Biodiversity Across the Borders

Moving forward with lessons learned

Conference Program and Abstracts

Future Regions Research Centre
Federation University Australia

10th June 2022

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'*Biodiversity across the Borders*' Conference

Theme: "Biodiversity conservation: moving forward with lessons learned"

ABSTRACTS

Future Regions Research Centre
Federation University Australia
Mt Helen, Ballarat,
Victoria

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9th Biodiversity Across the Borders Conference – Program

8:00	**Registration** **VENUE**: **1870 Founders Hall Theatre (Building B)**, Mt. Helen Campus, Federation University Australia, Ballarat	
8:40	**Introduction, an acknowledgement of Country and Housekeeping announcement** **KRISTIN MONIE**	
8:50	**Opening of '*Biodiversity across the Borders*' conference** **PROF. CHRIS HUTCHISON** – DVCR & I, Federation University Australia	
9:00	**Introduction: DR. JOHN WRIGHT** **Keynote Address:** **PROF. BRENDAN WINTLE** Science for saving species – reflections on 6 years of the Threatened Species Recovery Hub and the challenges that lie ahead for biodiversity conservation science	
	VENUE: Caro Main Hall Theatre **CHAIR**: **PROF. KEIR REEVES (DIRECTOR, FUTURE REGIONS RESEARCH CENTRE)**	
	PLENARY SESSION	
9:35	**PROF. KATIE HOLMES** Learning lessons from environmental history	
9:55	**DR. PAUL GIBSON-ROY** Learnings from grassy community restoration to-date can inform strategic decision making for landscape-scale implementation going forward	
10:15	**DR. LIZ ZNIDERSIC** Soundscapes - Acoustic monitoring for conservation	
	Morning tea 10:35 – 11:10 **(Poster session)**	
	SESSION 2	
	New technologies - Do we need to change the way we do research? VENUE: Caro Main Hall Theatre **CHAIR: DR. MATT SWAN**	**Environmental history – What can we learn from the past to guide the future?** VENUE: Geoffrey Blainey Auditorium **CHAIR: DR. GRANT PALMER**
11:15	**PROF. TRENT PENMAN** How well can we predict future fire regimes and biodiversity impacts?	**DR. NICK SCHULTZ** Land-use legacies limit the effectiveness of switches in disturbance type to restore endangered grasslands
11:30	**PROF. BILL BALLARD** Advances on the dingo genome using fourth generation long-read sequencing	**DR. BEN ZEEMAN** The importance of CFA volunteers in endangered grassland conservation and the challenge of burning
11:45	**DR. NICK MURPHY** DNA is everywhere….the opportunities and challenges of eDNA monitoring of biodiversity	**HAYLEY SIME** Legacy effects of sheep grazing on landscape function in grassy woodlands
12:00	**DR. LACHLAN HOWELL** Drones as an emerging wildlife monitoring tool: progress, challenges and opportunities	**DR. LANCE LLOYD** An ecological history of the Wimmera River Basin: a scoping study
12:15	**DR. DUC THANH NGUYEN** Use of AI for wildlife data analytics	**ELLA PLUMANNS POUTON** How useful are plant functional types in understanding the effects of fire history on plant abundance?

12:30	**DR. JOSÉ LAHOZ-MONFORT** Conservation technology: the rise and consolidation of an emerging discipline	**TALIA HUMPHRIES** The control of a dominant grassland weed can be an opportunity for restoration
	LUNCH BREAK 12:45 – 1:45, Albert Coates Complex **(Poster session)**	
	SESSION 3	
	Making decisions for conservation VENUE: Caro Main Hall Theatre **CHAIR: PROF. ANDREW BENNETT**	**Biodiversity and Community engagement** VENUE: Geoffrey Blainey Auditorium **CHAIR: PROF. WENDY WRIGHT**
2:00	**PROF. EUAN RITCHIE** Extinction rates and where to next for Australia	**DR. NICK PORCH** Integrating terrestrial invertebrate diversity into conservation planning – barriers and opportunities
2:15	**DR. DOUG ROBINSON** Conservation planning and decision-making approach in the context of climate change	**RACHEL MCINTOSH** What should be considered when aggregating vegetation classifications? A comparison of Ecological Fire Groups with Ecological Vegetation Classes
2:30	**DR. CARLA ARCHIBALD** Navigating climate crossroads for Australian biodiversity under CMIP6 climate change scenarios	**JACINTA HUMPHREY** Housing or habitat: What drives patterns of avian species richness in urban landscapes?
2:45	**DR. SAMANTHA GROVER** “Is this data?” Lessons for biodiversity conservation from an Antarctic collaborative autoethnography	**EMILY MATHEWS** Between a rock and a hard place: Site selection for Brush-tailed Rock-wallaby translocation using structured decision making
3:00	**IAN MANSERGH, DR. DAVID CHEAL, JOHN BURCH AND HARRY ALLEN** Loss of traditional owner land management leading to rapid mammalian population collapses in the Murray–Darling basin	**DR. JESS REEVES** The benefit of Landcare participation to bushfire recovery in East Gippsland and Northeast Victoria
	Afternoon tea 3:15 – 3:45 **(Poster session)**	
	Session 4	
3:45	**Panel Discussion:** Biodiversity Conservation: Moving forward with lessons learned **VENUE: Caro Main Hall Theatre CHAIR: PROF. DON DRISCOLL** **Panel Members: PROF. BRENDAN WINTLE; PROF. KATIE HOLMES; DR. PAUL GIBSON-ROY; DR. CARLA ARCHIBALD; DR. JESS REEVES; PROF. EUAN RITCHIE**	
4:45	**Closing Address:** **DR. BARRY KENTISH**	

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KEYNOTE ADDRESS

Science for saving species – reflections on 6 years of the Threatened Species Recovery Hub and the challenges ahead for biodiversity conservation

BRENDAN WINTLE

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Abstract

Biodiversity underpins all aspects of our life, from food systems to culture and identity, economy, and health. Animals pollinate 90% of crops; 70% of medicines are derived from animals and plants; natural ecosystems remain the only viable large-scale carbon sink. Yet biodiversity is in precipitous decline around the world and even more so in Australia. The World Economic Forum ranks biodiversity loss in the top four risks to the global economy. In Australia, catastrophic policy failures are leading to dramatic biodiversity losses and ecosystem declines. The NESP Threatened Species Recovery Hub was put in place by Minister Hunt in 2016 to provide knowledge support to managers and policy makers across the country seeking to recover threatened species. The Hub undertook 147 research and knowledge sharing projects with over 250 partner organisations including 65 Traditional Owner groups. It responded with science support to emerging crises such as myrtle rust, chytrid fungus and the 2019-20 bushfires. The Hub contributed to parliamentary inquiries into extinction, the Samuel Review of the EPBC Act and crucial initiatives such as the Feral Cat Taskforce. We were able to paint a very clear picture of the state and trends in biodiversity, including development of the threatened species index, convening crucial work on ecosystem collapse and setting out the funding required to recover Australia's threatened species. The Hub came to an end in December 2021. I will reflect on the NESP TSR Hub achievements and the strengths and weaknesses of the NESP model. I will conclude by highlighting key knowledge challenges and emerging opportunities to harness a growing global appreciation of the existential crisis we face to bring greater focus on biodiversity conservation opportunities.

Notes:

PLENARY TALK

Learning lessons from environmental history

KATIE HOLMES

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Abstract

We 'row forward looking back,' writes the American historian and essayist Rebecca Solnit in her book Hope in the Dark, as she argues for the need to know and tell histories about the individuals and social movements that have changed the world for the better[1]. Such stories remind us that things can be different and that we can create positive change. With predictions for the future of escalating climate and ecological crises, such remembering is an important contribution of environmental history. Another is the reminder that the 'natural world' is also cultural: how we see it, imagine it, study it, live in it, are all shaped by our culture. Understanding the changing human/nature entanglement, and its implications for how we have lived in the world, lies at the heart of environmental history. The current climate and ecological crisis is a result of particular historical processes of colonialism, industrialisation, and extraction – practices which exploit the world's resources for the benefits of the few. Environmental history can show the pathways that have led to our present predicament, and the ecological and human costs. It can also show the paths not taken, the alternative futures we have yet to imagine and the profound social, cultural, political and economic implications of not acting to address the critical loss of biodiversity and eco-systems services. Environmental historians are also well placed to understand the complex histories of place and identity and the need for responses that address the local and regional experiences of communities facing times of crisis. Within these histories we can find the values of stewardship, care and justice which must guide our relationships with the ecological world.

Notes:

[1] Rebecca Solnit, *Hope in the Dark: Untold Histories, Wild Possibilities*, Rev. ed.. (Edinburgh: Canongate, 2016), xxiv.

PLENARY TALK

Learnings from grassy community restoration to-date can inform strategic decision making for landscape-scale implementation going forward

PAUL GIBSON-ROY

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Abstract

Grasslands and grassy woodlands are among Australia's most impacted communities. Neither is well represented in national reserve systems and despite various environmental protection policies, they continue to be lost to agriculture and development. Offset schemes are increasingly prominent mechanisms used to derive some 'gain' from this situation by imposing offset obligations that must match and exceed losses by protecting and managing existing remnants. However, while there is clear evidence that ecological restoration can repair and reconstruct grasslands and grassy woodlands, unlike in jurisdictions like the EU and the USA there is little in the way of government policy or directive that encourages and supports these practices. Given this reality, the knowledge their restoration is feasible, and because resource limits always apply, strategic planning, prioritisation, and coordination (inclusive and representative of all stakeholders) from regional, to catchment, to state, to national levels will be necessary to ensure that future grassy community restoration does not remain small scale, sporadic and one-off. The establishment of clear time and location-based restoration goals at all landscape levels, underpinned by an understanding of all resourcing needs and costs will ensure restoration is conducted strategically, is properly funded and resourced, and uses appropriate techniques. This approach would increase the likelihood that projects succeed, that restoration targets are reached, that biodiversity is preserved, and that the restoration sector develops from a 'cottage industry' into a vibrant, thriving industry creating careers and businesses opportunities for individuals and communities across Australia. In this way we will finally be able to achieve landscape-scale grassland and grassy woodland restoration.

Notes:

PLENARY TALK

Soundscapes – Acoustic monitoring for conservation

ELIZABETH ZNIDERSIC

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Abstract

Rapid changes on both the environmental and economic front are placing pressure on ecologists to adopt novel technologies that enable them to monitor smarter, faster and in a cost-effective manner. This fast-moving evolution towards technology involves the processing of large quantities of data collected in the field. This in turn demands researchers with widely different skill sets, biological and computational, to work collaboratively and to share knowledge across their complementary areas of expertise. Acoustic monitoring can be used to detect specific vocal species or to monitor the general "soundscape". A soundscape is a useful tool for an ecologist, looking past single species to indicators of ecosystem health, species diversity and temporal changes on a landscape scale. Soundscapes can also be used to benchmark restoration and, importantly, as a tool to restore landscapes. Restoration using sound is a new concept which has the potential to guide diverse stakeholder groups towards a common purpose, defining on-ground works toward agreed targets representing the true complexity of ecosystems. The future of conservation requires many techniques to enhance, fast-track and manage ecosystems.

Notes:

Tools for predicting future fire impacts on biodiversity

TRENT PENMAN AND SARAH MCCOLL-GAUSDEN

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Abstract

There is no doubt that fire regimes are changing and will continue to change with predicted global climatic change. Most studies attempt to predict future fire risk as changes in weather without considering the indirect effects of climate change on other aspects such as fuel moisture, fuel load and vegetation structure. These changes are important as they could exacerbate or counteract changes to fire regimes driven solely by fire weather. Fire regimes are fundamental to determining population dynamics for many species in native vegetation. Therefore, we need more accurate spatial and temporal predictions of fire regimes into the future. In this talk, we present a relatively new fire regime model – FROST (fire regimes & operations simulation tool). The tool allows us to consider both simple and complex biodiversity responses to current and future fire regimes. We will provide examples from work in Alpine Ash, Grampians and the NSW Blue Mountains. These outputs disentangle the climate change impacts on fire weather, fire regimes and species demography. Furthermore, it is the first step in developing a method for prioritising species based on fire risk under climate change.

Notes:

What is an Australian dingo? Time for a fresh perspective

BILL BALLARD

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Abstract

Species, and species definitions have been a source of debate in a multitude of systems. Many are familiar with the biological species concept where species are considered reproductively isolated in natural systems. We now know that the dingo is an evolutionary intermediate between the wolf and domestic dogs – but this does not necessarily mean it is a distinct biological species – at least according to the biological species concept. Dingoes hybridise and produce fertile offspring when they mate with domestic dogs. Currently, however, it is not known whether mating is random or there is assortative mating (i.e., do dingoes prefer to mate with dingoes) as is reported with wolves and domestic dogs in America. So, what constitutes a dingo? Is an Australian Cattle Dog a dingo as it was likely developed through a process involving the selective breeding of domestic herding breeds and dingoes? Is the offspring of a pure dingo and a domestic dog a dingo? If you backcross such a 50% dingo-dog back to a genetically pure dingo is that then a dingo? The answer to this seemingly simple question differs between states in Australia and scientists, such that the debate is ongoing and often acrimonious. In this talk I will propose, for discussion, an alternative approach that is underpinned by our new knowledge of the dingo genome.

Notes:

DNA is everywhere....the opportunities and challenges of eDNA monitoring of biodiversity

NICK MURPHY

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Abstract

Environmental DNA (eDNA) technologies are providing an exciting tool for detecting species presence and abundance where other methods prove expensive, time consuming or impossible. Rapid advances mean that eDNA detection of both aquatic and terrestrial species can now be used on limited samples of water, soil, vegetation, scat, insect blood and even air. The resulting data can be used to target a species of interest, determine patterns amongst communities of species or even recreate past environments. Developments in collection techniques and the increased sensitivity and portability of genetic methods mean the eDNA field is growing at an exponential rate, greatly expanding the eDNA toolkit. The fact that DNA is everywhere, however, means that their important considerations are required when undertaking eDNA monitoring. This talk will use evidence from several recent eDNA studies to explain the opportunities provided by eDNA monitoring, detail the challenges of incorporating eDNA into biodiversity monitoring and outline the future of the rapidly growing range of eDNA techniques.

Notes:

Drones as an emerging wildlife monitoring tool: progress, challenges and opportunities

LACHLAN HOWELL

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Abstract

Remotely piloted aircraft systems (RPAS or drones) with thermal imaging technology have experienced a rapid rise in technological advancement and use across many sectors. This has included a rapid uptake of drones for diverse environmental challenges and applications, including globally as an emerging tool for surveying and detecting wildlife. Various studies highlight the utility of drones as a tool to detect cryptic wildlife species in diverse habitats and highlight their cost-efficiency benefits against other conventional wildlife monitoring techniques. In addition, the development of machine learning and automated detection capabilities shows promise to revolutionise wildlife drone monitoring and further increase efficiency and accuracy. Despite this, drone technology and these accompanying technologies are far from optimised for many wildlife species. Applied research questions remain and many practical challenges require solutions before drones can become a mainstream tool in the conservation toolbox. This talk will briefly summarise the emerging evidence for drones as a wildlife monitoring tool using the case study of koala population monitoring, discuss the logistical realities and challenges of using drones to monitor cryptic wildlife in complex terrain, and highlight the exciting management and research opportunities across various taxa and habitats for drones to improve Australian wildlife population and habitat monitoring outcomes.

Notes:

Use of AI for wildlife data analytics

DUC THANH NGUYEN

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Abstract

Artificial Intelligence (AI) has been applied widely in many aspects of our daily life ranging from human-centred technologies to natural supporting services. Recently, AI has found applications in environmental studies including automatic wildlife data analytics and biodiversity monitoring, e.g., camera-trap systems for monitoring of animals in their natural habitat. In this presentation, we will present research on animal detection and localization from camera-trap videos. This research focuses on small-size animals including frogs, lizards, birds, small/big mammals, spiders, and scorpions.

Notes:

Conservation technology: the rise and consolidation of an emerging discipline

JOSÉ J. LAHOZ-MONFORT

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Abstract

The range of technologies currently used in ecological monitoring and conservation is staggering, with some long-established methods (e.g. telemetry, remote sensing) but also innovative uses often adopted from other disciplines and being trialled in the field (e.g. autonomous vehicles, sensor networks). These by itself could fill a whole conference! But there is still a huge opportunity gap. Until recently, conservation and ecology have mostly been consumers of technology driven by big industries (military, biomedical, consumer). A growing international movement believes it is time to move to the driver's seat, becoming innovation leaders, actively seeking to design novel technologies and devices to suit our needs. New collaborative forms of creation (e.g. open source) and the dawn of a new industrial revolution, with more agile design and production cycles, open the window to the development of cheaper, modular, more targeted technology. I will talk about this powerful transition, happening now, from a series of scattered applications of technology to the emergence of "conservation technology" as a self-conscious discipline of its own right. This coming of age is unprecedented and faces many technical, human and organisational challenges. Although collaborations are slowly emerging, we need a coordinated approach to establish bridges between disciplines, and explore new mechanisms for collaboration, funding, and production. I will discuss what I think are the tell-tale signs that this transition is actually happening, and dare to have a look in the crystal ball about what to expect in the next decade.

Notes:

Land-use legacies limit the effectiveness of switches in disturbance type to restore endangered grasslands

NICK SCHULTZ[1], JODI PRICE[2], JOSHUA HODGES[2], MICHAEL CLELAND[2] AND JOHN MORGAN[3]

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Abstract

Temperate native grasslands in Australia have been decimated across their range since European colonization, and the few remnants are mostly fragmented and degraded. Changes in disturbance type, particularly the removal of Indigenous fire and the introduction of livestock grazing, resulted in the local extinction of fire-dependent and grazing-sensitive native species, and an increase in exotic species. Recently, native grasslands have been acquired to improve the reservation status and management strategies have been implemented that involve the removal of livestock grazing and the reintroduction of fire or other biomass reduction methods. Many medium and long-term ecological studies have observed a change in disturbance type, so we asked: how can we learn from these studies to guide future disturbance management in grasslands? We reviewed literature that reports instances where there has been a disturbance switch to examine how the native composition of grasslands respond. We found mostly no change in native and exotic species richness when management changed from stock grazing to fire (at least in the short term, ≤10 years). Positive outcomes for other disturbance shifts (grazing→mowing, or cultivation→grazing) occurred only when the disturbance type was (1) accompanied by seed addition, or (2) in landscapes with a high proportion of grassy vegetation so that dispersal from nearby remnant sites was possible. This suggests that seed- and/or dispersal-limitation may limit passive restoration outcomes in fragmented landscapes, and further studies are needed to improve out seed addition techniques for grasslands. We should continue to observe the longer-term impacts of switches in disturbance regimes, and whether recovery thresholds have already been crossed.

Notes:

The importance of CFA volunteers in endangered grassland conservation and the challenge of burning

BEN ZEEMAN

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Abstract

Roadside burning of grassy vegetation by community volunteers through the Country Fire Authority (CFA) has long been an important activity for reducing bushfire risk in Victoria's rural landscapes. In south-west Victoria, the practice has also been critical for conserving high-quality and critically endangered native grassland. However, the practice of roadside burning is in decline. A social survey of community volunteer fire brigade members was undertaken to examine the drivers of this decline, what motivates people to participate in roadside burning and the factors that have enabled roadside burning to occur. The results of the survey formed the basis of discussion between CFA volunteers and environmental agencies, leading to novel approaches to roadside burning in the Westmere fire region coupled with ecological monitoring. Over the past year, brigades in the Westmere region increased the amount of roadside burning undertaken from just a few km annually to 250 km. This presentation will describe the challenge faced by CFA volunteers to maintain roadside burning programs, the important work of brigades in the Westmere region over the past year and early monitoring results. Reversing the decline in roadside burning is critical for both conserving critically endangered native grasslands and ensuring that the rural community remains engaged in fire management as climate change alters the nature of bushfire in Victoria.

Notes:

Land-use legacy effects on landscape function in grassy woodlands

HAYLEY SIME

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Abstract

Since the earliest years of European settlement, agricultural development and intensification has caused significant degradation in the grassy ecosystems of north-central Victoria. There is growing concern that threatened woodland ecosystems are underrepresented in Victoria's reserves system, leaving them vulnerable to further degradation and clearance. A concerted effort is therefore being made to preserve grassy woodland remnants, securing them from further clearance or disturbance. Preservation alone, however, is not enough to ensure persistence of these grassy woodlands. Furthermore, it is often necessary to restore these habitats. Effective restoration requires an understanding of current and historic drivers of change, such as sheep grazing regimes. We investigated the legacy impacts of agricultural land use in grassy woodlands and hypothesised that historic sheep grazing regimes have impacted current-day plant community composition and landscape function. We also hypothesised that the scale and intensity of the impacts will depend on the nature of grazing and that the relationship between landscape function and plant species composition may not be straightforward. David Tongway's landscape function analysis methods (a rapid visual tool to assess landscape function) were combined with more direct measures of soil 'health' to assess landscape function. This study found that there is a legacy of land use in the composition and landscape function of grassy woodlands. Woodlands where historic grazing management incorporated long rest periods tended to have higher landscape function (higher soil carbon, water infiltration etc.) than sites that were not as extensively rested. In addition, these woodlands supported a higher cover and frequency of perennial vegetation, and a high density of summer growing grasses. By contrast, woodlands that have been infrequently rested from grazing pressure were dominated by annual species. Thus, historic sheep grazing may have had a lasting impact on the landscape function of grassy woodland reserves.

Notes:

An Ecological History of the Wimmera River Basin: A scoping study

LANCE LLOYD[1,2] AND PETER GELL[1,3]

[1]Federation University Australia, [2]Lloyd Environmental, [3]Diatoma

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Abstract

This project is scoping what we know about the ecological history of the Wimmera River. The project is using multiple lines of evidence to confirm a timeframe of the major elements of the ecosystem that were present and major trends observed. These lines of evidence include the scientific and grey literature, some preliminary sediment cores looking at the palaeoecological record, explorers' journals and oral history (gained through a workshop with community members and approaches to knowledgeable individuals). We are focusing upon fish and aquatic plants as the major groups, but also bringing what evidence can be found on other groups of animals and plants. This work is being undertaken for the Wimmera CMA who are seeking an understanding of the past in order to be able to manage the system in a more effective way into the future.

Notes:

How useful are plant functional types in understanding the effects of fire history on plant abundance?

ELLA PLUMANNS POUTON

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Abstract

Fire is a key environmental filter that influences which species occur, where they occur, and at what abundances. Consequently, plants exhibit a variety of functional traits that help them cope with recurrent fire and other environmental conditions. Assessing plant functional traits can provide a mechanistic understanding of how fire filters plant species and shapes local communities. In this study, we make predictions for how fire may determine the relative abundance of species with similar combinations of traits i.e. Plant Functional Types (PFTs) and test these predictions with empirical data. We ask, can we use PFTs to make accurate a priori predictions on how fire influences abundance? We develop Plant Functional Types (PFTs) for relevant species, based on review and synthesis of plant traits using the AusTraits and Victorian Vital Attributes databases. We then develop graphical *a priori* predictions for how time since the last fire and mean fire interval influence relative abundance of plants within each PFT. Finally, we test the predictions with empirical data collected from floristic surveys conducted at 57 sites within Gariwerd- Grampians National Park. We calculate relative abundance from plant occurrence in 0 to 33 quadrats at each site, across a 100m transect. We use Generalised Additive Models to analyses the influence of both time since the last fire and mean fire interval on individual species within each PFT. We then match these to the predetermined matrices to test the accuracy of the graphical a priori predictions. Our study demonstrates the utility in using PFTs to make informed a priori predictions. This work progresses a fundamental enquiry in ecology of if we can use mechanistic principles to make predictions on how environmental drivers such as fire determine relative abundance. Because this study focuses on the mechanisms that shape plant populations, we expect that these predictions will be applicable to many fire-prone environments globally.

Notes:

An integrated approach for the landscape scale management of the invasive tussock grass; *Nassella trichotoma*

TALIA HUMPHRIES AND SINGARAYER FLORENTINE

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Abstract

Invasive plants are considered one of the biggest threats to environmental assets, and once established, they can be immensely difficult to control. *Nassella trichotoma* is an aggressive, perennial grass species, and is considered one of the most economically damaging weeds to grazing systems as well as one of the leading causes of biodiversity loss in grassland communities. This species produces high density seedbanks, and is able to survive disturbances such as fire, frost, or grazing. The present study explored the effect of 13 different combinations of herbicide, fire, double-knockback, fencing, tillage, and broadcasting seeds on reducing the above and below-ground density of *N. trichotoma*. Above-ground data was collected using transect lines, and the surveys took place over five sampling periods. The soil seedbank was surveyed using core samples taken over three sampling periods. The data was assessed using a hierarchy analysis, whereby the most significant result achieved with the least number of treatments was selected as the optimal treatment. The treatments that included fire performed significantly better at i) reducing *N. trichotoma* and ii) increasing the establishment of the broadcast seeds. Fire also effectively reduced *N. trichotoma*'s seedbank. Tillage with or without fire was also observed to provide significant control of *N. trichotoma*. This study demonstrated that the combined efforts of herbicide, fire and broadcasting seeds will significantly reduce the above and below-ground density of *N. trichotoma*.

Notes:

Extinction rates and where to next for Australia?

EUAN RITCHIE

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Abstract

We are in the grips of Earth's sixth mass extinction event, and Australia, a hyper diverse continent, holds an unenviable conservation record. Much of our continent's biota is endemic and its conservation depends heavily on the efficacy of legislation and management actions. Here, we calculated modern-day extinction rates for Australian terrestrial vertebrates and plants—between 1900 to 2022—using an established formula to calculate extinctions per million species years (E/MSY), and we contrast these rates to global metrics. In Australia, 38 plant extinctions have been documented, equating to a modern-day extinction rate 42 × the background extinction rate of 0.35 E/MSY and double global estimates. The 51 documented vertebrate extinctions equate to a modern extinction rate 78 × the background rate (2 E/MSY) which is approximately 4 × greater than current global estimates. Mammals are faring worst, with an extinction rate more than four hundred times higher than the expected background rate, which is almost 17 × the global modern-day estimate. We caution that our extinction estimates are likely highly conservative, as we didn't consider extinction debts, co-extinctions, nor potential extinction cascades. Strengthening, enforcing and aligning environmental policy and legislation, and substantially increasing conservation investment, will be essential for sustained implementation of conservation actions aimed at preventing further extinctions and arresting Australia's dire biodiversity trajectory.

Notes:

Addressing the 'A' in 'CAR' – improving adequacy of ecosystems and populations in a Comprehensive, Adequate and Representative reserve system on private land

DOUG ROBINSON

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Abstract

Systematic conservation reserve planning is a well-established discipline which has been used to inform reserve design in many parts of the world. Many of these approaches have focused on the representation of ecosystem units at various scales or the risk of loss of particular ecosystems if they are not reserved. These approaches equate with the National Reserve System's criteria for ensuring 'Comprehensive' and 'Representative' reserve systems at a bioregional scale. In the context of the global biodiversity crisis and accelerating climate change, it is increasingly important to focus on the protection and conservation of areas which help improve the 'Adequacy' of the reserve system by helping maintain and enhance the integrity and viability of ecosystems and species. In Victoria, Australia, this issue is complicated by the fact that many of its under-represented ecosystems and threatened species occur primarily on private land and often in small, isolated remnants across the two-thirds of Victoria which is freehold land. Working with research partners from RMIT University and Arthur Rylah Institute, Trust for Nature has developed refined set of focal landscapes in which to focus its conservation effort to maximise the chances of maintaining healthy ecosystems and species' populations in a rapidly changing climate. These landscapes will underpin the Trust's updated Statewide Conservation Plan and conservation work for the next decade.

Notes:

Navigating climate crossroads for Australian biodiversity under CMIP6 climate change scenarios

CARLA ARCHIBALD

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Abstract

Climate change is a major factor influencing the suitability of habitat for biodiversity in Australia. Climate shifts in species ranges can present considerable management challenges for land use planning. If the suitable climate space for species changes, this could cause redundancies in existing protected areas network or shine a light on new priorities for consideration. In this presentation, I discuss my new research as a part of the 'Land Use Futures' project that aims to quantify whether suitable climate space for Australian species will change through time or in space, and if so by how much and in what direction. Up-to-date information on species' climate niches will enable researchers and stakeholders to conduct analyses that contribute toward the protection of biodiversity under climate change. This study also provides the first glimpse into how different CMIP6 climate change scenarios may impact Australian biodiversity.

Notes:

“Is this data?” Lessons for biodiversity conservation from an Antarctic collaborative autoethnography

SAMANTHA GROVER

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Abstract

Wicked problems such as biodiversity conservation and climate change require authentically transdisciplinary approaches to achieve the collaborations required to solve them. While multi inter and transdisciplinary research are increasingly popular adjectives in academia, truly transformative collaborations are rare. Many of us working towards biodiversity conservation in the natural or biophysical sciences recognise the importance of the social sciences and environmental history in particular. This paper shares a case study from Antarctica, in which a group of natural and social scientists undertook a collaborative autoethnography as a learning tool; an empirical way to collect and analyse self-reflection that led to transformative change in research practices. Grappling with questions such as “Is this data?” and “What does it mean to me to be a (white) woman in science?” in a positive, open hearted yet challenging academic space enabled researchers to evolve their understanding of their own and other’s disciplinary expertise and potential contributions. An example of a resulting collaboration, encompassing soil science, ecology and environmental sociology, from biodiversity conservation research in Central Kalimantan, Indonesia, evidences the success of this learning tool.

Notes:

Loss of traditional owner land management leading to rapid mammalian population collapses in the Murray–Darling basin

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Abstract

The 19th century mass mammal extinctions in the Murray–Darling basin are examined in the context of prior traditional land management. A model of grassland dynamics reveals a multi-trophic level productive pulse 1 to 5 years post-fire followed by senescence and increasing flammability. Traditional Owner patch-mosaic burning of grassland optimized human and mammalian food (including tubers, seeds and fungi) and decreased fire risk. Over at least 40,000 years, the persistence and abundance of fauna responded to this energetically closed self-reinforcing management. In 1830, depopulation (disease, massacres and displacement) effectively ended traditional management, an ecologically traumatic event that extinguished these productivity pulses. Populations of c.20 mammal species collapsed, and all eco-engineering and mycophagous species, such as bilbies, bettongs and bandicoots, rapidly disappeared, before the establishment of feral predators (hitherto the only proffered explanation for the mammalian collapse).

Notes:

Integrating terrestrial invertebrate diversity into conservation planning – barriers and opportunities

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Abstract

Although lists of threatened species don't suggest it, the majority of species at risk of extinction are likely to be terrestrial invertebrates. Terrestrial invertebrates include thousands of range-restricted taxa that are often from systems with uncertain futures, yet they are seldom considered in conservation planning. A combination of factors, including unfamiliarity with their incredible diversity, lack of expertise, a poor fit within approaches to assessing conservation status, and the rapid turnover of taxa across landscapes, contribute to this status quo. There are simple things that we can and should do better to address this. Determining which places are particularly important for invertebrate diversity is a good first step – we can do this with current knowledge. Developing a better understanding of selected focal taxa and factors that threaten them is a straightforward follow-up. To rapidly develop knowledge, bar-coding can be used to efficiently assess poorly known taxa in groups known to be species rich, frequently narrow range, and taxonomically difficult. Within a decade we could be much better placed to understand the likely impacts of fire and climate change – two related factors that are likely to especially impact our ancient and unique terrestrial invertebrate fauna. We can do this – we just have to want to do it.

Notes:

What should be considered when aggregating vegetation classifications? A comparison of Ecological Fire Groups with Ecological Vegetation Classes

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Abstract

Natural patterns of vegetation are driven by numerous abiotic and biotic factors. Understanding how such factors influence vegetation can inform the use of mapped vegetation categories in land management and improve management practice. Semi-arid western Victoria is a fire-prone region, with large conservation reserves (Big Desert Wilderness Park, Little Desert National Park). Precipitation decreases and temperature increases from south to north (~100 mm less annual rainfall in the north). For fire management, vegetation is classified into broad Ecological Fire Groups (EFGs), based on aggregating finer Ecological Vegetation Classes (EVCs). We conducted floristic and vegetation structure surveys at sites stratified by location, EFG, and time since last fire. We aimed to: 1) document floristic patterns in the vegetation associated with environmental variation (climate, soil texture), and 2) use these results to assess the relevance of management classifications. The climatic gradient accounted for more variation in composition and structure between sites than the relatively coarse EFG classification. Fine-scale EVCs were most effective in capturing underlying floristic and structural variation and reflected north-south environmental differences. The climatic gradient appears to be a strong driver of vegetation composition and structure in this semi-arid region, likely through water availability influencing species composition via life-history traits. Abiotic variables such as climate should be incorporated into decision making when aggregating vegetation classes.

Notes:

Housing or habitat: What drives patterns of avian species richness in urban landscapes?

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Abstract

Urbanisation alters natural habitats by removing vegetation and replacing it with human infrastructure. An increased cover of housing and impervious surfaces has been correlated with a decline in avian species richness. Further, the extent of land covered by native vegetation is a strong predictor of bird diversity in urban spaces. Few studies, however, have investigated the relative influence of both housing and habitat. Whilst these variables are interrelated, the amount of available habitat varies considerably between suburbs of similar housing cover. An improved understanding of the influence of these two variables may help plan for more sustainable cities and aid species conservation in contested spaces. I used a landscape-scale approach to investigate the impact of urban development on avian species richness in greater Melbourne. I selected 30 study landscapes (each 100 ha), stratified to represent gradients of housing cover (from 9–39%) and canopy tree cover (13–63%), and conducted 1,500 timed bird surveys (50 per landscape) over a period of 16 months. My results show that housing cover has a strong influence on landscape-level species richness, with more developed suburbs recording fewer bird species. In contrast, landscapes with more canopy tree cover and a greater extent of surrounding native bushland recorded higher levels of bird diversity. These findings indicate that canopy trees and bushland patches are important for conserving birds in urban spaces, but their benefits may be moderated by the intensity of local housing development.

Notes:

Between a rock and a hard place: Site selection for Brush-tailed Rock-wallaby translocation using structured decision making

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Abstract

Despite advances in conservation management, the number of threatened species continues to rise globally. In Australia, since European colonisation, we have seen increased extinction rates and significant population declines for many species. This project contributes to conservation of an iconic threatened species, the Brush-tailed Rock-wallaby (BTRW) (*Petrogale penicillata*), by identifying potential release sites for captive-bred wallabies in order to support the establishment of new BTRW colonies in Victoria and the ACT. Structured Decision Making (SDM) (Gregory *et al*. 2012) involving a panel of experts will be used to identify and rank key habitat attributes for BTRW. Highly ranked attributes will be used to create a habitat suitability model (HSM) for BTRW, employing Geographic Information System (GIS) methods, remote sensing data and Maxent software. The HSM will facilitate identification of potential release sites. These sites will be ranked from most to least feasible by the expert panel through a second SDM process.

Notes:

The benefit of Landcare participation to bushfire recovery in East Gippsland and North East Victoria

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Abstract

The 'Black Summer' bushfires of 2019-20 engulfed large swathes of eastern Victoria and southeastern New South Wales. In the decade prior, these regions had also experienced extended drought, floods and fires. In the two years since, there has been the added burden of the COVID-19 pandemic, heightening disconnection. These impacts have been borne by both the human and non-human communities of these regions.

As a collaboration of social and environmental scientists, we undertook research to explore the contributions of local groups to environmental and biodiversity recovery after bushfires and how involvement in these groups affected their members' well-being. This comprised interviews with 21 members of community-based environmentally focused groups from East Gippsland and North East Victoria, who had been affected by the fires. We also undertook a workshop with representatives from a range of agencies supporting environmental recovery.

Although the focus of the groups varied widely – from soil and pasture management, through revegetation and pest plant control to installing nest boxes and citizen science, participation in these activities, where possible, added benefit to their social connection and sense of agency after such a traumatic event. The study also highlighted an opportunity. Most environmental recovery activity is undertaken on public land. Landcare and other environment groups can greatly extend the reach of environmental recovery activities by connecting with private landholders in disaster affected areas.

Notes:

Poster Abstracts

PhD research project

Cross-cultural relationships in natural resource management: Understanding the nature and experiences of partnership and collaboration

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Abstract

Globally, conservation policy that excludes Indigenous peoples is being challenged, and land management and conservation sectors are formally undertaking more socially equitable forms of planning and management. In Australia, the last two decades have been a time for reconciliation and reform. Contemporary government reforms in Victoria (and elsewhere) have focused on institutional administrative agreements and governance arrangements as reform instruments, to facilitate and support the recognition of pre-existing land rights, self-determination, and to structure a new model of partnership and collaboration. Traditional Owners partner with a range of public sector land managers at a Commonwealth, state, and local scale and collaborate with other non-profit and research organisations across a range of programs and projects. Partnership and collaboration as concepts have a spectrum of contextual meanings, interpretations, and expectations, and the interface of western and indigenous natural resource management is complex. Partnership and collaborations bring together experiences and resources from multiple stakeholders. They also bring organizational cultures, regulations, and expectations. The foundations of this research lie within the competing interests and tensions of partnerships and collaborations. This research is being conducted at a time when in Australia, engaging Indigenous People and their knowledge systems in biodiversity conservation and cultural and contemporary fire management practice is increasingly common as a way of addressing social justice and environmental management agendas.

Notes:

Preliminary study of the phytoplankton and zooplankton communities in Lake Wendouree during the Autumn season

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Abstract

Plankton communities are the aquatic organisms that mobilise at the aid of water currents. They are ideal model organisms to facilitate the study of lake ecosystems, because of their small body size, high abundance and their relatively short generation time. It shows seasonal variation in distribution, abundance and diversity, particularly in shallow temperate lakes, and its major role in the pelagic food web justifies its central place in a wide range of experimental studies. Plankton can be categorized as plant-like 'phytoplankton' and animal-like 'zooplankton'. Phytoplankton are the most common primary producers and act as the base for aquatic food webs. Zooplankton provide the link in the food chain between phytoplankton and fish communities. However, the diversity, abundance and distribution of these plankton communities have not been investigated in Lake Wendouree. Therefore, this preliminary study seeks to find these communities structure and abundance in Lake Wendouree during the autumn season. Among phytoplankton communities Chlorophytes, Bacillariophytes, Dinophytes, Euglenophytes, and Cyanophytes have been identified. Interestingly Chlorophytes and Bacillariophytes are dominant groups while Cyanophytes are very less, indicating that Lake experiencing a healthy system. Similarly, Rotifers and Cladocera are predominant zooplankton than Copepods. Nutrient loading, over harvesting of aquatic vegetation and global warming can be a threat near future via favouring Cyanophyte blooms. Thus, frequent monitoring of plankton community structure in Lake Wendouree is essential for management measures.

Notes:

When the platypus river turns orange: Monitoring and addressing impacts of sedimentation on platypus habitat in Bacchus Marsh

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Abstract

The Werribee River through Bacchus Marsh supports a population of platypus (*Ornithorhynchus anatinus*), a species recently listed as threatened in Victoria. Over the past three years this section of the Werribee River has frequently turned an orange hue, in response to sediment runoff from rapid, large-scale urban development occurring alongside the river and its tributaries. This is concerning, given increased sediment input can affect the availability of macroinvertebrates on which platypus feed, and hence platypus survival.

In response to these concerns, Bacchus Marsh Platypus Alliance developed the "MAISOP Project" (Monitoring and Addressing Impacts of Sedimentation On Platypus habitat). The MAISOP Project aims to: a) Monitor and analyse associations between construction-related sediment input and macroinvertebrate availability in platypus habitat of the Werribee River, Bacchus Marsh; and b) Use these findings to develop and implement strategies to prevent and address impacts, including an education and advocacy program in collaboration with industry, local government and others. The project is led by community volunteers and citizen scientists of Bacchus Marsh Platypus Alliance, who have reached out to collaborate with experienced ecologists, biologists and others in relevant fields.

Three monitoring sites have been established in the relevant section of the Werribee River: upstream, midway, and downstream of the main urban development area in Bacchus Marsh. At these sites, turbidity and electrical conductivity data will be collected using real-time water quality sensors. Data on macroinvertebrate type and abundance will be collected at set periods by citizen scientists trained in standardised macroinvertebrate survey techniques. Trained citizen scientists will also conduct platypus surveys at set periods, using the Australian Platypus Monitoring Network's standard visual survey method. Data will be analysed using multivariate analysis techniques, taking into account rainfall and other parameters.

Findings will be used to inform an "Operation Sediment" Action Plan" for the Werribee River through Bacchus Marsh, in collaboration with industry and government stakeholders. Findings will also help contribute to the boarder knowledge base on impacts of construction-related sediment on platypus habitat parameters.

Notes:

Cassytha distribution in Australia and Brunei: A joint collaboration to unravel angiosperm host- parasite interactions in Australasia

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Abstract

Cassytha is an angiosperm aerial stem hemiparasite belongs to the family Lauraceae. It has increasingly influenced agricultural and natural ecosystems by its parasitic effects on a wide range of host species. Here we give a report regarding ongoing work on its distribution in Australia and Brunei. In Australia, 16 species are found distributed around the coast and within inland shrublands and forests. Among them, *C. pubescens* (snotty gobble) is common in south-eastern Australia and *C. filiformis* and *C. capillaris* are found mainly in tropical Queensland. Only 13 host species have been explicitly recorded for native *Cassytha* species, with some studies referring to associated species or species that were climbed by *Cassytha*, not stating if they are true host species. The common host families vulnerable to *Cassytha* parasitism are Fabaceae and Myrtaceae, whilst common host genera are *Acacia*, *Eucalyptus* and *Casuarina*. It has been noted that *Cassytha* species have the potential of using a biocontrol agent similar to alien invasive weeds.

In Brunei Darussalam, the first occurrence of pantropical *C. filiformis* was reported in 1991, and thus far this is the only species recorded in Brunei. Ongoing studies in Brunei have recorded a heavy presence of *Cassytha* in the endangered coastal heath forests known as 'Kerangas'. Recent studies conducted in Brunei, found that 17 dicotyledonous host plants vulnerable to *C. filiformis*. Host species that have the highest frequency of infection are the native pioneer species, *Dillenia suffruticosa* and *Melastoma malabathricum,* as well as the invasive species, *Acacia mangium* and *Acacia auriculiformis.* It is notable that *C. filiformis* has also infected native heath forest species such as *Nepenthes gracilis, Elaeocarpus mastersii, Rhodomyrtus tormentosa, Buchanania arborescens* and *Timonius flavescens*. These findings imply that despite its wide range of host preferences, *C. filiformis* demonstrated high host specificity among the coastal heath forest species. Further, increased water availability and nitrogen supply can intensify the negative impacts of *Cassytha* on their hosts, therefore we suggest that extreme climate events associated with heavy rains and flooding in coastal habitats are likely to enhance *Cassytha* performance compared to their hosts. Ongoing studies have shown three *Cassytha* species native to Australia (*C. capillaris*, *C. filiformis* and *C. pubescens*) have so far spread into tropical and subtropical regions of New Zealand, Asia and Africa. Hence, it is important to monitor the future spread of Australian *Cassytha* (via ocean currents) to coastal habitats of nearby SE Asian and Pacific regions.

Notes:_____

Effect of salinity on seed germination of potentially invasive weed *Chenopodium acuminatum* Willd. (Amaranthaceae)

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Abstract

Germination events of plants often occur after rainfall in saline environments that dilutes the soil salinity, viz. recovery germination. Previous germination studies have rarely considered exposure duration to salt stress and none of them have investigated recovery germination under low-salt concentrations other than distilled water. Main objective of this study was to investigate the effects of salinity, exposure duration and low-salt recovery solutions on seed germination of the invasive weed *Chenopodium acuminatum* to get a clear insight about the germination strategy exhibited by this species in saline habitats. We tested: 1) the effects of salinity and exposure duration on the initial germination and recovery germination in distilled water, (2) the influence of salinity, exposure duration and recovery solution concentrations on recovery germination of *C. acuminatum*. Seeds were initially exposed to 0-400 mM NaCl for 10, 20 and 30 d. Subsequent recovery experiment was conducted differently. For those initially treated with 100 and 200 mM NaCl, recovery solution was distilled water, while for those initially treated with 300 and 400 mM NaCl, the recovery solutions were distilled water, 50 and 100 mM NaCl. At the end of each exposure duration, the initial germination percentage and rate, recovery germination percentage and rate, and total germination percentage were calculated. Results showed that the recovery germination percentage and rate significantly decreased when the exposure duration extended. Seeds could subsequently recover to germinate at high percentages in recovery salt solutions for short duration, but the recovery percentage and rate in high initial salinity, combined with high exposure duration and high recovery salt concentrations were remarkable lower. More than 30% of the ungerminated seeds were viable after the recovery experiment. We suggest *C. acuminatum* exhibits a 'cautious' strategy of germination to avoid injury from long-term salt stress and ensure survival for the subsequent continuation of its population under unfavourable saline conditions. Based on these findings, it is timely to monitor spread of Australian *Chenopodium* species (i.e., *C. album* - Fat Hen/Goosefoot) due to varying saline conditions associated with the climate change impacted rainfall patterns.

Notes:

Seed germination tolerances of *Tecticornia lylei*, a salt lake samphire from an arid zone Endangered Ecological Community

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Abstract

Samphire species from salt lakes in arid zones face particular challenges during reproduction due to the harsh environments they inhabit. High temperatures, salinity, and minimal or intermittent rainfall are common features of these regions. Seeds must be able to withstand extremes of salinity and moisture stress until conditions are suitable for germination. While samphires are halophytes which can reproduce under saline conditions, the species vary substantially in their tolerances to extremes, and there is a lack of data on the germination behaviour of most *Tecticornia* species in Australia. *Tecticornia lylei* low open-shrubland is a largely monospecific Endangered Ecological Community that occurs on the fringes of salt lakes in far south-west New South Wales. Very little is known about the community or its dominant species, *Tecticornia lylei*, which is also endangered in Victoria. Seedling recruitment in New South Wales populations is lacking, therefore it is important to understand the environmental factors that influence germination. This study explored seed germination tolerances to temperature, light, burial depth, salinity and osmotic stress, as well as the ability to recover from stress. *Tecticornia lylei* seeds germinated across a range of temperatures (optimal 17/7°C), regardless of light conditions. The species was tolerant of high salinity (1200 mM NaCl) and dry conditions (-1.5 MPa), and while germination percentages reduced at higher levels of stress, further germination occurred after rinsing with fresh water. Seeds emerged from depths up to 1.5 cm, with optimal emergence at 0.25 cm. While this species germinates optimally at lower temperatures, reduced salinity and moisture stress, and with seeds buried just below the soil surface, it will also tolerate higher stress conditions and continue to germinate in low numbers. This is a useful strategy in arid zones, as while some seeds will germinate under high stress conditions, the majority will germinate only when rainfall is adequate to reduce salinity, increase soil moisture and maximise chances of seedling survival. However, this presents concerns about future population structure and sustainability with increased temperatures, salinity and extended droughts likely with climate change.

Notes:

Landcare – it ain't over yet tour

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Abstract

Landcare has been active for over 30 years and the Wimmera has been a region renowned for active Land carers and groups. Everyday farmers are adopting and looking for new innovative ways to operate more sustainably, but what is Landcare and what will it look like in the future? Groups are finding it harder and harder to attract new members and attracting resources to help implement improvements to increase their productivity and protect and enhance the environment. Is Landcare just about planting trees and setting aside land for biolinks and shelter belts or is Landcare about a whole catchment approach and connecting communities through a range of activities and practices? This initiative is about exploring the three stages: past, present and future, and beginning to consider implementing different initiatives that may not be the 'norm' for Landcare over the years. With over 10 landcare groups across the Upper Wimmera Catchment, is the future about increasing group numbers and filling in gaps across the catchment to fulfil the Grampian to Pyrenees Biolink strategy or could it be more about better understanding our cultural history and reaching out to non-landcare people and learning about what they do and how they care for the land within the community and apply their knowledge and skills to reach a catchment wide outcome? These posters attempt to show the various stages and opportunities for the future of Landcare.

Notes:_____

Assessing the risk to key revegetation species from a changing climate

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Abstract

Declines in vegetation communities lead not only to a decline in flora species but also to the fauna species that rely on them for habitat and other ecosystem services. Vegetation management is therefore an important means of providing ecosystem services including habitat provision, water filtration and cycling, soil stabilising, and amenity, and recreation services. Vegetation management is also a major area of investment where assessment and amelioration of threats from our changing climate is an important consideration. Critical to the long- term success of revegetation management is the need to carefully consider species and provenance selection to avoid failures in planted sites, resulting in increased costs and reduced ecosystem services.

Melbourne Water is a statutory authority with responsibilities for land and waterways throughout the greater Melbourne region. The aim of this collaborative research project was to use species distribution models to assess the risk of 31 key revegetation species used by Melbourne Water to a changing climate. We also examined this response further for a subset of six species using a combined approach of species distribution models, a mechanistic model, an in-situ drought trial, and germination trials to explore their potential distributions under climate change. The importance of provenance selection and patterns of local adaptation on determining species risk to climate change was further investigated for one species – River Red Gum (*Eucalyptus camaldulensis*). Finally, we used climate matching to identify areas within the contemporary distribution of modelled species that a climate similar to that predicted for the Melbourne Water region under a changed climate.

We gained a greater understanding of the factors that shape the current distribution of key revegetation species and their risk, and this can guide species selection for revegetation. We also gained knowledge on the recruitment niche of six of these species to climatic factors and how predictions from mechanistic models vary from SDMs We used these results to quantify species vulnerability to changing climate and map potential changes in the distribution of species with the Melbourne Water region. We found that species exhibited a range of responses to climate variables and modelling approach. A common trend was a shift to higher elevations and riparian areas under climate change. Species that were broadly distributed across climate gradients had more potential climate analogues available compared to species with a distribution across a narrower climate gradient. Across the Melbourne Water region, wetter and cooler areas were predicted to increase in aridity at a faster rate than areas that were initially more arid. This indicates that climate change risks are unlikely to be uniform across the region. This analysis has informed some practical management recommendations for Melbourne Water revegetation works to increase resilience under a changing climate, including species selection, sourcing of plants and seeds, and identification of priority areas and risks.