienced a closure of their parent mine. The subsequent responses of various actors including government, the parent company and the host community were identified. A comparison of these responses was made to formulate key factors necessary to aid policy makers and relevant actors in the development of sustainability strategies in the event of mine closure or restructuring.

While the circumstances surrounding the closure of the mines and the context in which they operate all differed, key similarities and relevant lessons were drawn from their experience. The impacts of negative changes within the industry can be detrimental to host communities who remain dependent on the parent company or industry. The result can potentially be a dislocation and fracturing of community cohesion. The poster touches on the impacts of mine closure on communities and is aimed to highlight the need for further research and investigation into the future sustainability and viability of resource dependent communities, including those in rangelands.

# Developing online tools to foster cross-property collaboration for environmental action and enterprise options

**Professor GRACIELA METTERNICHT<sup>1</sup>**, Dr Peter Ampt<sup>2</sup>, Dr Alex Baumber<sup>3</sup>, Dr Rebecca Cross<sup>2</sup>, Ms Emily Berry<sup>1</sup>  
<sup>1</sup>University Of New South Wales Australia, Sydney, Australia, <sup>2</sup>Sydney Institute of Agriculture, School of Life and Environmental Sciences, University of Sydney, SYDNEY, Australia, <sup>3</sup>Faculty of Transdisciplinary Innovation, University of Technology Sydney, SYDNEY, Australia

## Poster Presentation

### **Biography:**

*Graciela Metternicht is a Professor of Environmental Geography in the School of Biological, Earth and Environmental Sciences, University of New South Wales. She is a member of the Science-Policy Interface of the UN Convention to Combat Desertification, the College of Experts of the Australian Research Council, and the IUCN Dryland Ecosystem Specialist Group. Her research interest is primarily in the fields of environmental geography, with a focus on geospatial technologies and their application in environmental management (mapping and monitoring, sustainable land management, land degradation, indicators, ecosystem services) and sustainability.*

*Prior to joining UNSW, Professor Metternicht was Regional Coordinator of Early Warning and Assessment of the United Nations Environment Programme (UNEP). Previous academic appointments include Head of Discipline and Professor of Geospatial Systems and Environmental Management at the School of Natural and Built Environments of the UniSA, and Professor of Spatial Sciences at Curtin University of Technology.*

While landholders generally focus on land management at the property scale, cross-property collaboration has the potential to enhance the viability of both environmental actions and enterprise options that cut across property boundaries. On the environmental front, issues such as habitat connectivity, riparian management, soil erosion and weed and pest control could benefit from increased collaboration, while collaborative commercial activities could potentially include ecotourism, agroforestry, biobanking, carbon farming and kangaroo management.

Online spatial tools have shown to offer enhanced opportunities for collaboration by enabling landholders to connect with one another, to identify landscape-scale opportunities for environmental or commercial collaboration and to act as a repository of user-generated spatial data including monitoring results and case studies. This paper reports on the work of the Landholder Collaboration project led by the University of Sydney and University of New South Wales, with Landcare NSW and Local Land Services NSW as key partners. Landholders groups in two regions of the NSW Central Tablelands are involved in a pilot study to develop and test an online tool to enhance collaboration. A review of existing tools has identified a niche opportunity for a user-friendly tool that allows landholders to share monitoring and other data and practical experiences while deciding who to share their information with (i.e. everyone or just a select group). Social research with the two pilot groups has also identified a lack of reliable internet access as a major barrier for many landholders, and data security as a key priority. Leading natural resource management issues identified for inclusion in the pilot testing phase of the tool in 2017 include weed and pest management, landscape-scale revegetation corridors and ecotourism.

# SUCSESSES AND CHALLENGES OF DELIVERING BROADSCALE ECOLOGICAL RESTORATION, BOUNCEBACK PROGRAM, SOUTH AUSTRALIA

Ms Trish Mooney<sup>1</sup>

<sup>1</sup>Natural Resources SA Arid Lands, Port Augusta, Australia

## Poster Presentation

### **Biography:**

*Trish Mooney has worked with some amazing people delivering conservation programs in South Australia over the last 20 years or so, working on Kangaroo Island and in the SA Arid Lands. She has worked as the Bounceback Project Officer since 2011.*

Trish Mooney, Rob Brandle and Greg Patrick

Natural Resources SA Arid Lands

South Australian Department of Environment, Water and Natural Resources

The Bounceback Program has undertaken 25 years of broadscale feral fox and goat control, currently covering around 700,000 ha across the semi-arid ranges of central South Australia. The program aims to promote recovery of threatened species such as the yellow-footed rock-wallaby, and native vegetation habitats across the Flinders, Gawler and Olary Ranges. From its commencement, Bounceback has operated on and off park, through partnerships with pastoral properties and NGO and private conservation reserves. The presentation will summarise evidence from long term and more recently commenced monitoring programs that demonstrate the effectiveness of the Bounceback Program in managing threats and promoting ecological recovery.

The long term involvement of off park properties has been critical to Bounceback's success, as control of feral pests, such as foxes, goat and rabbits, requires a coordinated, broadscale effort. We will discuss the challenges involved with maintaining landholder commitment to a conservation program, particularly in relation to the triple bottom line, i.e. whether a particular pest control activity has economic benefits for the landholder's business as well as environmental outcomes.

# Harnessing Environmental Markets to Improve Productivity and Ecosystem Resilience in Australian Rangelands

Sinclair Jennifer<sup>1</sup>, Mr Dave Moore<sup>1</sup>

<sup>1</sup>Greencollar Group, The Rocks, Australia

## Poster Presentation

### **Biography:**

*Dave is GreenCollar's General Manager & Head of Business Origination. He holds a juris doctor from the University of New South Wales and is a solicitor of the Supreme Court of NSW. Dave has extensive experience navigating land sector based projects through the legal and regulatory landscape of the Commonwealths Carbon Farming Initiative.*

*Prior to studying law Dave spent 10 years working for major investments banks both domestically and overseas. His main areas of focus were listed and non-listed structured transactions to institutional and professional investors covering a range of asset classes.*

*Having worked extensively in the corporate sector, Dave has a critical understanding of the complex regulatory and commercial environment which projects must navigate to achieve commercial success. Dave also holds a Media and Communications degree majoring in Political Science from the University of New South Wales.*

Agricultural productivity in Australian rangelands is under threat from environmental, agricultural and economic factors. Pastoralism, unpredictable market forces and extreme climatic events such as drought, floods and fire may result in significant landscape degradation and loss of productivity in the absence of sustainable land management practices.

Environmental markets seek to mitigate these pressures on agricultural industries through the implementation of new and innovative mechanisms to incentivize the implementation of sustainable land management practices whilst maintaining primary productivity. The establishment of Australia's Emissions Reduction Fund, which pays farmers to generate carbon offsets, has led to numerous carbon farming projects throughout rural Australian in many high intensity pastoral regions.

In addition to carbon sequestration and emissions reduction projects, there are additional opportunities to achieve positive environmental outcomes and improve primary productivity. For example, the development of improved feral animal management systems, increased biodiversity and better watershed management (such as water spreading) in addition to the ability to create supporting ecosystems services markets.

These projects produce a variety of associated environmental and economic co-benefits. For example, economic benefits include, the diversification of income streams and access to a reliable cash flow for farmers to enhance on-farm infrastructure and therefore improve productivity. Environmental benefits include the ability to increase the resilience of native landscapes, enabling of sustainable grazing techniques and stocking rates within rangeland projects.

The carbon industry and related environmental markets are rapidly maturing although gaining a complete understanding of the interactions of land-use and land-use change on rangeland ecosystem services and land values is a challenge that lies ahead. Ongoing research will inform how to manage the balance between pasture utilization, carbon sequestration and emissions and sustainable stocking rates through best practice to ensure that a property can achieve mixed land use.

# Herbage response to shrub reduction in contrasting land classes in semi-arid woodlands of W NSW

**Mr Warren Muller<sup>1</sup>**, Dr James Noble<sup>2</sup>, Dr Richard Greene<sup>3</sup>

<sup>1</sup>CSIRO Land & Water, Canberra, Australia, <sup>2</sup>6/23 Evans Street, Mittagong, Australia, <sup>3</sup>FSES, ANU, Canberra, Australia

## Poster Presentation

### **Biography:**

*I have spent the whole of my career at CSIRO as an applied statistician, with over 40 years employed in variously named divisions and units employing mathematicians and statisticians. After formal retirement, for the past four years I have been an Honorary Fellow, currently in CSIRO Land & Water.*

*My role has been as a statistical consultant specialising in the application of statistical methodology in the biological and environmental sciences. I have collaborated with a large number of CSIRO scientists, mostly in Land & Water and Agriculture, and have also undertaken a diverse range of consultancies for clients outside CSIRO. My work has resulted in over 90 scientific publications, primarily in application discipline journals as a joint author, and many client reports. I first worked with scientists in CSIRO rangelands programs in the 1970s and continued working with ecologists in CSIRO Canberra and Darwin throughout my career.*

Uncontrolled growth of shrubs in the semi-arid woodlands of eastern Australia has been termed the 'woody weed problem'. The presence of unwanted shrubs has resulted in reduced herbage production in most years, hence reduced livestock carrying capacity with consequent economic impact with loss of productivity. It would be possible to examine the relationship between shrub density and herbage productivity by an observational study of sites with varying shrub densities. However shrub density may just be an indicator of site quality, and not necessarily related to herbage productivity. Consequently an experiment was established in 1991 on a property c. 50 km northwest of Louth, NSW, to manipulate shrub densities and measure herbage responses at 6 samplings over the following four years. Three sites were selected at different positions within each of two land classes, sandy mulga, dominated by hopbush (*Dodonaea* spp.), and ironwood mulga, dominated by punty bush (*Senna artemisioides* subsp. *filifolia*). Within each site seven 30 x 30m plots were selected and a gradient of seven shrub reduction treatments (0%, 25%, 50%, 70%, 80%, 90%, 100%) was applied to the plots at random in August 1991. Treatments comprised selective burning of the appropriate number of shrubs to achieve the required reduction. Ground cover percentages of forbs, grasses, shrubs, soil and wood were estimated before treatments were applied. Biomass and composition of grasses and forbs was measured on each plot on six occasions from October 1992 to September 1996. There were strong positive relationships between herbage production and percentage shrub reduction within each land class at different measurement times in the experiment. These varied according to the distance from water and the component of vegetation measured. A selection of these relationships is presented and the implications for management by shrub reduction are discussed.

# Bridging the Divide: Implications of Social Variations Between First- and Multi-Generational Ranchers

Phd Candidate Katherine Munden-Dixon<sup>1</sup>

<sup>1</sup>University of California, Davis, Davis, United States

Oral Presentation - Regional & Community Development in the Rangelands

## **Biography:**

*Kate Munden-Dixon is a PhD candidate at the University of California, Davis in the Geography program specializing in food systems research. Prior to UC Davis, Kate worked for The University of Georgia as the Sustainable Agriculture Research and Education (SARE) Program Assistant. In this position, she worked with small- and mid-scale farmers and ranchers to develop food hubs and efficient agroecology practices. Kate has degrees from The University of Georgia - A.B., International Affairs, 2004; MEPD, Masters of Environmental Planning and Design, 2011. Her current research focuses on the political ecology of livestock and ranchers in California.*

California's ranching landscape is shifting as new ranchers enter, often with differing socio-economic backgrounds and goals. In contrast to multigenerational ranchers (MGRs), first-generational ranchers (FGRs) are more likely to be younger, highly educated, non-White, non-Hispanic and female (Ahearn and Newton 2009). This talk will explore how FGRs' operations, values, concerns and information sources from MGRs within California. Identifying these differences, as well as the nexus of similarities is critical, as previous research has indicated that understanding variations in FGRs operations and decision-making is key to crafting policies and initiatives to support these beginning ranchers and the health of rangelands (Huntsinger and Oviedo 2014). This presentation will conclude with an exploration into how beginning ranchers' success is enabled, and offer potential lessons for other rangelands undergoing demographic transitions.

## Kids on Country - Outback Ecology Camps at Witchelina Nature Reserve are providing Aboriginal students with opportunities for further education and employment on traditional lands.

Ms Caroline Nefiodovas<sup>1</sup>, Ms Jacquie Dealtry<sup>2</sup>

<sup>1</sup>Nature Foundation SA, Hindmarsh, Australia, <sup>2</sup>Heathgate Resources, Adelaide, Australia

### Lightning and Poster Presentation

#### **Biography:**

*Caroline is responsible for helping Industry better connect with nature and to see nature as an important part of business. She works closely with mining and petroleum companies, The South Australian Chamber of Mines and Energy, renewables companies, infrastructure organisations, and regional and aboriginal communities.*

*Caroline is passionate about improving the prospects for the environment, balanced with the needs of business, society and future generations. She has studied environmental science, holds a diploma in project management and has worked on climate change project and in the telecommunications and human resources management industries.*

Conservation charity Nature Foundation SA is leading a series of 'Kids on Country' outback ecology work experience camps at Witchelina Nature Reserve, just north of Lyndhurst in northern SA.

The camps form a gateway for students to participate in the Aboriginal School Mentoring Program (ASMP), a dynamic program developed by Heathgate Resources Senior Human Resources Advisor, Jacquie Dealtry. The ASMP won the 2016 SA Premier's Community Excellence Award in Mining and Energy for Excellence in Social Inclusion. An innovative collaboration between Heathgate Resources, Port Augusta Secondary School, Career Employment Group and Nature Foundation SA is providing unique learning experiences for Aboriginal high school students "on country" at Witchelina Nature Reserve.

The camp program is designed to not only ensure students thoroughly enjoy their time at Witchelina, but also to gain important life skills such as living away from home in a remote location. The students gain conservation land management experience by participating in activities alongside Nature Foundation SA ecologists and conservation managers. Students spend four days in and around the Witchelina homestead precinct participating in field activities such as a Geocache Treasure Hunt, Bird Watching and a Plant Identification Walk where they develop skills in map reading, conducting bird surveys, flora and fauna identification and data management. As part of the safety induction on site, students are taught how to operate UHF radios and GPS units for use in the field. By learning about the range of work Nature Foundation does in conservation and land management, students are also discovering potential jobs available on the lands.

The broader ASMP connects students with opportunities for further education and possible employment within the Resources Industry. The program is aimed at providing young Aboriginal students with the skills, opportunities and self-belief to complete their schooling and step out into the workplace with confidence.



# A Natural Partnership - Conservation charity Nature Foundation SA's partnership with industry is having a positive impact on nature conservation in the SA Arid Lands

Caroline Nefiodovas<sup>1</sup>, Mr Alex Nankivell<sup>1</sup>, Dr Marina Louter<sup>2</sup>

<sup>1</sup>Nature Foundation SA, Adelaide, Australia, <sup>2</sup>Flinders University, Adelaide, Australia

## Oral Presentation - Regional & Community Development in the Rangelands

### **Biography:**

*Conservation Programs Manager with Nature Foundation SA since 2008 responsible for strategic and operational sides of Nature Foundation SA business operations, from writing management plans to overseeing their on- the-ground implementation. Alex holds a Bachelor of Applied Science in Environmental Management and a Masters of Project Management*

Many might think that a partnership between resources companies and a conservation charity is an unlikely one. However, both sides are landowners and managers sharing some clear synergies and goals, including a concern for nature conservation. Both want meaningful relationships with neighbours, the local community and traditional owners. There are multiple opportunities for information sharing and collaboration.

Nature Foundation began working with South Australian mining and petroleum companies in 2009 as a third party provider, to assist them meet their legislative requirements under South Australia's Native Vegetation Act 1991. Approved native vegetation clearance must be offset by an action that will produce an overall environmental gain, known as a Significant Environmental Benefit (SEB).

While it is a constant challenge for Nature Foundation SA to fund its ambitious conservation objectives, early partnerships with companies such as Santos and Beach Energy ultimately led to the establishment of Witchelina Nature Reserve (4,200 square kilometres), a former pastoral station located near Lyndhurst. Witchelina is an established SEB credit site providing clearance proponents an alternative to paying into the Native Vegetation Fund or undertaking an offset project themselves.

Nature Foundation SA has built its 36-year history through partnerships with governments, industry, universities, Aboriginal communities and community groups. These partnerships have yielded landscape-scale conservation outcomes at Witchelina and demonstrable environmental gains, research opportunities and involvement of the wider community in conservation activities.

# Can greenies and graziers be friends? Profitable grazing supports reptiles in a tropical savanna rangeland

Mrs Heather Neilly, O'Reagain Peter, Lin Schwarzkopf, Jeremy Vanderwal

## Poster Presentations

Rangelands are used primarily for grazing by domestic livestock, however, their role in conservation cannot be overlooked. 'Off-reserve' conservation in agricultural landscapes implies a trade-off between maintaining the ecological processes that support biodiversity and food production and profitability. To evaluate the potential biodiversity trade-off in rangelands we need to understand how different livestock grazing strategies affect biodiversity, and also how they perform in terms of food production and profitability. We monitored reptile community response over three years, to four cattle-grazing strategies (Heavy, Moderate and Variable stocking rates and a Rotational wet season spelling treatment) in a replicated, long-term grazing trial. Simultaneously, measures of animal production, profitability and land condition were collected for the different treatments. Overall reptile abundance was lower in the Heavy grazing treatment, however there was little difference between the other 3 treatments. Yearly and seasonal differences in precipitation significantly affected reptile abundance. As drought conditions worsened over the three years, the negative impact of the Heavy grazing treatment became more pronounced. The economic and land condition metrics also followed the same trend. Not only did heavy grazing negatively impact reptiles, it is also the least profitable grazing strategy over the long term with the least productive pasture. This suggests that in this tropical savanna rangeland there is no trade-off between economic performance and reptile abundance and diversity. Grazing regimes with a moderate stocking rate or flexible management strategy were better able to buffer the effect of drought resulting in a more resilient reptile community and better economic outcomes in dry years.

## Middleback Station - a pastoral legacy

Andrew Nicolson Snr

### Oral Presentation - Legacy in the Rangelands - Middleback

Middleback and its associated properties, especially Roopena, which are located around and pre-date Whyalla and have recently been acquired by Defence to expand the Cultana military training area, have left a remarkable legacy for rangelands science and management in South Australia and beyond.

Due to the availability of good water from Wizzo Well, and the entrepreneurial engineering spirit of pioneer George Nicolson, Middleback demonstrated the appropriateness of the 'Waite' model of pastoral development: small paddocks, a small mob of sheep in each and dependant on a single watering point off-centre towards the NE corner.

Andrew Sr and his brother Don both enjoyed higher education in agriculture and time away from the property, and both had a strong interest in scientific pastoral management. They actively sought out innovative ideas, and supported University research and teaching for some 40 years, spawning a rich legacy of research, researchers and generations of undergraduate students touched by the Middleback experience. This session will explore these and other Middleback legacies. Andrew Sr, supported by his son Andrew Jr, will be interviewed by one of the Middleback graduates, Dr Martin Andrew.

This history of the Middleback properties, authored by Andrew Sr, has just been published as "Wizzo. The Story of a Well and the Nicolson Family". Autographed copies of this book will be available for sale after this session. (Watch out for the review by Dr Noelene Duckett – another Middleback graduate – in the forthcoming issue of "Range Management Newsletter").

# The benefits of avoiding soil organic carbon loss by wind erosion in western NSW

Dr Adrian Chappell<sup>3</sup>, Dr Cathy Waters<sup>2</sup>, Dr Susan Orgill<sup>1</sup>

<sup>1</sup>NSW Department of Primary Industries, Wagga Wagga, Australia, <sup>2</sup>NSW Department of Primary Industries, Trangie, Australia, <sup>3</sup>School of Earth and Ocean Sciences, Cardiff University, Cardiff, United Kingdom

## Lightning Presentation

### **Biography:**

*Susan has worked in NSW DPI for more than 10 years on a range of soil projects. Susan's current research is focused on developing management strategies to increase carbon in agricultural soil. Her areas of interest are carbon fractionation, subsoil carbon sequestration, management of pastures to increase soil organic matter and dynamics of carbon in the rangelands. Susan has also recently completed her PhD which investigated environmental (climate and parent material) and land management factors that influence organic carbon accumulations in perennial pastures.*

The Australian Government's Emissions Reduction Fund (ERF) developed projects across extensive areas in southern Australian rangelands to sequester carbon (C) in woody vegetation. However, the loss of soil organic carbon (SOC) by wind erosion is not considered in the C budget. Wind erosion processes are highly selective, removing preferentially fine SOC- and nutrient-rich soil. Enriched dust can be transported rapidly and over long distances resulting in net loss from the terrestrial ecosystem and reduced soil fertility, moisture holding capacity and soil aggregate stability which may feedback to promote more erosion. Wind erosion is strongly influenced by the vegetation height, width and spacing (lateral) cover i.e., species type and distribution. Consequently, changes in structure and spatial distribution of vegetation associated with land management (including ERF projects) can accelerate soil erosion and reduce the quality of the soil. This unintended and potentially irreversible soil degradation will negatively impact on rangeland resource condition.

We investigated the amount, quality and change between 2000 and 2016 of wind erosion and dust emission from the Cobar and Mulga Lands bioregions in western NSW. We used a model created in the Google Earth Engine (GEE) with satellite (MODIS) and Global Land Data Assimilation System (GLDAS) wind and soil data. Wind erosion and SOC, nitrogen (N) and phosphorous (P) dust emission was calculated every 8 days, at 500 m pixels. The long-term average wind speed and soil moisture did not change during the period. However, lateral cover reduced or was persistently below the level prone to wind erosion. We attribute wind erosion, dust emission and the loss of SOC, N and P to current management of vegetation and consider its implications for long-term ERF carbon farming projects and future management.

# In search of tropically adapted cattle: does size matter?

Dr Lester Pahl<sup>1</sup>

<sup>1</sup>Department Of Agriculture And Fisheries Queensland, Toowoomba, Australia

Oral Presentation - Northern Australia - the new frontier

## **Biography:**

*After obtaining post-graduate qualifications and spending a few years working in wildlife ecology, Lester migrated into the extensive livestock industries of Queensland. Over 23 years with the Department of Agriculture and Fisheries Queensland, Lester has worked on total grazing pressure involving sheep, macropods and feral goats, environmental management systems and ecolabelling in the pastoral industry, and bio-economic modelling of beef industry management practices and the effects of climate variability and climate change.*

The body size of individuals of a species of herbivore in the tropics can be half that of individuals of the same species in temperate zones. This occurs because the tropics do not have the large quantities of high quality, young, green grass leaves needed by large herbivores for growth, gestation, lactation and replenishment of weight lost during the dry season. Instead, the tropics have large quantities of tall grasses containing high levels of fibre and lignin. Herbivores take a long time to masticate and ruminate this, and they take a long time to digest it. This limits their dry matter intake, and consequently the energy and nutrients available to them.

Tropical environments select for cattle with small frame size, while industry selects for large frame size. Industry maintains large cattle through a range of management practices, sometimes with very high costs. It is proposed that smaller framed cows will more regularly achieve condition scores needed for high weaning rates. Higher weaning rates should increase the amount of beef produced per hectare, and smaller framed cows may have lower production costs.

# “BITEBACK” A MODEL OF COMMUNITY DRIVEN PEST MANAGEMENT IN SOUTH AUSTRALIA

Mr Greg Patrick<sup>1</sup>

<sup>1</sup>Department of Environment, Water & Natural Resources, SA Arid Lands NRM, Port Augusta, Australia

## Poster Presentation

### **Biography:**

*Greg Patrick has been delivering biosecurity programs in the rangelands over the last 17 years. The key focus during this time has been assisting land holders in the agricultural and pastoral regions of SA to improve their viability by managing threats such as pest plants and animals on their properties. More recently, as the Team Leader Biosecurity in Natural Resources SA Arid Lands Greg has been overseeing the team working on coordinating community's efforts to reduce wild dog impacts on the livestock industry through the "Biteback" program. Prior to his time in with NRM Greg worked as a commercial pilot servicing the aboriginal communities across the central and western deserts of SA, WA and NT.*

Wild dogs, including dingoes, play an important ecological and cultural role in South Australia, but they can also be a serious livestock pest. In South Australia wild dogs are managed strategically across two distinct management zones, inside (south of) the dog fence, where the dingo is a declared pest animal and outside (north of) the dog fence, where the dingo is categorised as unprotected native wildlife.

The “BiteBack” Program commenced in 2009 initiated by landholders in the Flinders Ranges when they noticed an increase in wild dog attacks on sheep. Managed by the SA Arid Lands Natural Resources Management Board and in partnership with landholders, industry and government, Biteback is an example of a coordinated approach to wild dog management. Management south of the fence has the aim of removing wild dogs to ensure viability of sheep production which would be unviable in the presence of a large wild dog population. Management north of the dog fence has the aim of minimise wild dog impacts to the cattle industry while maintaining the ecological and cultural roles of wild dogs.

Key to the effectiveness of Biteback is the coordinated and systematic control carried out by land managers. 21 community based Local Area Planning groups have been formed to undertake coordinated district scale control activities. These include development of local plans to define the groups commitment in wild dog control, bi-annual coordinated baiting programs, trapping training workshops, communication and reporting wild dog activity.

With around an 80% participation rate, across 180 pastoral and freehold properties, over an area of 200,000km<sup>2</sup>, BiteBack continues to improve the pastoral community's ability to manage an ongoing threat to livestock in the SA rangelands.

# Building drought resilient regions: lessons from central western Queensland

Mr Peter Whip<sup>2</sup>, Dr David Phelps<sup>1</sup>

<sup>1</sup>Department of Agriculture and Fisheries, Longreach, Australia, <sup>2</sup>PRW Agribusiness, Longreach, Australia

## Oral Presentation - Coping with Drought

There are indications that grass-roots communities, Local, State and Australian governments are recognising the need for a framework to identify issues and solutions at a regional scale. Vulnerability theory has emerged globally as an approach to help build regional resilience, especially to climate variability and drought. Within central-western Queensland, on-going drought since 2012 has highlighted an above-average adaptive capacity, but high exposure to the impacts of drought. The economy depends on the financial success of grazing, which is directly coupled to a variable climate and high drought risk. A large proportion of the region's town economies and population depends on the grazing industry, and shocks to the grazing economy lead to high socioeconomic impacts. The exposure and sensitivity to these shocks is far greater than in eastern Queensland which is more populous and has a more diversified economic base.

Resilience can be enhanced or undermined through a range of actions, and is generally enhanced when external parties engage with local communities to determine their needs. Socioeconomic responses which build resilience include improved infrastructure, economic diversification, enhanced governance and strengthening human capital. Socioeconomic responses which undermine resilience include a loss of decision making power, excessive population change, and maladapted management systems.

Determining vulnerability based on regional factors of:

- exposure (stress factors, exposed population, and socioeconomics);
- sensitivity (characterised by technology, socioeconomics and regional activities); and
- adaptive capacity (human capital, governance systems and livelihoods)

is recommended as a useful framework to build resilience.

# Cost or quality: How are drones and new technology changing natural resource management?

Ms Kylie Piper<sup>1</sup>

<sup>1</sup>University of Adelaide, , Australia

## Lightning Presentation

### **Biography:**

*Kylie is currently undertaking a Masters of Science by Research at the University of Adelaide within the Centre for Applied Conservation Sciences. Through her project she is working with Bush Heritage Australia staff on properties in Rangelands areas across Australia. Her research aims to develop a tool to assist natural resource managers to make practical and timely decisions on the cost-effectiveness of new technologies for monitoring, including drones and image recognition software.*

*She has a background in business and regional community development and science communications along with formal qualifications in zoology from UNSW and interactive multimedia from UTS. Her varied career has taken her from the Australian Museum and the Australian Geographic Society in Sydney, to the Australian Age of Dinosaurs Museum of Natural History in central west QLD, to Arid Recovery in remote SA where she was General Manager/CEO from 2010-2015.*

To increase the take up of new technology by conservation and natural resource managers, the value to project outcomes and associated costs must be understood. Developing a thorough understanding of the usefulness of a new technology and impact on business practices within organisations is essential. In conservation and natural resource management this may include gaining an understanding of the methodology and accuracy of data collection and its relevance to on-ground management practices as well as cost of implementation. However, few organisations have the resources or opportunities to gain a full understanding of all aspects of each individual technology which is critical to support informed decisions on their uptake. The application of new technologies such as un-manned aerial vehicles (drones) within the conservation and natural resource management industries has the potential to cover new areas for monitoring of species and allow access into remote or difficult terrain. As in other areas, misconceptions by conservation managers and practitioners surrounding drones can lead to delays adoption. Some general perceptions surrounding new technology include:

1. methods that use technology are more expensive than field based studies
2. information gained is not relevant for a particular project
3. data gathered is unreliable
4. technology is difficult to use
5. introduction of technology may replace professionals
6. the cost of implementation and training is not affordable

Evaluation of projects using drones has been limited to date, but often includes references to individual species or has limited scope for cross project comparisons. Development of ways to incorporate overall project and organisational needs into a standardised evaluation of technologies is key to their implementation.



# Investigating the value of seasonal climate forecast for beef grazing enterprises: Charters Towers case study

Dr Kate Reardon-Smith<sup>1</sup>, Dr Duc-Anh An-Vo<sup>1</sup>, A/Prof Shahbaz Mushtaq<sup>1</sup>, Mr David Cobon<sup>1</sup>, Dr Shreevatsa Kodur<sup>2</sup>

<sup>1</sup>International Centre For Applied Climate Sciences, University of Southern Queensland, Toowoomba, Australia, <sup>2</sup>Institute for Agriculture and the Environment (Research), University of Southern Queensland, Toowoomba, Australia

## Lightning Presentation

### **Biography:**

*Kate is a Research Fellow (Integrated Climate Science Applications) at the International Centre for Applied Climate Sciences (ICACS) and Institute for Agriculture and the Environment (IAgE) at the University of Southern Queensland (USQ). She has over 20 years of professional and community experience, spanning a range of fields including agro-ecology, climate risk management and sustainable land management systems. She is involved in cross-disciplinary research which integrates climate modelling, agricultural production systems, ecology, spatial modelling and environmental policy to support improved decision making and sustainable natural resource management.*

Seasonal climate forecasts (SCFs) have potential to improve productivity and profitability in agricultural industries, but are often underutilised due to insufficient evidence of the economic value of forecasts and especially when the forecasts are associated with uncertainty. In this study, we demonstrate the value of integrating SCFs at various forecast quality (skill) levels to reduce investment or opportunity losses for a grazing enterprise case study at Charters Towers. A seasonal forecast system based on ENSO phases was parameterised by forecast quality to predict seasonal precipitation tercile (i.e. wet, neutral, dry) categories. We developed a bio-economic model of forecast use, explicitly incorporating forecast uncertainty. Using ag-systems production simulation software (i.e. GRASP, NABSA) calibrated using the case study information, we simulated pasture growth, herd dynamics and annual economic returns under different climatic conditions. We then employed a regret and value function approach to quantify the potential economic value of using SCFs in decision making.

Applying this conservative economic modelling approach, we show that skilled SCF systems contribute considerable value to farm level decision making. At the current SCF skill of 60% (derived by correlating the ENSO signal and historical climate data at Charters Towers), a forecast value of AUD6000 per annum was realised; improvement of 10% in forecast skill (to 70% accuracy) would potentially result in AUD2000 additional annual benefit; and a perfect (no regret) forecast could result in increased return of AUD19000 per annum (18% of the case study average annual net profit of AUD104000).

Improvements in the skill and reliability of SCFs is likely to drive wider uptake of climate forecasts in agricultural decision making. We also anticipate that an integrated framework, such as that developed in this study, will provide a pathway for better communication with end users to support improved use of forecasts in agricultural decision making.

# The Western Australian Rangelands Roundtable

## Mr Rodney Safstrom<sup>1</sup>

<sup>1</sup>Department Of Agriculture And Food, Western Australia, South Perth, Australia

### **Biography:**

*Biography Rodney Safstrom BSC (forestry), Melb; MSc (NRM) UWA.*

*Rodney works for the Department of Agriculture and Food in Western Australia and has previously run his consulting business. He has been a member of the Conservation Commission of Western Australia and Chair of Greening Australia Western Australia. Over the past 25 years he has contributed in the WA rangelands in biodiversity conservation, eco-tourism, rangelands ecology, soil and land conservation, weed policy and land use planning. His current focus is in developing soil and land conservation guidelines for new irrigation developments in the rangelands, leading a working group seeking to support improvements in rangelands condition and economics in the southern WA rangelands and supporting fellow rangeland scientists. His greatest interest is in improving how we communicate as he sees this as just as important as technical matters.*

### Rangelands Conference Roundtable 2017

A forum for people passionate about contributing to rangeland social, economic and ecological science, designed to share learning across agencies, consultants, pastoralists and other interested people; and contribute to sustainability in the rangelands

The Western Australian Rangelands Roundtable is a non-hierarchical knowledge sharing meeting. It includes people from the consultant industry, government, not-for profit and University sectors, with social, economic and environmental skills and experience related to the rangelands of Western Australia. It is based on having an equal voice and space to speak. It is a forum for listening and asking questions rather than argumentative debate. Benefits include learning through sharing, enabling collaborations and for new ideas to emerge.

In this conference a roundtable is proposed for each day of the conference. At these roundtables Rod Safstrom and Gaye McKenzie will briefly share their experiences of the WA Rangelands Roundtable, share the protocols they use and invite participants to experience the format in a Rangelands Conference Roundtable. The theme for the Rangelands Conference Roundtable will be for participants to share their experience of the conference and explore creating across skill area and/or across sector collaborations. Sharing our individual experiences may enable participants to take home ideas to improve their own collaborations. Themes and ideas from the roundtables will be captured for sharing post conference. There is potential for on-going non-state based roundtables using platforms such as Skype.

Round Table is a form of academic discussion. Participants agree on a specific topic to discuss and debate. Each person is given equal right to participate, as illustrated by the idea of a circular layout referred to in the term roundtable (Wikipedia). Guidelines include listening with intent to understand, valuing all perspectives, taking turns to speak, opportunities for questions, respect for time and allowing silences.

# 'Pass the Parcel' - How petroleum companies are avoiding their rehabilitation responsibilities in Far SW Queensland.

Dr Rob Savory<sup>1</sup>

<sup>1</sup>*RSES, McCracken, Australia*

## Poster Presentation

Petroleum exploration in Far SW Queensland commenced in the early 1980s under the Petroleum Act 1923. Many seismic lines were bulldozed across the rangeland, usually with two passes. The rehabilitation requirements at that time were (i) installation diversion banks at suitable intervals across the seismic lines and, (ii) the respreading of the graded windrows back across the seismic lines. Generally, these requirements were completely ignored and as a result there has been serious soil erosion.

Gully-head advancement rates of up to 14 metres/year have been recorded and some gullies are now 10m wide x 1.5m deep x hundreds of metres long

Land degradation on petroleum tenements in Far SW Queensland has largely been ignored by State regulators. Inspections by environmental staff are rare, primarily because Eromanga is more than 1,000 km west of Brisbane.

Over the past 30 years, petroleum companies have taken advantage of this isolation and have, with very few exceptions, ignored their rehabilitation responsibilities. Companies are required to lodge a rehabilitation security bond, known as a Financial Assurance (FA), with the Government. These FAs are of little environmental value because they are based on old data and do not accurately reflect the continually increasing extent of the erosion nor the continually increasing costs of rehabilitation.

A petroleum company can sell on its tenements (complete with its environmental liabilities) to another company; this with no transfer inspection by the Department of Environment & Heritage Protection (EHP). For example, there have been five consecutive operators of tenement ATP269P since 1980. During this time, almost no rehabilitation has been undertaken.

In September 2016, in accordance with the 'duty to notify' provisions sections 320-320G of the EPA Act, the writer and an ATP269P-affected Eromanga landowner formally notified the EHP of serious environmental harm resulting from petroleum activities. The outcome is pending.

# TERN AusCover: Delivering Imagery and Services to Industry and Landholders in the Rangelands

Dr Peter Scarth<sup>1,3,5</sup>, Dr Andre (Alex) Held<sup>4,5</sup>, Dr Bek Christensen<sup>5,3</sup>, Prof Stuart Phinn<sup>1,3,5</sup>, Prof Graciela Metternicht<sup>2,5</sup>

<sup>1</sup>Joint Remote Sensing Research Program, St Lucia, Australia, <sup>2</sup>University of New South Wales, Kensington, Australia, <sup>3</sup>The University of Queensland, St Lucia, Australia, <sup>4</sup>CSIRO, Canberra, Australia, <sup>5</sup>TERN Auscover, St Lucia, Australia

## Oral Presentation - Monitoring after ACRIS

### **Biography:**

*Peter Scarth works with a cross disciplinary team team at the Joint Remote Sensing Research Centre (JRSRP) to develop data management systems and mathematical models that measure and map both major and more subtle changes in Australia's vegetation using large earth observation data sets linked to vegetation field data systems. By building demonstrated value on our collective ecosystem data and engaging with stakeholders across academia, government and industry he aims to maintain and extend our data holdings and build "long science" to address wicked problems in the land management space. Peter also works within TERN/Auscover to democratise management and access to spatial data and promote uptake of products by researchers, policy and the public. As an application developer he has a particular interest in delivering difficult to use data in a ways that tell a compelling stories.*

In the Australian rangelands, Terrestrial Ecosystem Research Network (TERN) collaborates with several groups including the NT Department of Land Resource Management (DLRM), the Queensland Department of Science, Information Technology and Innovation (DSITI), the Australian Collaborative Rangelands Information System (ACRIS), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). These collaborations have led to the development of biophysical products tailored for the Australian Rangelands including MODIS, Landsat and Sentinel-2 fractional cover, fractional ground cover, burnt area mapping and persistent green state and trend products.

These products underpin several rangeland-specific information products, including the Dynamic Reference Cover Method (DRCM) to assess the state and trends in rangeland environments; bare and green cover deciles to report on the current and historical condition of the grazing resource; and custom anomaly products to compare past and current conditions against a known baseline period. As well paddock, property and regional time series plots are used for comparative cover analysis with tools such as VegMachine and the NRM Spatial Hub.

Products are delivered through time series-enabled web mapping and customised web-processing services, enabling full time series over any spatial extent to be retrieved in seconds. The tools allow interrogation and summarization of massive earth observation data sets in an accessible, producer-friendly way, and are being used by graziers monitoring paddock condition, organisations supporting land management initiatives in Great Barrier Reef catchments, and students developing tools to understand land condition and degradation. Internet tools are supporting several other land condition mapping tools and will inform global efforts to combat desertification by reporting on UN Sustainable Development Goal 15 and associated indicator of annual change in degraded or desertified arable land.

# Utility of Integrated Monitoring for an Evidence Based Approach to Rangeland Management in the Northern Territory

**Dr Andrew Scott<sup>1</sup>**, Mr Cameron Wallace<sup>1</sup>, Mr Laurie Tait<sup>1</sup>, Dr Henry Brink<sup>1</sup>, Mr Jason Barnettson<sup>1,2</sup>

<sup>1</sup>Department Of Environment And Natural Resources, Alice Springs, Australia, <sup>2</sup>Joint Remote Sensing Research Program and the Remote Sensing Research Centre at the University of Queensland, Brisbane, Australia

## Poster Presentation

### **Biography:**

*Andrew Scott is a Rangelands Monitoring Officer for the Department of Environment and Natural Resources in the Northern Territory, based in Alice Springs.*

Long-term monitoring is important in arid rangelands because both rainfall and management can cause large temporal and spatial changes in vegetation cover and composition. In the Northern Territory (NT), rangeland monitoring has been undertaken in various forms since the late 1970's, and is legislated under the Pastoral Land Act.

An integrated monitoring programme was introduced in 2013, combining remotely-sensed imagery of fractional ground cover with improved ground-based monitoring. The satellite data are being progressively validated for pastorally productive land types in the NT, which will allow cost-effective monitoring of changes in vegetation cover at plot, paddock and regional scales at key times within a year and over many years.

The ground-based monitoring occurs at permanent sites on each of the NT's 223 pastoral leases, with a planned five-year return interval. Fractional ground cover is measured using the published ABARES method ('star transect') and adds value because it: (i) provides more quantitative data than previously collected; (ii) is used to calibrate and validate remote sensing data; (iii) can be adapted to collect multiple lines of evidence on rangeland condition that remote sensing alone cannot provide; and (iv) allows immediate feedback on ground cover to be given to pastoralists at the time of monitoring. This method is an Australian standard and can thus also contribute to future national monitoring programmes.

In 2017 integrated monitoring will collect data across approximately 140,000 km<sup>2</sup> of pastoral land in the NT, delivering improved annual reporting to the Pastoral Land Board and lessees, based on objective information on ground cover dynamics and other indicators of land condition (pasture species composition, persistence of perennial grasses, erosion, and tree / grass balance). The expanded monitoring programme has been well received by the pastoral industry, and enables monitoring to become part of rangeland management.

# Buffel busting: pasture composition after 33 years of *Cenchrus ciliaris* removal in central Queensland rangelands

Dr Jen Silcock<sup>1</sup>, Mr Russell Fairfax<sup>2</sup>, Mr Ian Hoch<sup>2</sup>

<sup>1</sup>University Of Queensland, Brisbane, Australia, <sup>2</sup>Kerand Station, Alpha, Australia

## Lightning and Poster Presentation

### **Biography:**

*Jen Silcock is a postdoctoral researcher with the Threatened Species Recovery Hub, based at the University of Queensland. Her research focuses on threatened plant and animal species including the enigmatic night parrot, plant translocations for conservation, grazing impacts in rangelands, historical ecology and vegetation dynamics, wetland mapping and appreciation, combined with a liberal dose of general desert wandering.*

Buffel grass (*Cenchrus ciliaris*) is native to Africa, Asia and the Middle East and has been actively encouraged as a pasture grass in the drier regions of the United States, Mexico and Australia. It is fast-growing, strongly perennial, resistant to drought, fire and grazing, produces high yields of palatable forage and seeds prolifically. These traits have enabled it to rapidly colonise new continents. It now covers over 50 million hectares of inland Australia, including in central Queensland where vast swathes of woodland and scrub are now dominated by buffel grass.

The same traits that make buffel desirable to the grazier render it an ecological nightmare. Impacts include massive reductions in native fauna and flora, altered fire regimes and soil properties. Across Australia, growing numbers of people are trying to rid their patch of this invasive grass. A central Queensland grazier provides the only example of deliberate buffel removal on grazing land for primary production as well as biodiversity benefits.

After >100,000 hours over 33 years, Ian Hoch has reclaimed around eight hectares across three land types. The greatest increase in floristic diversity is on productive alluvial plains, with an increase in species richness of >90%. In the *Bothriochloa*/*Aristida* native woodland pastures, a suite of palatable perennial pasture grasses are significantly less frequent in unweeded areas, and this niche is colonised by unpalatable winter annual herbs, while numerous species were only found in weeded treatments. These results are mirrored in other buffel removal examples, notably in central Australia. Removal is currently impossible on any but small scales, but reclaimed areas demonstrate what has been lost in buffel monocultures. They also provide habitat for species that would otherwise become locally extinct, particularly in more fertile land types, and valuable seed sources for recolonisation of areas currently dominated by buffel grass.

# Managing risk in Australian Rangelands in a Transitioning Landscape and Climate

Rachael Nolan<sup>2</sup>, [Dr Jennifer Sinclair](#)<sup>1</sup>

<sup>1</sup>Greencollar Group, The Rocks, Australia, <sup>2</sup>University Technology Sydney, Sydney, Australia

## Poster Presentation

### **Biography:**

*Jenny is an experienced natural resource specialist with extensive research, project development and management experience with traditional and incentive-based conservation programs. She has worked in terrestrial, aquatic and marine environments on a diverse range of projects covering land-use, conservation, ecology, genetics, demography, behaviour and evolution. She specialises in research and management of environmental projects and utilising market mechanisms to deliver positive environmental outcomes. Jenny has worked with both rural and indigenous communities to improve land management and ecosystem resilience in Mexico and Australia and has coordinated biodiversity and conservation programs in Australia, the Antarctic and subantarctic territories. She has a background in ecology, evolution, environmental policy and philosophy and holds an Honors Degree from The University of Texas at Austin and a PhD from Macquarie University. Jenny owns and lives at Cape Bernier, an award-winning vineyard in Tasmania's SE coast and is Head of Research & Project Services at GreenCollar.*

Environmental threats, such as drought, extreme climatic events, fire and feral animals present tangible economic risks to Australian rangelands. When such events occur, their severity and extent may vary across the landscape depending on a range of factors such as land use and management practices. The past decade has seen growth in the use of environmental market mechanisms to incentivize sustainable land management to improve productivity and mitigate environmental risk. For example, the Australian Emissions Reduction Fund has secured close to 150Mt of carbon abatement by paying rural landholders to implement projects that sequester carbon or reduce greenhouse gas emissions.

Ongoing monitoring of such projects is critical for understanding how land management practices interact with environmental threats and enables assessment of environmental and commercial risks throughout the project lifecycle. We have developed a comprehensive monitoring framework to assess land managed jointly for carbon offsets and agricultural production to ensure project integrity and security. With over 2M hectares of rangelands under management, the data generated from the monitoring program provides a unique opportunity to explore land use and land use change in face of a transitioning landscape and climate. The data generated is also being used to assess and manage risks associated with water availability, vegetation management, fire management, and grazing pressure of livestock, native and feral animals with the foresight that a risk assessment and mitigation activity response framework will play a significant role in protecting Australia's rural assets.

A better understanding of the interactions between land management practices and environmental threats may guide more efficient use of preventative measures with the aim of building ecosystem resilience and protecting our key investments.

# Social acceptability of feral animal and native herbivore management in meeting TGP targets

Dr Katrina Sinclair<sup>1,2</sup>, Dr Ron Hacker<sup>3</sup>, Dr Allan Curtis<sup>2</sup>, Ms Trudie Atkinson<sup>4</sup>

<sup>1</sup>NSW Department of Primary Industries, Wollongbar, Australia, <sup>2</sup>Graham Centre for Agricultural Innovation, Charles Sturt University, Wagga Wagga, Australia, <sup>3</sup>Ron Hacker Rangeland Consulting Services, Tenambit, Australia, <sup>4</sup>NSW Department of Primary Industries, Trangie, Australia

## Poster Presentation

### **Biography:**

*Katrina is employed by NSW DPI as a Social Research Officer. Katrina is recognised for her expertise in the agronomy and management of tropical and temperate forages for coastal livestock production and in the management of climate risk in subtropical climates. More recently, she has contributed to the understanding of deliberate transformative change and its consequences for contemporary agriculture. This PhD research study has provided helpful insights for policymakers, industry organisations, and practitioners in how they can support agricultural industries and their producers' considering the need for transformation in a changing climate. Recent social research projects: "Performance-based management of ground cover for drought mitigation in NSW rangelands", "Understanding rural landholders' perspectives on the NSW cattle tick program" and the current project, "Social acceptability of feral animal and native herbivore management in meeting TGP targets".*

Total grazing pressure (TGP) is a key driver of productivity in rangeland livestock production systems and sustainable grazing management requires the management of grazing pressure from pest animals (feral animals and native macropods). The practices used to manage these species must be socially acceptable if rangeland livestock industries are to maintain their "social licence to operate" (SLO). While the attitudes of the wider public are ultimately important their attitudes will be shaped by influential communities of interest (e.g., animal welfare, environment, recreational groups). That is, these influential communities of interest will largely determine the extensive livestock industry's ability to implement specific control practices. This project will investigate the attitudes of the influential communities of interest, and other stakeholders, to current and potential future pest control practices in extensive production systems. A workshop with government agents, researchers, industry representatives, producers and other supply chain stakeholders will identify current and any likely future pest control practices and evaluate their cost effectiveness, practicality and long-term impact. The researchers will review the literature examining the community acceptability of pest animal control practices in agricultural and NRM contexts. Interviews with opinion leaders/representatives of influential communities of interest will then explore their views of the social acceptability of the control practices. Insights from this process will be used to suggest how the extensive livestock industry can most effectively engage and communicate around this topic.



# Koonamore: the TGB Osborn Vegetation Reserve; 90 years of change recorded

Dr Russell Sinclair<sup>1</sup>, Dr Jose Facelli<sup>1</sup>

<sup>1</sup>The University Of Adelaide, Adelaide, Australia

## Lightning and Poster Presentation

### **Biography:**

*Russ Sinclair has been managing the TGB Osborn Vegetation Reserve at Koonamore for 45 years, as lecturer & senior lecturer in the Botany Dept, and since retiring in 2002 as visiting research fellow in the School of Biological Sciences, University of Adelaide.*

*Since retiring, he has worked on managing the Reserve archives, and also running annual work camps at the Reserve for student volunteers who help with the annual re-mapping of permanent quadrats, photographing permanent photopoints, checking the reserve for rabbit activity and the fence for breaches, and other general maintenance.*

The TGB Osborn Vegetation Reserve, on Koonamore station in the NE Pastoral area of South Australia, is almost certainly the longest-running vegetation monitoring project of its type in Australia.

It was established by Prof TGB Osborn, Professor of Botany in the University of Adelaide in 1925. A 4 km<sup>2</sup> rectangle in a heavily overgrazed area was fenced to exclude rabbits and sheep, and permanent quadrats and photopoints set up to record changes in the vegetation.

The area is predominantly chenopod shrubland, with several species of saltbush (*Atriplex* spp) bluebush (*Maireana* spp) and others. Larger shrub species include *Senna*, *Dodonaea*, *Eremophila* and *Acacia*. The tree layer consists of false sandalwood (*Myoporum platycarpum*), mulga (*Acacia aneura*), black oak (*Casuarina pauper*) and bullock bush (*Alectryon oleifolius*).

After the initial elimination of rabbits inside the Reserve fence, control slackened and numbers increased again, until serious rabbit control was resumed in the 1970's. Since then annual checking, fumigating of warrens, regular fence repair and the arrival of myxo and calici viruses, have kept numbers very low. Consequently the Reserve has had about 50 years without sheep, plus 40 years virtually without either sheep or rabbits. Changes over that time have been very striking.

Reserve data have been used for many studies on the ecology of this vegetation, and its responses to rainfall events in the erratic climate of the region. Such records are very valuable for studying long-term trends, and with the current and expected climate changes they will become increasingly relevant.

A new project begun in 2016 by a research group from Flinders University is measuring movement of CO<sub>2</sub> in and out of the soil and vegetation in the Reserve. This may be very important if it shows that such un-grazed vegetation can act as a significant sink for atmospheric CO<sub>2</sub>.

# Monitoring in the Australian Rangelands: Where we've come from and where we should be headed.

**Mr Ben Sparrow**<sup>1</sup>

<sup>1</sup>*TERN, School of Biological Sciences, Faculty of Sciences, The University of Adelaide, Adelaide, Australia*

## Oral Presentation - Monitoring after ACRIS

The need for a widespread national ecosystem monitoring program for Australian rangelands is often identified (Eyre et al, 2011; Smyth and James, 2004; Watson and Novelty, 2004). Such a program is necessary to inform on the magnitude and direction of change in biodiversity and productivity of these vast and environmentally and economically important lands. This recognition is most often framed negatively – that we don't know enough about our biodiversity, that we are not collecting biodiversity data and do not have monitoring programs in place to effectively inform on these issues. Whilst in a holistic sense this is indeed true it is important to acknowledge that a great deal of excellent rangeland monitoring work has occurred in Australia over many decades to inform on these issues. The success of WARMS (Watson et al, 2007), ACRIS (Bastin et al, 2009) and TERN Ausplots (Guerin et al, 2017) are some examples, but there are others. None of these programs get close to realising our ideal monitoring network, but they have achieved parts of that vision well. They form a basis from which we can incrementally improve our sampling. This paper investigates what the essential components to an holistic rangeland monitoring should include, which of these components already exist and what, as a community, we need to advocate for in the future. There are many reasons to be optimistic about this continuing journey.

# Transformative rangeland futures: narratives and learning

Dr Mark Stafford Smith

Conference Keynote Address - Transformative rangeland futures: narratives and learning

## **Biography:**

*Dr Mark Stafford Smith is based in Canberra and looks after coordinating Adaptation Research across CSIRO. He interacts regularly with national and international policy issues around adaptation.*

*In 2013 he was appointed Chair of the inaugural Science Committee for Future Earth, which aims to help coordinate research towards global sustainability worldwide.*

*By background, he lived in Alice Springs for 20 years and, as a desert systems ecologist and past CEO of the Desert Knowledge Cooperative Research Centre (CRC), focusing on the science of desert living and sustainable management of outback environments.*

'Transformation' is a powerful and even frightening term. Yet we live in a world full of pressures for change. Rangelands globally, and in Australia, have been homes to long-lived stable cultures, at the same time as experiencing major past changes, so these can be reconciled. Today, rangelands in lower income countries tend to be facing challenges from increasing populations, climate change and conflict. By contrast, in high income countries like Australia, the mirror tends to be decreasing populations, climate change and political disinterest. Both are underpinned by failures of governance, usually due to limited understanding in those governing from afar. Our conceptualisation of change has also evolved in recent decades – once it asked how to return to some supposed past stable state; then it evolved to asking how change to some new, but stable, state; now at least we are starting to embrace issues that arise when you start to accept the reality of on-going change. In this, narratives – the stories we tell ourselves, implicitly or explicitly, about our lives and our opportunities – are deeply important. What is the positive narrative of the Australian rangelands that can help us navigate an ever-changing future?

# Rainfall and pasture information to communicate the risk of long-term drought sequences and climate awareness

**Mr Grant Stone<sup>1</sup>**, Mr David Ahrens<sup>1</sup>, Mr John Carter<sup>1</sup>, Mr Greg McKeon<sup>1</sup>

<sup>1</sup>Department Of Science, Information Technology And Innovation, Brisbane, Australia

## Lightning Presentation

### **Biography:**

*Grant Stone is a Senior Scientist with the Grazing Lands Systems group within DSITI (Department of Science, Information Technology and Innovation), based at the EcoSciences Precinct, Brisbane.*

*Grant has spent over 37 years involved with rural industries. He initially worked as a livestock and property agent across regional Queensland before studying Agricultural Science (University of Queensland).*

*For the last 19 years, Grant has worked as a scientist with the Queensland government involving climate impacts on natural resource systems for the grazing lands. He has been involved in modelling pasture production and utilisation across Queensland and identifying potential climate change impacts on the distribution and carrying capacity of livestock across northern Australia.*

*Recent activities include: science communication of climate, pasture and ground cover products for Grazing BMP (Best Management Practice); and assisting rural communities and industries to identify potential climate change impacts, vulnerability and adaptive capacity using a risk assessment framework.*

Rainfall is of vital importance for rangeland ecosystems and pastoral enterprises with respect to their function and production. A poster showing a historical annual rainfall percentile analysis (available from the LongPaddock website <https://www.longpaddock.qld.gov.au/>) was originally produced in 1997. Since then, thousands of these maps have found their way onto office walls, into graziers' homes and university curricula. The maps display annual rainfall (April-March), 'relative to history' on a 5 x 5 km pixel grid (nationally) for a 126-year extent (1890-2016). Sequences of the El Niño Southern Oscillation (ENSO) and Inter decadal Pacific Oscillation (IPO) are also shown as time series graphs. New variants of these posters have now been generated to include annual pasture growth and the past cyclone tracks annotated per annual map.

A further analysis of the original rainfall poster has summarised 127 years of rainfall data into 18 well-known 'wet and dry' periods. These periods ranging from 5 to 13 years, have had dramatic impacts on Queensland's rangeland and pastoral zones, consequently, historical commentaries (social, climate and economic) have been added for each period to build a rich picture of the past. This poster presents as an attractive, insightful and powerful discussion product for climate awareness. For example, for extended periods of low- and well-below average rainfall relate caution to property investment or infrastructure activities; while extended wetter periods are likely to be more beneficial from a resource and production standpoint. Further analysis is being undertaken to determine if there are identifiable patterns within the climate system (e.g. ocean circulation, ENSO, IPO combinations) that might signal the change from a wet to a dry period, or the converse.

Digital versions of all the posters and annual update patches are available from the DSITI LongPaddock website <https://www.longpaddock.qld.gov.au/> as pdf documents. For hardcopy posters email [Rouseabout@dsiti.qld.gov.au](mailto:Rouseabout@dsiti.qld.gov.au).

# The Leigh Creek Transition: Moving from Closed Town to Regional Hub

## Mr Mark Sutton<sup>1</sup>

<sup>1</sup>Outback Communities Authority, Port Augusta, Australia

### Oral Presentation - Transitioning to New Industries

#### **Biography:**

*Mark has a commitment to the outback developed over a period of 20 years of living and working in the region. He first arrived in the region in 1993 as a Constable with the South Australia Police and, over nine years, was stationed at Leigh Creek, Marree, Innamincka, Marla, the Pitjantjatjara Lands, Coober Pedy, Woomera, Roxby Downs, Andamooka, William Creek and finally at Oodnadatta.*

*Whilst in Oodnadatta, Mark also served as the Chair of the Oodnadatta Progress Association (1999-2002) and shortly afterward accepted the position of Community Development Officer with the Outback Community Development Trust based in Port Augusta. Soon after, Mark took on the role of Manager and, in 2010, took on his current role.*

*Mark is the General Manager of the Office for the Outback Communities Authority (OCA), a South Australian Government Statutory Authority responsible for community development and limited 'local government' service provision in the out-of-councils area of the state.*

*Mark's knowledge of the region and its people is widely acknowledged and his input is frequently sought in developing regional policy, ranging from economic development to drought response to infrastructure provision.*

How do you transition a remote closed mining-town to a sustainable, regional service centre?

This was the dilemma facing the South Australian State Government in mid-2015, when Alinta Energy announced it was ceasing its Flinders Operations. Coal extraction from the Leigh Creek open cut mine would end within months, and closure of the Port Augusta Power Station would follow suit shortly after, posing significant challenges, all with enormous social and economic effects.

To set the scene: Leigh Creek is a planned and laid out town, some 550km north of Adelaide, situated in a natural arid amphitheatre, in a picturesque part of the Northern Flinders Ranges. The town would not look out of place in metropolitan Adelaide. Leigh Creek is the anti-outback town, with footpaths, sealed roads, street lighting, an Olympic-sized swimming pool, sprung floor stadium and the greenest oval in the Outback. There is also an all-weather airport with dual runways, long enough to land a 737, kerbside rubbish collection and a landfill facility.

The town was built in the early 1980s, and has been a closed town for decades. With no incentive to invite the outside world in, it was poorly signed and inward facing.

Presented with three options; close the town, create a Regional Government Service hub or create a revitalised township, the State Government expressed a clear desire for Leigh Creek to remain a service hub, providing essential services to over 700 community members, pastoralists, business operators and service providers living in the Northern Flinders Ranges that allowed for revitalisation.

Enter Leigh Creek Futures: a committee, chaired by Dr Jane Lomax-Smith, ex-Minister for Tourism; engaged by the Premier to progress the town revitalisation by building social capacity and by promoting the town as being 'Open for Business'. Since officially reverting to State Government management on 1 January 2017, Leigh Creek is very much a town in transition to becoming a self-sustaining service hub for the Northern Flinders region.

Significant work has been undertaken to transfer responsibilities for different aspects of the township to relevant government agencies; for example the reverse osmosis water reticulation system to SA Water, the housing and infrastructure to the Department of Planning, Transport and Infrastructure. The Outback Communities Authority would take on the town administration role and continue to deliver all municipal services in a 'business as usual' manner.

The township is on the way to becoming a vibrant, tourist-friendly town; Leigh Creek is in the heart of the Northern Flinders Ranges and the perfect hub for tourists to discover the many cultural, environmental and aesthetic attractions nearby.

# Shot gun Farming in the Rangelands

**Mr Ray Thompson<sup>1</sup>**

<sup>1</sup>Central West Local Land Services, Nyngan, Australia

## Poster Presentation

### ***Biography:***

*Ray Thompson has restored and revegetated over 37,000 hectares of scalded semi-arid Rangelands in Western New South Wales using the waterponding and waterspreading technique over the last 36 years. Ray can protect and enhance ground cover, stop water and wind erosion and return the landscape back to a productive environmentally healthy ecosystem which is a win/win for the landholder and the environment.*

With the future onset of drying climates, the ways to utilize every drop of water that lands in the paddock (Landscape) is being implemented by a Hermidale farmer / grazier.

A joint five year partnership funded from the Australian Government's National Landcare Programme and Catchment Action NSW with the local landholders from the Cobar Peneplain of New South Wales and the Central West Local Land Services at Nyngan, has given legs to a number of waterspreading projects.

Waterspreading is a land rehabilitation technique that targets the variability of rainfall and runoff in semi-arid systems to initiate long term changes in ground cover by evenly spreading and disperse rainwater flow over country with gentle slopes less than three percent. The driving mechanism behind the success of waterspreading is the reduction of the energy of water flow, meaning a large reduction in soil erosion and an increase in water infiltration. This abstract outlines the effect of waterspreading at 'Trowell Creek' in western NSW, which has just begun implementing a waterspreading system in the last 2 years. This study outlines the shot gun approach of using cereals and grasses between the Waterspreading banks to obtain dramatic changes in pasture condition and diversity, and long term changes in surface soil properties, that occur following waterspreading. These dramatic yet persistent changes exemplify the benefits of implementing rehabilitation that is based upon the processes that govern resource movement and productivity within semi-arid systems, namely, recognition of variability in rainfall and runoff, and management of this.

Waterspreading involves creating a series of small banks to direct water away from eroding drainage lines to areas where it would normally not flow. Each bank is designed to slow and spread water as it continues down slope, increasing infiltration as to better suit native grasses and shot gun seed mix.

# 20 Years of Ecosystem Restoration at Arid Recovery: successes, challenges and the future

Dr Katherine Tuft<sup>1</sup>, Katherine Moseby, John Read

<sup>1</sup>*Arid Recovery, Roxby Downs, Australia*

## Oral Presentation - Legacy in the Rangelands - Arid Recovery

Australia has lost a third of its mammal species within the last 200 years, the worst extinction rate of anywhere in the world. Nowhere has this been worse than in the arid zone.

Arid Recovery is a conservation NGO near Roxby Downs in northern South Australia. We work in partnership with BHP Billiton, the SA government and Adelaide University. In 1997, a predator-proof fenced reserve was constructed across a 14 square km patch of sand dunes, mulga and cypress pine. All feral cats, foxes and rabbits were painstakingly hunted down and removed. Then, for the first time in almost a century, bilbies, burrowing bettongs, western barred bandicoots and stick-nest rats were returned to the landscape.

20 years later, the reserve has grown to 123 square km and supports self-sustaining populations of reintroduced mammals. The ecosystem has been transformed by the removal of rabbits and introduced predators, and by the digging activities of bettongs, bilbies and bandicoots that have changed soil properties and germination rates. Food webs have shifted within the reserve over time, with some of the in situ fauna now more common and others less so.

Over the next 20 years we will continue to build on the valuable long-term monitoring data set. There are also plans to reintroduce native mammalian predators into the reserve, such as western quolls. Looking further into the future, we are working with collaborators to test new methods to ultimately bring threatened species back into the wider landscape, outside of fenced reserves.



# How much does a cow eat? A billion dollar question for northern Australian development

Dr Dionne Walsh<sup>1</sup>, Mr Ian McLean<sup>2</sup>, Dr Steven Bray<sup>3</sup>, Dr Shane Blakeley

<sup>1</sup>NT Department Of Primary Industry & Resources, Darwin, Australia, <sup>2</sup>Bush Agribusiness Pty Ltd, Withcott, Australia, <sup>3</sup>Qld Department of Agriculture & Fisheries, Rockhampton, Australia

## Lightning Presentation

### **Biography:**

*Dionne has 22 years' experience as a researcher and adviser in rangeland management. Her expertise is in land capability assessment, livestock carrying capacity and advising producers on profitable grazing management systems. She has been privileged to work with the extensive cattle and sheep industries in South Australia, the USA, Western Australia and the Northern Territory.*

*After completing a Ph.D. at the University of Adelaide on the dietary behaviour of Merino sheep, she spent three years working for the Department of Agriculture in Western Australia based at Meekatharra.*

*After moving to Alice Springs in 2001, she operated her own successful consulting business working with pastoralists, Landcare groups, government agencies and university clients. Since 2009 Dionne has worked for the Northern Territory Government leading a team responsible for delivering research and advisory services to the northern beef industry.*

Estimates of feed intake are required for calculating livestock carrying capacity, forage budgeting and planning supplementary feeding programs. Using inappropriate estimates of intake has serious economic and environmental implications but there is limited evidence to support the existing intake assumptions for cattle grazing the Australian rangelands.

Two recent projects have collated the existing data and created tools to improve these assumptions. McLean & Blakeley (2014) standardised the estimation of beef cattle grazing loads in extensive environments. Importantly, their Animal Equivalent (AE) model includes the energy demand associated with growth and walking; two crucial factors that have been ignored in the existing assumptions. In order to populate the AE model, data for live weight, live weight gain, genotype, pregnancy rates and lactation rates are required. Fortuitously, these data have recently been collated for all the pastoral regions of Queensland and the Northern Territory (Bray et al. 2015). By integrating these datasets with the AE model, we have been able to generate specific AE tables and intake estimates for those regions.

Cattle grazing is the predominant land use across northern Australia with approximately 14 million head but, in many cases, there is a mismatch between feed demand and supply; with both under and over-utilisation an issue. Knowing how much an animal eats is literally a billion dollar number in the sustainable development of northern Australia.

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# Addressing feed supply and demand through total grazing pressure management in southern Australian rangelands: key issues and opportunities

Dr Cathleen Waters<sup>1</sup>, Dr Dean Revell<sup>2</sup>, Mr Kieran Massie<sup>3</sup>, Mr Russell Grant<sup>4</sup>, Dr Lester Pahl<sup>5</sup>, Dr Jodie Reseigh<sup>6</sup>, Ms Trudie Atkinson<sup>1</sup>

<sup>1</sup>NSW Department of Primary Industries, Trangie, Australia, <sup>2</sup>Revell Science, Duncraig, Australia, <sup>3</sup>Rangelands NRM, Perth, Australia, <sup>4</sup>Local Land Service Western Region, Cobar, Australia, <sup>5</sup>Department of Agriculture and Fisheries, Toowoomba, Australia, <sup>6</sup>Rural solutions, Adelaide, Australia, <sup>7</sup>NSW Department of Primary Industries, Trangie, Australia

## **Biography:**

*Dean has had 25 years of research experience. He is currently working in partnership with producer groups including the Kimberley Pilbara Cattlemen's Association, the Mingenew Irwin Group and the West Midlands Group in WA, to develop projects to add value to the supply chain for rangeland livestock. Over the past 2 years, he has managed an Innovation Grant project in the WA rangelands: 'Managing feed supply and ground cover in the rangelands through nutritional shepherding'. This activity worked collaboratively with Rangelands NRM, Stress Free Stockmanship, CSIRO and pastoralists throughout WA. Dean developed the underlying principles and a suite of methods for landholders to positively influence grazing patterns, to increase the efficiency of mustering, and to provide practical options for adjusting stocking rates within a season. The approaches, based on animal nutrition and behavioural science, are described as Rangelands Self Herding.*

The management of the grazing intensity through alternative livestock grazing systems has had a long history of research with often inconsistent results. In part, this is due to a failure to account for additional grazing pressure from native and feral animal populations which can be substantial. While considerable innovation and uptake of total grazing pressure (TGP) management has occurred in southern Australian rangelands (e.g., through partial exclusion and cluster fencing) an understanding of the impacts on livestock and pasture production, natural resource condition and animal welfare is lacking. Where impacts of TGP are high and feed-base consumption is greater than what is desired within the livestock system, an imbalance between feed supply and demand may lead to negative and sometimes irreversible impacts.

This project is a partnership between four states (QLD, NSW, SA and WA) to deliver a review of the current information and a research investment plan for Meat & Livestock Australia (MLA). The cross-jurisdictional and cross-sector approach adopted, involves pastoralists, researchers, extension agencies, policy developers and NRM bodies with the potential to deliver production gains to more than 1.9 million km<sup>2</sup> of Australian rangelands. This approach will also allow information gaps and perspectives to be gathered at regional and national scales.

Here, we use a number of case studies for a range of TGP management options and outline their impacts at regional and farm scales. This information can help to shape management decisions and support the ongoing development of TGP management programs within NRM bodies of southern Australian rangelands. In addition, we identify how and why TGP adoption approaches have sometimes been unsuccessful in triggering change. We discuss these results in terms of short-term benefits for livestock businesses and long-term benefits such as increased economic earnings for the industry and positive animal welfare and natural resource outcomes.

# Assessing the impacts and opportunities from carbon farming in western NSW

**Dr Cathleen Waters**<sup>1</sup>, Dr Annette Cowie<sup>2</sup>, Dr Susan Orgill<sup>3</sup>, Ms Fiona Garland<sup>4</sup>, Dr Marja Simpson<sup>5</sup>, Dr Adrian Chappell<sup>6</sup>, Dr Keryn Paul<sup>7</sup>, Dr Geoff Cockfield<sup>8</sup>, Mr Russell Grant<sup>9</sup>

<sup>1</sup>NSW Department Of Primary Industries, Trangie , Australia, <sup>2</sup>NSW Department of Primary Industries, 2351, Armidale , Australia, <sup>3</sup>NSW Department of Primary Industries, Wagga Wagga , Australia, <sup>4</sup>Local Land Service Western Region , Bourke NSW , Australia, <sup>5</sup>NSW Department of Primary Industries , Orange , Australia, <sup>6</sup>School of Earth and Ocean Sciences, Cardiff University, Cardiff , United Kingdom, <sup>7</sup>CSIRO , Canberra, Australia, <sup>8</sup>University of Southern Queensland , Toowoomba , Australia, <sup>9</sup>Local Land Service Western Region , Cobar , Australia

## Oral Presentation - Transitioning to New Industries

### **Biography:**

*Cathy is a Senior Research Scientist with NSW DPI based at Trangie. Cathy has worked in rangeland ecology for the past 20 years. She completed her PhD on the evolutionary development of native grasses. She is an active member of the Australian Rangeland Council and holds adjunct positions at UNE and Arizona State University. Her current research is primarily focused on the role of biodiversity in supporting ecosystem services within rangelands. Cathy is currently managing a number of projects including "addressing feed supply and demand through total grazing pressure management" a recently commenced national MLA project in southern Australian rangelands; "The role of ecological thinning for biodiversity" which is providing valuable insights into biodiversity and habitat changes over time in woody regeneration; "The impacts and opportunities from carbon farming in western NSW" is a major NSW government initiative which is examining the environmental, social and economic impacts from carbon farming.*

Emissions Reduction Fund (ERF) carbon sequestration projects aim to store carbon in woody vegetation for up to 100 years by avoiding deforestation or managing natural regeneration. This project addresses a lack of data around the carbon (C) storage potential of rangelands vegetation and soils. Initial results show high density Mulga (~2000 stems ha<sup>-1</sup>) to have the lowest C pool (~5 t C ha<sup>-1</sup>) but at densities <500 stems ha<sup>-1</sup> additional benefit from Eucalyptus spp. can allow six- fold increases in the vegetation C pool. Conversely, high density Box communities represent the most valuable positions within the landscape for carbon (vegetation and soil) as well as biodiversity. Soil erosion modelling suggests that soil is removed by wind erosion (0.1-10 t ha<sup>-1</sup> y<sup>-1</sup>) and where the C stock is small (3 t C ha<sup>-1</sup>) up to 1 t C ha<sup>-1</sup> y<sup>-1</sup> may have been removed. Increasing the C pools in vegetation would need to exceed this rate to have a net sequestration benefit. Economic analyses reveal carbon farming to have a 25-30 year benefit but in the long-term opportunity costs will require offsetting through livestock productivity gains.

# Determining the scale of the opportunity for agricultural and water resource development in northern Australia

Dr Ian Watson<sup>1</sup>, Dr Cuan Petheram<sup>1</sup>, Dr Chris Chilcott<sup>1</sup>, Dr Andrew Ash<sup>1</sup>, Dr Peter Stone<sup>1</sup>

<sup>1</sup>CSIRO, Townsville, Australia

## Oral Presentation - Northern Australia - the new frontier

### **Biography:**

*Ian Watson, is the Officer in Charge of CSIRO's Townsville lab, in north Queensland. He has been with CSIRO for nearly 10 years, having previously worked for the Department of Agriculture in Western Australia for over 20 years. Ian has a background in pastoral and range management, particularly rangeland monitoring. Since 2012 he has worked on several projects addressing the potential for the development of northern Australia and in a large agricultural aid program in west and central Africa.*

The Australian Government, jurisdictional governments and many local communities are actively encouraging the agricultural intensification of northern Australia. Indeed the Australian Government has released the "Our North, Our Future: White Paper on Developing Northern Australia" and the "Agricultural Competitiveness White Paper", both of which highlighted the opportunity for northern Australia's land and water resources to enable regional development.

Over the last decade CSIRO has led a suite of projects which can be best summarised as helping to determine the scale of the opportunity for irrigated and dryland agriculture, intensified beef production and other opportunities such as inland and coastal aquaculture.

These projects have provided regional summaries of: the surface and groundwater resources in terms of the amount of water that could be extracted for consumptive use; opportunities for mosaic style irrigation; opportunities for surface water capture; land suitability; crop and forage potential; supply chain and transport logistics issues; potential impacts on fisheries; considerations of land tenure and a review of the history of some of the major agricultural developments in the north. In addition to examining opportunities and constraints, these studies have identified factors that need to be considered to reduce risks in production, natural resource management, and socio-economics.

The presentation will consider these in summary but focus on the results of a large study examining the opportunities for development in the Gulf country of Queensland and discussion of an even larger study underway in the Mitchell catchment (Qld), the Fitzroy catchment (WA) and four catchments around Darwin. Both these studies encompassed a wide range of factors relating to development including soil and water resources, farming systems and market opportunities, potential ecological impacts, aquatic biodiversity and Indigenous rights, interests and values.

# Ecosystem drivers in rangelands; perceptions of drought and climate change

Associate Professor Ralph D.B. (Wal) Whalley<sup>1</sup>

<sup>1</sup>University Of New England, Armidale, Australia

Oral Presentation - Coping with Drought

## **Biography:**

*Foundation member of the Australian Rangeland Society and presently Associate Editor of The Rangeland Journal. Editor in Chief of the Journal from 1999 to 2011. Research interests for many years in the ecology of Australian native grasses, grassland ecology and weeds of grasslands.*

Water availability is the major driver of ecosystem function throughout the rangelands of most of Australia. The only exception is in the rangelands at high elevations where temperature also becomes important. Otherwise, ecosystem activity starts when water becomes available and ceases when the water supply has become exhausted. Our native plants and animals are adapted to these stop-go ecosystems and have evolved appropriate breeding systems. There have been no major mass extinctions such as have occurred in the northern hemisphere in recent geological times. The breeding systems of those native Australian grasses that have been studied, particularly those that have done well since the European invasion, indicate that they are well adapted to cope with future climate changes.

In a continent where rangeland ecosystems are well adapted to the episodic availability of water, the term 'drought' is inappropriate and should be discarded. Instead, the managers of all commercial rangeland animal production enterprises need to accept that their activities should be adjusted so that they can survive periodic shut-downs when water is not available. Then, when water becomes available again, ecosystem activities have re-commenced and pasture growth is well under way, grazing can re-commence. Managers, if they haven't already done so, must redesign their commercial activities to survive the dry periods. If most managers can accept these ecological realities, there are important social and economic implications for the whole of Australia. Part of this system re-design must take into account the general predictions for future Australian climates. That is, that weather extremes will become more frequent, there will be a general warming and there will be more frequent summer rainfall events in the southern parts of the continent and more winter-rain in the north.

# Overview of the National Burning Project

Greg Esnouf, Simon Wicks<sup>2</sup>

<sup>1</sup>AFAC, Melbourne, Australia, <sup>2</sup>Department of Environment Water and Natural Resources, Adelaide, Australia

## Lightning Presentation

### **Biography:**

*Greg Esnouf is Currently responsible for the implementation of the National Burning project for AFAC, developing principles and frameworks to support a more holistic and consistent approach to prescribed burning. He also supports the Rural & Land Management Group and Predictive Services Group.*

*Greg has Extensive experience in use of fire as a management tool on public land and has extensive experience in bushfire fighting at all levels of operations including State Coordinator.*

*He has had a continuous involvement with wildfire and public land management for over 40 years including 25 years in forestry, land management and fire management in the Department of Sustainability and Environment and 15 years as Deputy Chief Officer for CFA Victoria.*

The Australasian Fire and Emergency Service Authorities Council (AFAC), is the National Council for fire and emergency services in Australia. Through the National Burning Project, AFAC is undertaking a major national collaborative project to bring together inter-related aspects of prescribed burning to design guiding frameworks and principles for a more cohesive approach to prescribed burning.

Developing national frameworks and approaches has taken extensive consultation across fire management practitioners from all over Australia, and has fostered shared knowledge and networks among those that strategise and operationalise prescribed burning objectives. The project aims to aid in communicating these approaches to gain acceptance of the science and practices that underpin prescribed burning programs.

The benefits of national frameworks and guidelines lie in developing consensus collaboratively, developing relationships, the improved strategies that come from accessing best practice, the ability to align varying approaches, a greater economy derived from using common standards and through achieving improved performance.

This poster presents a summary of the outcomes of the National Burning Project including:

- The National Position on Prescribed Burning;
- National best practice guidelines for planning and implementing prescribed burns;
- National frameworks to address prescribed burning risks associated with ecological, fuel management, smoke, greenhouse and operational safety issues;
- Training manuals to support a range of prescribed burning competencies;
- Objectives and monitoring frameworks;
- Case studies; and
- Reviews of science, best practice and capability.

# Growing Sustainably: The Physical and Social Capital of Pastoralism in South Australia

Mrs Jackie Williams

## Oral Presentation - Pastoral Industry Trends in the Southern Rangelands

### **Biography:**

*I was born in England and immigrated to Australia with my family in 1967 at the age of 6. I grew up in Adelaide, and studied to become a primary teacher. I taught in several city and country locations, including 12 years as principal. In early 2009 I met my now husband, Tony Williams of Mt Barry Station, and at the end of that year I relinquished my principalship to move to Mt Barry.*

*Mt Barry Station, 4960 square km, is in the far north of South Australia, 950 km from Adelaide, situated halfway between the towns of Coober Pedy and Oodnadatta. It is part of the Williams Cattle Company portfolio, which, with the recent acquisition of Anna Creek and the Peake, includes seven pastoral properties measuring 45,000 square kilometres, and grazing and cropping land and a feedlot around Carrieton in the Flinders Ranges.*

*Since arriving in the bush I have learnt to cook, along with the myriad of roles that station women take on. I am currently chair of the Marla Oodnadatta NRM Group. I have a keen interest on sustainable pastoral practice, as well as an unquenchable thirst for education and learning in all its forms. I am also secretary of other committees including the Oodnadatta Bronco Branding, Bronco Branding SA and the SA Outback Roads Action Group. I am lucky enough to teach for 2 days a week at the Coober Pedy Area School and in my spare time I study university Spanish by distance.*

“Growing sustainably” is a broad and multi-faceted concept that I will explore further in this paper. As pastoralists, we would immediately think of growing sustainably as focusing on the environmental sustainability of our land. That is indeed part of my premise, but I consider a pastoral business as an organic being, a living, growing thing that requires careful management.

Stephen Covey, in his book “The Seven Habits of Highly Effective People” (Covey, 1989), identifies physical, financial and human resources as the main aspects of effective business management. He also has developed a model of the whole person paradigm, encompassing the body, mind, heart and spirit. In both models, he emphasises the need to maintain a balance across each of these aspects. He uses Aesop’s fable of the Goose that laid the Golden Eggs as a guide, and this is a guide for us all.

I will focus on the evolution of Williams Cattle Company as one model of growing sustainably.

# The Accidental Counselor: more to beef extension officers than technical advice

Mrs Megan Willis<sup>1</sup>

<sup>1</sup>Department Of Agriculture And Fisheries, Charters Towers, Australia

## Oral Presentation - Coping with Drought

### **Biography:**

*Megan Willis has been based in Charters Towers as DAF beef extension officer since 2011. Her main areas of expertise are grazing land management, land condition assessment, workshop facilitation and property mapping, specifically the Spatial Hub. She was Grazing BMP Coordinator and Stocktake Coordinator for 3 years. She currently coordinates Grazing BMP part time and is lead editor for the Northern Muster.*

Queensland Department of Agriculture and Fisheries (DAF) beef extension officers are recognised for their technical knowledge and skills but less acknowledged is the integral support role they play as a confidante, especially in times of crisis. During drought not only is the technical advice provided by beef extension officers essential, but so are good listening skills, compassion, empathy and the ability to recognise signs of deteriorating mental health. DAF beef extension officers were interviewed to capture their personal experiences working with graziers during the current drought to implement management practices, many of which are prerequisite to meet the requirements of government funding. The findings demonstrate the important role beef extension officers play as a link to technical and mental health resources to alleviate the stress of living on a drought-stricken property. The information gathered has been compared with research that has been undertaken on the topic more generally. Recommendations are made to assist extension officers to effectively do their job and be an integral part of the mental health support community.



# Pastoralists as conservation providers - a new stewardship incentive mechanism for the South Australian rangelands.

Mr Andrew Willson<sup>1</sup>, Mr Anthony Freebairn<sup>1</sup>

<sup>1</sup>Department of Environment, Water and Natural Resources, Adelaide, Australia

## Oral Presentation - Transitioning to New Industries

### **Biography:**

*Andrew has been working in the arid rangelands of SA, NSW and the NT in many different roles - research, project manager, and policy. He lived and breathed conservation stewardship for many years in the SA arid lands region, running a pilot to develop the new conservation stewardship mechanism for pastoralists. His main interest now is in supporting the Pastoral Board of SA with sound policy contributions to manage the SA pastoral lands sustainably.*

Conservation protection in the rangelands has mostly been achieved through the public and private reserve network, consisting of either formal reserves or pastoral properties managed for conservation purposes. Pastoralists have traditionally not had the opportunity to be recognised as formal conservation providers whilst managing pastoral enterprises.

The lack of available stewardship mechanisms for pastoralists to enter into the conservation market has thus created an “either/or” situation whereby whole properties are either managed for pastoral purposes or conservation. This also limits the ability of government conservation policy programs to achieve a full range of outcomes at multiple geographic scales.

The pastoral stewardship incentive pilot project aimed to develop a new mechanism to enable a compensatory payment to offset the loss of production incurred by pastoralists from setting aside portions of properties from pastoral use. The incentive is paid as an upfront lump-sum to the registered leaseholder through a grant agreement. The agreement specifies that a conservation covenant will be registered on the property’s lease for a fixed term (of up to 42 years), with approval required from the Pastoral Board for the change of land use. Monitoring and compliance of the agreement is largely incorporated into the existing pastoral regulatory system.

Considerable interest was received from the pastoral community during the pilot’s region-wide expression-of-interest process. A direct offer and negotiation approach in finalising the incentive value and agreement conditions was used rather than an auction or reverse tender process. An incentive economic valuation model was developed to provide an objective estimation of the incentive payment.

The pilot has resulted in the establishment of stewardship agreement areas on two properties, totalling 194 km<sup>2</sup>, enabling the pastoralists to be recognised conservation providers for public benefit. The areas conserve ecosystems poorly represented in the national reserve system.

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