'*Biodiversity Across the Borders*' Conference

Theme: "BIODIVERSITY IN RURAL LANDSCAPES"

ABSTRACTS

Centre for Environmental Management
Federation University Australia
Mt Helen, Ballarat,
Victoria

Edited by: S. K. Florentine & G. J. Ambrose

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Program

8:00	**Registration** **VENUE**: **1870 Founders Hall Theatre**, Mt. Helen campus, Federation University Australia	
8:45	**Introduction and Welcome** **PROF. MARK SANDEMAN** – Executive Dean, Faculty of Science & Technology, Federation University Australia	
8:50	**PROF. TODD WALKER (Deputy VC Engagement), Federation University Australia**	
8:55	**PROF. ANDREW SMITH (Deputy VC Academic) Federation University Australia** **Opening of '*Biodiversity across the Borders*' conference**	
9:00	**Introduced by: PROF. FRANK STAGNITTI** – (**Deputy VC Research & Innovation**), Federation University Australia **Keynote Address:** **ASSOC. PROF. IAN LUNT** (CHARLES STURT UNIVERSITY) From science to inspiration: 10 tips to promote ecological literacy and successful conservation in our communities.	
	VENUE: Caro Main Hall Theatre CHAIR: **KAREN DOUGLAS** (Deputy Chancellor) Federation University Australia	
	PLENARY SESSION	
9:35	**DR. KELLY MILLER** (DEAKIN UNIVERSITY) You think what? Building a better understanding of the human dimensions of biodiversity conservation.	
9:55	**DR. GRAEME NEWELL** (ARTHUR RYLAH INSTITUTE FOR ENVIRONMENTAL RESEARCH) Victoria's native vegetation: combining ecology and informatics for new insights.	
10:20	**ASSOC. PROF. SARAH BEKESSY** (RMIT) Planning for biodiversity at the urban-rural fringe.	
	Morning tea 10:40 – 11:15 **Venue: TBA** **Poster Session**	
	SESSION 2	
	Restoration and Management **VENUE: Caro Main Hall Theatre** **CHAIR: PROF. ANDREW BENNETT**	**Fire and Wildlife Habitat** **VENUE: Studio Theatre** **CHAIR: ASSOC. PROF. ALAN YORK**
11:20	**DR. ROHAN CLARKE** The benefits of revegetation for woodland birds in rural landscapes.	**BILLY GEARY** Landscape properties mediate spatial predator-prey interactions in a fire-prone system.
11:35	**DR. ADAM BESTER** Lessons from the Glenelg River restoration project.	**CAROLINA GALINDEZ-SILVA** How do wallabies hop during fire?
11:50	**ASSOC. PROF. S. K. FLORENTINE** Assessment of past restoration efforts in rural landscapes: where to from here?	**JULIAN BROWN** Challenges for plants and their pollinators in fire-prone landscapes.
12:05	**DR. ANGIE HASLEM** Landscape properties mediate the effect of severe drought on bird communities in rural landscapes.	**BLAKE ALLAN** Using cost-effective technologies to improve our knowledge of animal habitat use.
12:20	**DR. KAY MORRIS** Wetland connectivity and management.	**PROF. DAVE WATSON** Wildlife restoration: applying lessons learned from revegetation to safeguard native animal populations.

	LUNCH BREAK 12:35 – 1:30, Albert Coates Complex **Poster Session**	
	SESSION 3	
	Climate, Land Conservation and Management **VENUE**: **Caro Main Hall Theatre** **CHAIR**: **CRAIG WHITEFORD**	**Biodiversity Management in Agricultural Landscapes** **VENUE: Studio Theatre** **CHAIR: DR. JOHN WRIGHT**
1:45	**PROF. ROGER JONES** Rapid shifts in regional climate: shocks or opportunities?	**DR. PETER SPOONER** Biodiversity interactions in mallee almond crops.
2:00	**DR. JIM RADFORD** Pulling the right lever at the right time: Bush Heritage's multi-faceted approach to conserve biodiversity in rural landscapes in southern Australia.	**DR. NICK SCHULTZ** Rethinking grazing as a landscape-scale process.
2:15	**DR. DOUG ROBINSON** Trust for Nature's conservation vision for rural Victoria: a private-land lens.	**DR. MICHELLE CASANOVA** Management of wetlands for biodiversity in an agricultural landscape.
2:30	**BRONWYN HRADSKY** Where does the fox go? GPS tracking predators across forest and farmland	**DR. SIMON WATSON** Conserving biodiversity in human landscapes - patterns in time and space.
2:45	**DR. MANU SAUNDERS** Costs vs benefits of birds and insects in agricultural landscapes. Case study: Victorian apple orchards.	**DANIEL FLAIM** Post-cultivation recovery of a semi-arid Victorian grassland.
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3:35	**Panel Discussion: Biodiversity in rural landscapes: direction for the future** **VENUE: Caro Main Hall Theatre CHAIR: PROF. MIKE CLARKE** Panel Members: PROF. ROGER JONES, ASSOC. PROF. SARAH BEKESSY; BRONWYN HRADSKY; DR. ADAM BESTER & DR. DOUG ROBINSON	
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KEYNOTE ADDRESS:

From science to inspiration: 10 tips to promote ecological literacy and successful conservation in our communities.

I. D. LUNT

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Abstract

As evidenced by this conference, an enormous amount of great conservation science is being produced. Science and on-ground learning have never been more important. Nevertheless, good science is under attack by people with different values who want to achieve different outcomes. The pseudo-science of climate change denial, anti-vaccination and alpine grazing are prominent examples. These topics remind us that great science (like great management) is necessary but inadequate. We need to achieve more.

For a start, we need to communicate better. We need to re-package our work to create stories that entertain, engage and inform the world. We live at the best time to achieve this. We can no longer complain, "How do we get our messages out to the world?", because thanks to the internet we have free access to the best (and worst) platforms the world has ever known. But so does everybody else.

For our messages to be visible, they have to be really, really good. We all have to learn new skills and, more importantly, we have to re-learn a really old skill: how to tell great stories. To get ahead, we need to use new media to tell great stories that engage readers and attract new audiences. In this presentation, Ian provides insights on how we can improve the way we get our messages out, beyond the converted, to engage the broader community, so we can promote ecological literacy and successful conservation.

You think what? Building a better understanding of the human dimensions of biodiversity conservation.

K. K. MILLER

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Abstract

The 'human dimensions' field of study has its origins in wildlife management but it applies equally to all aspects of biodiversity conservation. In this context, human dimensions research focuses on what people value and know about biodiversity and whether or not their behaviours align with conservation objectives. The field draws from a range of social science disciplines such as social psychology, economics and sociology, and employs social research methods such as questionnaires, focus groups, interviews and observation of human behaviours.

This presentation will provide an overview of this field of study and how it can contribute to a better understanding of the likely success of conservation programs. Lessons learned from studies in Australia and overseas will be presented and will focus on the following key findings:

- An absence of human dimensions research can contribute to poor management outcomes.
- The controversial nature of many conservation issues necessitates a good understanding of the full range of values and perspectives among communities and stakeholder groups. Social-psychological theories can help us understand the links between concepts such as values, attitudes and behaviours.
- Opportunities for public participation in decision-making are essential.
- The values and attitudes observed in rural communities can differ significantly from those in urban communities.

In a Victorian context, research has shown that people have a relatively strong interest in learning about biodiversity and express strong emotional attachments to animals (often domestic animals, but not always). Such trends mirror those found in other countries and offer insights to promote biodiversity conservation to the wider community.

Victoria's native vegetation: combining ecology and informatics for new insights.

G. R. NEWELL[†1], M. D. WHITE[1], C. LIU[1], S. SINCLAIR[1] AND P. A. GRIFFIOEN[2]

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Abstract

Native vegetation is a critical feature of our environment that supports a range of cultural and societal needs as well as intrinsic environmental values. Agencies regularly use maps ('spatial models') of the distribution, composition, and quality of native vegetation, amongst other data, as key resources in conservation management.

Ecology as a discipline has developed historically from a natural history (i.e. descriptive) basis to incorporate mathematical / statistical rigour, and this progression is also evident in spatial representations of vegetation. Informatics and machine learning offer new approaches and opportunities for finding patterns in very large datasets that can assimilated from various sources. We have collated and developed a data library of spatial data relevant to the biota and ecosystems across SE Australia, and coupled this with a suite of machine learning tools, some of which are novel to ecological modelling.

These data and systems provide the capacity to produce 'maps' of varied ecological phenomena, including the distribution of flora and fauna (both current and pre-European settlement); community structure (e.g. vegetation type); community function (e.g. condition), and expressions of physiological and ecological traits. These tools allow us to learn, discover and represent ecological patterns, often intuitively understood by field ecologists, but which have thus far been difficult to express and visualise.

Collectively these products display a wide variety of ecological ideas, in addition to vegetation type or extent, and are useful in both developing and implementing environmental policies and programs for the Victorian Government. As data-driven models of ecological phenomena they also provide the basis for generating new ecological ideas, and support frameworks testing these ideas with new and relevant field data.

Planning for biodiversity at the urban-rural fringe.

S. A. BEKESSY[†] AND G. GARRARD

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Abstract

In Australia, over 50% of threatened species occur at the urban-rural fringe and accelerating urbanisation is now considered one of the greatest threats to biodiversity. Without a major re-think, it is likely that species and potentially whole ecosystem types will be lost due to the planned expansion of urban fringe areas. Two major problems are driving the loss of biodiversity on the urban fringe. Firstly, *once development occurs, ecosystems inevitably deteriorate and many species are unlikely to persist*. Over time, the fragmentation of the landscape, introduction of pests and weeds, increased roads and traffic and disturbance from intensive recreation results in the disappearance of sensitive flora and fauna species. These impacts can be controlled for, and substantially better outcomes are entirely possible. But this depends on better, scientifically driven development design that meets the needs of species and manages community use and perception. The second major problem is that *many of Australia's growth corridors are aligned with key biodiversity hotspots*. This inevitably leads to conflict in land use, with biodiversity values typically coming off second best and the continued expansion of the urban fringe, pushing further into biodiversity-rich areas. Alternatives to urban sprawl exist, but projections of the consequences of status quo and alternative scenarios for communities, local economies and biodiversity are urgently needed. I will present results of a project, funded by the Myer Foundation, that attempts to find solutions to these two problems; namely a protocol for Biodiversity Sensitive Urban Design and a set of planning scenarios that challenge the status quo of urban fringe expansion.

Landscape-level revegetation reverses the decline of woodland birds in agricultural mosaics.

R. CLARKE[†1,2], G. J. HOLLAND[2] AND A. F. BENNETT[2,3]

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Abstract

Replanting and restoration of vegetation is being undertaken in many regions where excessive loss of natural habitats has occurred. It generally is assumed that this will reverse faunal decline and reinstate the original biota. We examined the species richness and composition of woodland-dependent birds in 43 landscapes, each 8 km^2 in size, across an agricultural region in southern Australia. These were selected assets of landscapes in which wooded cover was: a) primarily remnant natural vegetation; b) a mixture of remnant and replanted vegetation; or c) primarily replanted vegetation. In each set, wooded vegetation cover ranged from <2% to ~19% of the landscape, the remainder being farmland with scattered trees. There were two key results. 1) Progressive loss of remnant woodland led to a decline in species richness of woodland birds and a simplified composition but, as landscapes increased in cover of revegetation, species richness increased, and species composition was enhanced. 2) The trajectory of recovery is not simply a reversal of the trajectory of decline. For a given cover of wooded vegetation, species richness was lower in revegetated landscapes and the avifaunal composition differed in predictable ways. Replanting offers conservation benefits at the landscape scale, but does not necessarily provide suitable habitat, at least in the short-term, for entire assemblages.

The Glenelg River restoration project – lessons learnt over a 14 year project.

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Abstract

In the early 2000s the Glenelg River was on the brink of ecological collapse due to low flows, poor water quality, loss of habitat, weed and carp invasion. Fourteen years ago the Glenelg Hopkins CMA, in conjunction with the community and other agencies, commenced the Glenelg River Restoration project, an ambitious undertaking to look at an integrated and long-term approach to restore health to the Glenelg River. Restoration of a river system can often take generations to see any results, but already the river is showing signs of biodiversity improvement. Works have included 1725 km of riparian fencing, over half a million trees and 796 km of direct seeding, the opening of 977 km of the river to fish movement and the establishment and use of an environmental flows entitlement. These works have resulted in several native fish species extending their range by hundreds of kilometres, a 150% increase in variegated pygmy perch and a 280% increase in blackfish numbers at sites with large wood reinstatement. Key learnings from the project to date have focused around the importance of: 1. Planning on a range of different geographic scales; 2. Partnerships and building relationships; 3. Integrating programs; 4. Demonstrating outcomes; 5. Taking risks and embracing novel approaches and 6. Selling the project. These results and learnings may have application to other river restoration projects across Australia.

Assessments of past restoration efforts: where to from here?

S. K. FLORENTINE

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Abstract

Restoration ecology is a relatively new science. It is still in the early stages of developing a broad knowledge base, conceptual framework and practical applications. There is currently an urgent need for this field to generate prescriptions to inform and guide vegetation restoration. These will enable management agencies to move away from *ad hoc*, site- and situation-specific projects and develop restoration programs that are landscape-scale and evidence-based. This is reminiscent of the formative years of conservation biology, when researchers realised the need to develop prescriptions for reserve delimitation.

Resource managers are currently urging researchers to provide them with clear and appropriate practical guidance, accessible tool-kits and directions that they can employ research findings into the restoration efforts facilitate the restore ecosystems to a self-sustaining state. Therefore, we have carried out landscape scale assessments of the past restoration efforts in and across two major catchments in south-western Victoria. In this talk, I would like to highlight some of the problems experienced in these restoration initiatives. Although our knowledge of habitat restoration has increased, we are still not implementing some lessons learned from previous landscape restoration efforts. Finally, in this presentation I will also discuss case studies that highlight some valuable outcomes of such work.

Landscape properties mediate the effect of severe drought on bird communities in rural landscapes.

A. HASLEM[†1,2,] D. G. NIMMO[1], J. Q. RADFORD[3] AND A. F. BENNETT[1,2]

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Abstract

Extreme weather events, such as drought, have strong impacts on native communities. In many regions, a predicted increase in the occurrence of such events will be imposed on landscapes already heavily modified by human land-use. Therefore, there is a need to understand how the effects of such events may be exacerbated or moderated by different patterns of landscape change. We used empirical data on woodland-dependent birds in 24 landscapes (each 100 km^2) in north-central Victoria, collected during and after a severe drought, to document change in the composition of bird assemblages. We examined whether landscape properties, such as habitat amount or productivity level, influenced the way bird communities changed in response to drought. To quantify change, we used pairwise indices of assemblage dissimilarity, partitioned into components representing change in a) the number (richness) and b) the identity (turnover) of species in assemblages. There was widespread loss of woodland birds in response to drought, with only partial recovery following drought-breaking rains. The response of bird assemblages to drought varied between landscapes, and was strongly associated with landscape properties. The extent of wooded vegetation had the greatest influence on overall assemblage change: landscapes with more native vegetation had more stable bird assemblages over time. However, for the component processes of richness- and turnover-related change, measures of landscape productivity had a stronger effect. Landscapes with more riparian vegetation maintained more stable assemblages in terms of richness, but exhibited greater turnover of individual species over time. These results emphasize the importance of the total extent of native vegetation – both overall cover *and* that occurring in productive parts of the landscape – for maintaining bird communities resistant to severe drought. While extreme climatic events cannot be prevented, their effects can be ameliorated by managing the pattern of native vegetation in rural landscapes.

Wetland connectivity and management.

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Abstract

Connectivity represents the ability of plants and animals to move among habitat patches in the landscape. Connectivity is an important consideration in the management of wetlands as it: (i) provides opportunities for both native and introduced species to expand their range and migrate in response to local and regional changes in habitat conditions, (ii) facilitates re-colonisation following local extinction events, and (iii) increases genetic diversity by promoting gene flow among populations.

A distinction is often made between structural and biotic connectivity. Structural connectivity often infers connectivity simply from the geographical arrangement of habitat patches in the landscape. In contrast, biotic connectivity considers how a species' mobility and responses to features of the landscape influences patterns of movement among habitat patches. As such, biotic connectivity provides a more realistic representation of the potential of organisms to move among habitat patches.

Although management has historically focused on individual wetlands, adequately protecting wetlands may often require the protection or restoration of wetlands with which they are biologically linked and the pathways that facilitate movement among them. As wetland systems support a diverse biota an understanding of connectivity for representative groups of aquatic organisms is needed to support management decisions.

In this paper we discuss how knowledge of habitat requirements, dispersal distances and landscape permeability can be used within a GIS framework to develop maps of potential biotic connectivity for waterbirds, amphibians and plants. The utility of these maps in guiding the spatial prioritisation of on-ground management activities that aim to protect high value wetlands, restore degraded wetlands or protect wetlands from the spread of weeds and /or diseases will be discussed.

Landscape properties mediate predator-prey interactions in a fire-prone system.

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Abstract

A range of factors can influence species' niches and distributions from the bottom-up and top-down. Fire, a widespread bottom-up process, affects fauna by altering vegetation structure and composition. Predators can also shape ecological communities, regulating herbivores and mesopredators from the top-down. Therefore, it is important to consider both habitat properties and predator-prey relationships when examining species distributions. We examined the spatial and temporal relationships within a mammal community occurring in Victoria's Big Desert-Wyperfeld region, a semi-arid area with a complex fire history. We used baited camera traps across 105 sites nested within 21 landscapes, as well as scat surveys for wild canids (*Canis* spp.), to determine the spatial relationships between predators, prey and the landscapes they inhabit. We examined the spatial relationships between species and the landscapes they inhabit using structural equation modelling. We also examined temporal relationships between predators and their prey using kernel density functions. Across the six mammal species modelled, fire history, vegetation and the reporting rate of predators or competitors all influenced spatial distribution at the landscape scale. Further, predators appeared to time their peaks in temporal activity to match their main prey source. We also highlight how changing one management regime may have flow-on effects through a community. This study emphasises the need to consider disturbance processes (i.e. fire) and biotic interactions together to better understand ecosystem dynamics, and for improving pest management and biodiversity conservation actions. Therefore, an integrated approach to landscape-scale pest and fire management is essential for good ecological outcomes.

The hop of wallabies during fire.

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Abstract

Animal movement is a vital process that influences the responses to a disturbance. Fire is a form of disturbance, and its effects depend on aspects of the fire regime. Several studies have been conducted on post-fire responses; fewer studies have, however, been undertaken during a fire event. My study incorporated GPS technology to investigate movement patterns of swamp wallabies (*Wallabia bicolor*) during a planned fire. The progression of the fire during 36 hours was modelled using the software Phoenix Rapidfire. To quantify the response during fire, I compared activity range size, location of the centre of activity and distance to gullies before and during fire. Additionally, I estimated the distance to the fire front, as well as energy expenditure during fire. Results indicated that all the wallabies avoided the fire front, by either moving parallel to it, or staying in unburnt areas or close to gullies within pre-fire activity ranges. Activity ranges became smaller during the fire, as expected, while energy expenditure increased, suggesting that although they did not move long distances, they were very active. No differences were found in the studied responses (activity range size, location of the centre of activity and distance to gullies) of swamp wallabies in relation to the percentage of activity range that was burnt; possibly because the amount of activity range burnt was relatively small and very patchy.

Challenges for plants and their pollinators in fire-prone landscapes.

J. M. BROWN[†], A. YORK AND F. CHRISTIE

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Abstract

Prescribed fire is a widely used conservation and land management tool, though research into its effectiveness in managing pollination has only recently begun. Fire effects have not been explored in sexually-deceptive pollination systems, and may be complex in Australia due to effects at both local- (flowering is often stimulated by fire, and the removal of surrounding biomass may enhance pollinator visitation) and landscape-scales. (Pollinators are predominantly parasitoid thynnine wasps whose abundance may be influenced by successional changes in insect host availability.) Here we investigate whether: 1) visitation is enhanced when the local environment is recently burnt; 2) pollinator hosts are associated with a particular successional stage; and 3) visitation increases with the proportion of the surrounding landscape covered by the successional stage associated with hosts. We collected data from Australian heathy woodland sites varying in successional status. We observed pollinator visitation to flowers of *Caladenia tentaculata* at each site and related it to the successional status of the vegetation at local- and landscape-scales. We related the number of hosts captured at each site to successional status at landscape-scales. There was weak evidence of association between local-scale successional status and pollinator visitation. Pollinator hosts were positively associated only with vegetation burnt 36-50 years ago. At the landscape-scale there was some evidence of a positive association between pollinator visitation and vegetation burnt 36-50 years ago, but the strongest positive association was with vegetation burnt 50 or more years ago. We suggest pollinators enter succession following establishment of insect hosts and subsequently impose top-down control. Our results suggest that fire management of pollination for thynnine-pollinated, sexually-deceptive orchids – which flower predominantly in the early post-fire environment – should include measures to maintain long-unburnt vegetation in the surrounding landscape.

Using cost-effective technologies to improve our knowledge of animal habitat use.

B. M. ALLAN[1†], D. G. NIMMO[1], J. P. Y. ARNOULD[1], J. K. MARTIN[2] AND E. G. RITCHIE[1]

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Abstract

Understanding how species use and are constrained by their environments is central to ecology, and integral to the effective conservation of biodiversity. However, collecting fine-scale information on how animals interact with their environment is challenging. I will outline two cost-effective methods of collecting high-resolution spatial and temporal data using off-the-shelf products.

Animal tracking - We built tracking collars comprising a GPS data logger and 3-axis accelerometer, to enable better recording of animal movement and habitat use. We assessed the difference in the quality of information obtained from the two data sources using bobucks (*Trichosurus cunninghami)* as a model species in an environment consisting of different habitat patch sizes and lengths. The combination of GPS technology with accelerometer data loggers provides detailed information on fine-scale spatial and temporal habitat use and a much more comprehensive understanding of how animals use specific areas within the environment. Notably, by combining the two technologies, we show a significant difference in how animals interact with different habitat patch sizes, lengths, and level of disturbance. By combining these technologies and techniques, we obtain new insights into how animals use specific environments, and gain a more comprehensive understanding of their ecology.

Unmanned Aerial Vehicles (UAVs) – Still a relatively new technology, UAVs are showing great potential for numerous applications, including monitoring management burns in real-time, surveillance of illegal practices such as logging or poaching of wildlife and collecting data from monitoring stations in regions difficult to access. I will provide an overview of how the technology can be used, and highlight the advantages and pitfalls of the technology.

Wildlife restoration: applying lessons learned from revegetation to safeguard native animal populations.

D. M. WATSON[†1] AND M. J. WATSON[1,2]

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Abstract

In most rural landscapes, remnants of native vegetation are surrounded by farmland. Although many native species come and go, many do not, with most reptiles, amphibians and small mammals effectively stranded. These isolated subpopulations are vulnerable to disturbance and resource limitation, and many are declining towards local extinction. In the same landscapes, other remnants where these species are absent are improving in habitat quality, both through natural regeneration and via active restoration efforts. So, for many species in many landscapes, populations resemble dynamic checkerboards: too many individuals in some patches of decreasing quality and no individuals in other patches of increasing quality. A short-term solution to this situation is to move animals to 'seed' these vacant patches. From a straight conservation point of view, these targeted translocations fill in the range of many species, increasing overall population size and reducing the likelihood of local extinction. From an ecological stand-point, this is a large, coordinated series of experiments, revealing functional roles and the mechanistic basis of habitat preferences. Once underway, this scheme would engage directly with the general public, rewarding best practice land management by offering landholders opportunities to restore wildlife to their properties. In contrast to conventional reintroduction schemes—expensive reactive interventions involving highly-trained specialists and captive-raised endangered species—this proactive, community-driven initiative is cheap and aims to avert future declines by *keeping common species common*. To realise this vision, several practicalities need to be resolved: protocols established regarding species and site selection (habitat extent, quality, configuration), minimum viable number of animals to move, maximum numbers to take from source populations, and population genetics. The Landcare movement has demonstrated the willingness of farmers to restore their properties with plants that used to grow there—why not give them the opportunity to put some of the animals back as well?

Rapid shifts in regional climate: shocks or opportunities?

R. N. JONES

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Abstract

The common view of climate change is that the human component, which is driven by rising greenhouse gases, changes gradually. Climate variability is seen as a random collection of processes that take place over days to decades; these interfere with the climate trend, sometimes slowing it and sometimes accelerating it. However, for past climates, including those revealed by the crater lakes of Western Victoria, trend-like behaviour is hard to find. Abrupt changes occur relatively frequently, and ecosystems respond to those changes, sometimes over thousands of years. An investigation of historical climate in south eastern Australia shows only two warming episodes, and if those shifts are extracted from the record, there is no trend. That warming came in two bursts, in 1968–73 and 1997–98. If natural variability influences are subtracted from that data, changes show these bursts have an anthropogenic origin. Similar dynamics occur elsewhere in Australia and in continental USA. The same behaviour occurs in climate model output. This finding hasn't been picked up by the research community because the appropriate statistical tests are not being used and because the research community is in defence mode against denialism, so feels the need to defend the trend. This evidence points to a climate system that is metastable, taking in energy until it becomes unstable, when it shifts into a new state. Ecologists will find this type of behaviour familiar. What can we do with this type of information? The last climate shift in 1997–98, which was global, caused consequent shifts in a range of related phenomena, including extreme temperatures, fire danger and grape harvesting dates, and is propagating through many natural systems. This suggests that the boiling frog is not a good metaphor for climate change, but that shocks are. How can we use this information to implement robust ecosystem management and encourage positive change?

Pulling the right lever at the right time: Bush Heritage Australia's multi-faceted approach to conserve biodiversity in rural landscapes in southern Australia.

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Abstract

Bush Heritage Australia is a national not-for-profit conservation organization that aims to secure and protect Australia's biodiversity and natural landscapes. We do this by acquiring and managing land in private conservation reserves and by supporting others to achieve conservation outcomes on their land. Together with our partners, we manage over 5 million ha of land and sea for biodiversity conservation. We use a variety of approaches and conservation management tools to protect and manage biodiversity in rural landscapes in southern Australia. Our choice of a particular strategy is determined by the prevailing ecological, biophysical and socio-economic factors. Private conservation reserves are suitable where the land retains high conservation values, faces imminent threats (e.g. clearing, extractive industries, ongoing degradation) and is available for purchase. However, not all ecosystems and species in rural landscapes are able to be secured in reserves (public and private), so other strategies must be used. In partnership with the Tasmanian Land Conservancy, we have established Australia's first non-government funded stewardship scheme in order to protect nationally threatened lowland grasslands and grassy woodlands in the midlands of Tasmania from agricultural intensification. Instead of buying land, this project pays farmers to manage their land for conservation through a series of long-term, rolling management agreements and includes regular monitoring and extension. This achieves our conservation aims and supports rural communities. In central Victoria, we are active in conservation management networks that provide support and advice to private landholders seeking to protect and enhance biodiversity. In the wheatbelt of Western Australia, Bush Heritage leads the Gundawa Regional Conservation Association, an independent group funded through mining offsets that coordinates and funds ecological research and cross-tenure landscape-scale management activities. Through applying a range of strategies that are fit-for-purpose, we can affect real conservation gains in rural landscapes.

Trust for Nature's conservation vision for rural Victoria: a private-land lens.

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Abstract

Despite its relatively small size in an Australian context, Victoria still comprises quite enough land (22 million ha) to be environmentally diverse and daunting in terms of the scale of conservation effort needed to retain or improve existing biodiversity values. Victoria is also large enough and varied enough that its rural landscapes reflect multiple layers of environmental context, human demography, land-use history and current land-use drivers such that there can be no coherent vision for biodiversity in rural Victoria. Instead, it is proposed that biodiversity visions for rural Victoria should be developed at appropriate landscape and social scales that are useful from a biodiversity perspective and achievable in a practical sense. It is also proposed that this approach could be improved by shifting from generalist ecological principles to more specific ecosystem and species targets set at the local scale but meaningful state-wide.

Notwithstanding that Victoria is diverse and complex in an environmental and socio-economic sense, there are some common themes and principles relevant across rural Victoria. First, private land is central to ongoing nature conservation in Victoria. Second, all rural land provides some habitat values. Third, native vegetation on rural land continues to be lost at a rate of several thousand hectares per year, a loss not yet matched by gains in protection. Fourth, protected areas on private land are critical to future maintenance of biodiversity, given rates of habitat loss and land ownership change. Fifth, effective extension and education programmes for landholders, farmers and the community are paramount to ensuring long-term maintenance of biodiversity on rural land.

Where does the fox go: GPS tracking predators across forest and farmland.

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Abstract

The introduced red fox *Vulpes vulpes* poses a major threat to Australia's native fauna. However, remarkably little is known about how foxes use Australian forest landscapes or how habitat modification influences relationships between foxes and their native prey. The role of roads in facilitating fox movement through dense forest, for example, remains unresolved, despite having been identified as a key research question nearly 20 years ago. We used GPS tracking collars to investigate fox habitat selection, activity patterns and ranging behaviour in the eucalypt forests of the Otway Ranges, south-eastern Australia. Vegetation types varied along a rainfall gradient from heathland to wet forest, while time-since-fire ranged from <6 months to >75 years. We obtained >14,000 fixes from 13 individuals, including males, breeding and non-breeding females, and dispersing sub-adults. All foxes were caught within the forest, but numerous animals had home ranges that also overlapped townships and/or farmland. Habitat selection within the home range was influenced by land-use type, proximity to forest edge and other landscape features such as roads and streams, but also varied with time of day. A better understanding of how foxes use forested and human-modified landscapes will help improve invasive predator management for biodiversity conservation.

Costs vs benefits of birds and insects in agricultural landscapes. Case study: south-east Australian apple orchards.

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Abstract

Animal activity can provide benefits to farmers through the provision of ecosystem services (ES) (e.g. pollination, biological control) or create costs by damaging crops, livestock or infrastructure. Traditionally, these two outcomes (positive and negative) have been treated separately, which results in many individual species or animal groups being labelled simplistically as 'pests' or 'beneficials'. Unfortunately, this approach may overlook the complex interactions and trade-offs occurring within the agricultural system across time and space. Sustainable agriculture depends on managing agro-ecosystems within the context of ecological trade-offs between animal activity and environmental variables. This links agricultural production and biodiversity conservation by moving beyond the limited scope of a single species group, ES or crop stage. Recent evidence shows that pollination and pest control ES can have synergistic effects on crop yield, yet few studies have considered these plant-animal interactions across taxonomic groups or landscape contexts. Here, we investigate whether different taxonomic groups (birds and insects) can synergistically influence crop yields through positive and negative effects on crop plants. We surveyed bird and insect communities in six apple orchards in southern Australia, from flowering to harvest. We also used 'open' and 'bird-excluded' treatments to measure fruit set and fruit damage on 10 focal trees per orchard. With our preliminary results, we identify relationships between animal activity and crop variables and show how ecological cost-benefit trade-offs can influence crop yields. We also look at potential relationships between environmental factors and the positive and negative outcomes of animal activity. This approach identifies net outcomes of animal activity within agro-ecosystems, which can promote biodiversity conservation and sustainable management practices in agricultural landscapes.

Biodiversity interactions with almond crops in the mallee – the conservation importance of living with nature.

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Abstract

Studies of biodiversity conservation in agricultural landscapes have almost always focussed on remnants of native habitat. However, the conservation value of entire landscapes, including the agricultural components, is now being increasingly recognised. In the last decade, many areas of the mallee have undergone rapid changes due to the development of irrigated horticultural and other industries. The Robinvale almond production region in NW Victoria is an ideal location to study the relationships between agriculture and biodiversity. The region contains a diverse array of agricultural land-uses such as almond, olive, viticulture, citrus and wheat crops. It supports a number of rare or threatened species such as the regent parrot, and is undergoing continued transformations due to expansion of the almond industry.

I will present some key findings from a five year research project, which showed that almond plantations provide important habitat and refuge for many threatened species. Focussing on native bird interactions, we found that parrots appear to rely more on almond crops for food when environmental conditions (i.e. drought) limit other food resources. Almond crops also provide important 'connections' for regent parrots and other birds to move throughout the landscape. The behaviour of wild animal species in agricultural can certainly inflict costs to farmers through direct or indirect damage to crops, but also provide benefits through the provision of ecosystem services (e.g. control of agricultural pests).

The role of production land uses in supporting native birds needs to be recognised by conservation management agencies. Simply focusing on native vegetation for improving conservation outcomes for species such as the regent parrot would overlook important information about the potential contribution of almonds to species persistence. Likewise, a sole focus by farmers on intensive production would ignore many potential financial benefits that interactions with insects and native birds can provide, leading to better agricultural sustainability.

Rethinking grazing as a landscape-scale process.

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Abstract

Questions: Grazing by livestock has greatly degraded vegetation in many Australian ecosystems. However, as soils have been transformed and grazing-sensitive species depleted, a more pertinent question for biodiversity conservation is: what is the current effect of livestock grazing on the biodiversity values of ecosystems? This question has been addressed in many studies in Australia. Most commonly, local-scale effects are considered by comparing grazed areas to ungrazed areas and observing changes in species density and composition. Large-scale effects have generally been less well-considered. Patterns observed at the local-scale can mask grazing effects occurring at larger scales, and determining large-scale effects – such as changes in beta diversity or species turnover – may be important for managing grazing for biodiversity conservation more effectively. However, there are significant challenges in achieving this. I will present data from grassy ecosystems on the North West Slopes of New South Wales that shows that simple measures of species density were not sufficient for evaluating conservation value, as they did not distinguish habitats with large numbers of common, generalist native species from those with species that were rare or restricted in the landscape. I will discuss the challenges faced when (1) evaluating species diversity at the landscape-scale for any one landscape or region, and (2) comparing grazing effects between landscapes or regions. We argue that a greater focus on large-scale grazing effects is needed in a range of habitats and regions to adequately evaluate the impacts of current grazing regimes on biodiversity values.

Management of temporary wetlands for biodiversity in an agricultural landscape.

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Abstract

Temporary wetlands are particularly abundant in the Victorian Volcanic Plains (VVP) and lower south-east of South Australia bioregions of south-eastern Australia. These wetlands are islands of biodiversity in a sea of agricultural production. It is estimated that they contain c. 90% of the metabolic, species, family and order-level biodiversity held in the landscape, in less than 10% of the area. The majority of wetlands in these regions are on farmland, and are owned and managed by farmers. The colliding trends of a drying climate and increasing agricultural production are placing temporary wetlands under pressure. Recent studies have investigated the water regimes and biodiversity values of these wetlands, as well as their management. The results indicate that management can have profound impacts on the functioning and diversity in these wetlands. Grazing (dependent on the type of animal and the stocking rate) can sometimes enhance native plant biodiversity, and cropping can reduce native plant biodiversity. The application of herbicides, soil ameliorants, insecticides and fungicides commonly used in cropping practices, along with nutrient additions and soil disturbance, affects both the seed bank (i.e. the regenerative potential) and the extant vegetation. Current and future studies are aimed at understanding the limitations to wetland persistence in this landscape, determining the recovery potential of wetlands that have been modified, and the economic consequences for farmers implementing different management practices on wetlands in this region. Some of the limitations to conservation are 1) a local lack of recognition of their national and international importance, 2) a failure to recognise the relationship between provision of habitat, and populations of valued fauna, 3) the perception that they are 'waste-land' unless brought into agricultural production, and 4) the idea that 'there's always another swamp' if an individual wetland is destroyed. Future activities aim to communicate the values and functions of wetlands to land-managers, and investigate alternative income sources from wetland conservation for farmers.

Conserving biodiversity in human landscapes - patterns in time and space.

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Abstract

The earth is increasingly becoming dominated by human-affected land-cover. Conservation of biodiversity relies on strategies which allow biodiversity to persist in these 'human landscapes'. My research aims to determine how human land-covers, and changes of these land-covers, affect ecological processes and biodiversity. Here, I highlight the potential of human land-covers to support a significant amount of biodiversity and maintain key ecosystem functions. I elaborate on this work, showing that the spatial arrangement of human land-covers can significantly affect landscape function for a suite of parrots, including the threatened eastern regent parrot *Polytelis anthopeplus monarchoides*. Our contemporaneous research demonstrates that many production landscapes experience regular land-cover changes (e.g. changing crop types in agricultural land) that can drive changes in the diversity and composition of the ecosystem. Moreover, the temporal pattern of land-cover-changes is shifting, with a notable increase in the frequency of changes. It is likely that the temporal characteristics of land changes (i.e. the sequence, frequency and time-span of land-cover change) will affect ecosystems over and above the effects of a contemporary change. Our research highlights that conservation of biodiversity will be most successful where land-management strategies consider the interacting effects of the spatial arrangement of human land-covers and the temporal processes of land-cover changes on ecological communities.

Post-cultivation recovery of a semi-arid Victorian grassland revealed using remotely sensed NDVI.

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Abstract

Previously cultivated or 'old-field' landscapes offer important opportunities for conservation, both in Australia and overseas. Like many other grasslands in south-eastern Australia, those of the Riverine Plains in Victoria and New South Wales have been largely cleared, and are Listed as a critically endangered community in the EPBC Act. Trust-For-Nature has purchased a series of properties at Wanderers Plain, Victoria, as part of a strategy to conserve this community. Most of their sites, however, have a history of cultivation in the recent or historic past that affects their current conservation value. My honours year project was to investigate the post-cultivation recovery of native grasslands at these sites. I did so using a series of space-for-time substitution comparisons based on time-since-cultivation. Results of these investigations showed differences between never and recently cultivated sites in terms of species density and composition, and soil chemistry. These differences were reduced or absent between never and historically cultivated sites. Such results are consistent with recovery of these grassland remnants with time-since-cultivation, as has been observed in other old-field studies in this community. Similar results were obtained using a novel technique that may be of practical interest to attendees. Here, remotely sensed NDVI data also suggest recovery of grasslands with time-since-cultivation. Additionally, seasonal range in NDVI can be mapped and used as a surrogate for vegetation quality in these systems. Using this technique, vegetation quality over large areas can be mapped quickly and inexpensively, with what appears to be some accuracy. The technique has potential for use in adaptive management of low-productivity grassland remnants.

Poster Abstracts

Deferred grazing - a tool to restore degraded native pastures.

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Abstract

In recent years, the concept of 'deferred grazing' has been actively discussed and implemented by farmers in southern Australia. Deferred grazing involves no defoliation of pastures for varying periods of time from spring to autumn. Several grazing management experiments, conducted by the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) near Ararat in western Victoria between 2002 and 2011, have resulted in the development of a series of deferred grazing strategies that could achieve both environmental and economic benefits for marginal farmland.

There are multiple benefits from deferred grazing when applied appropriately. Deferred grazing can increase perennial native grass density by 30 - 80% and reduce annual plant density by 40 - 70%, provided that the pasture contains at least 5 - 10% of desirable native species such as wallaby grass, weeping grass and kangaroo grass. The higher the proportion of desirable species, the more effective the deferred grazing will be.

Increases in perennial native species and decreases in annual species will result in higher groundcover in summer and autumn, and improvements in pasture yield, nutritive value and flow on biodiversity benefits through habitat improvement.

As native grasses need active management to bring about key contributions to biodiversity and landscape health, the Department produced a guide that can providing a tool for land managers to achieving both biodiversity and economic benefits on marginal farm land. For a copy of the Native Pasture Management guide contact the authors.

Modelling age class diversity under different wildfire management scenarios in a Heathland community.

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Abstract

Prescribed fire is a necessary tool for mitigating wildfire risk through managing forest fuels. As well as fuel management, attempts to use prescribed fire as a tool to protect and promote biodiversity are occurring. This is occurring through burning a patchwork or mosaic of age classes throughout the landscape. The concept behind mosaic burning is to promote landscape resilience through achieving a diversity of age classes across the landscape, and therefore a diversity of species compositions in differing successional stages. Furthermore, after the 2009 wildfires in Victoria a bushfire royal commission recommended increasing prescribed burning to around 5% of public land per year. Currently, land managers are uncertain what the ideal proportion of age classes across landscapes is, and what increased prescribed burning will mean for current plant species compositions.

To address this gap, we have parameterised the landscape succession and disturbance model LANDIS-II to attempt prediction of future landscape change under alternate wildfire management scenarios. This has occurred using data from a heavily managed Heathland community. Scenarios included burning 5% of public land as recommended, burning the current amount of around 1.7%, or no prescribed fire and periodic wildfires. Model results include resulting age class distributions and species richness after 50 and 100 years of each scenario.

As age class management is current practice, modelling such as this is important in order to build predictions under alternate scenarios and help inform land managers.

Wetland Revival- the need to restore live tree canopies in many Northern Victorian wetlands.

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Abstract

Wetland Revival is a proposed landscape scale ecological restoration project that will aim to restore River Red Gum and Black Box-dominated swamps across Northern Victoria. These wetland types have been severely impacted by degrading processes such as increased salinity and alteration of natural hydrology.

Many degraded wetlands occur in irrigation districts where they were used as basins to receive excess irrigation water. As a consequence they held water for extended periods of time, which drowned the canopy trees. In the case of the Avoca Marshes a weir was constructed on the overflow channel of Third Marsh, which increased the depth and duration of flooding in the whole wetland system. This caused the death of River Red Gums over an area of 1270 ha, including many large old trees.

Altogether approximately 13,600 ha of trees have been drowned in the North Central Catchment Management Authority area alone. The Ecological Vegetation Classes (EVCs) that occur in these wetlands include Intermittent Swampy woodland, Lignum Swampy Woodland and Red Gum Swamp. Most of these EVCs are regarded as either endangered or vulnerable in the bioregions where they occur.

This presentation will discuss potential techniques for restoring both live canopy trees and ground layer diversity in degraded wetlands in northern Victoria and report on initial restoration trials that have been conducted.

Investigating factors affecting restoration of native grassland in ex-cropland.

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Abstract

The ecological barriers to restoring ex-arable land to native grassland include soils that contain high levels of nitrogen and phosphorus, and an extensive seed bank of exotic weeds. These factors give exotic species a competitive advantage over native species, which can prevent the reintroduction of native species. In order to address this situation, we have established a replicated field experiment in former cropland near Werribee, Victoria, to test some novel methods for grassland restoration. This work includes the determination of the individual effects of high N and P levels, and the role of the exotic soil stored seed bank as barriers to restoration. Results will improve our understanding of these barriers to grassland restoration, and provide a stronger theoretical framework for further research.

In this poster presentation we focus on addressing the problem of the exotic seed bank. We trialled the use of large blocks of green waste taken from metropolitan green waste collections, which were predicted to generate enough heat to reduce the viability of the seed bank, allowing reseeding with native species. To test the impact of temperature generated from green waste on seed viability, the seeds of two weed species (*Nassella trichotoma* and *Galenia pubescens*) and one native species (*Themeda triandra*) were placed in nylon mesh bags and buried under the oversize green waste piles at three different depths (0, 5 and 10 cm). The temperatures produced in the soil by the hot green waste were measured by data loggers placed under the piles. The maximum temperature recorded was 63 C° and the viability of the buried seeds was dramatically reduced to 2, 0 and 3% for *N. trichotoma*, *G. pubescens* and *T. triandra,* respectively, after sitting under the hot green waste pile at 0 cm depth (compared with 82, 80 and 76% respectively in the control plots). This work has shown promising preliminary success as a potential technique for reducing weed seeds stored in the soil and creating suitable conditions for restoring ex-cropland land in Victorian Volcanic Plain grassland.

Influence of various environmental factors on seed germination and seedling emergence of a noxious environmental weed: *Galenia pubescens* (Carpet Weed).

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Abstract

Galenia pubescens, commonly known as Carpet Weed, is a woody prostrate perennial weed belonging to the family Aizoaceae. It has become more abundant in temperate native grasslands in the surrounding areas in western Melbourne. This invasive species is posing a considerable problem to the establishment and continued development of native grass. Until recently little was known about its seed ecology: germination, seed longevity and seedling emergence under various environmental conditions. Therefore, we investigated the effects of various factors on germination and seedling emergence of Carpet Weed in both laboratory and field experiments as a means of developing control strategies. Results show that Carpet Weed was able to germinate over a broad range of temperatures. The highest final germination rate (86%) was obtained in 17/7 ^{O}C for a 12:12 light:dark cycle, but the final germination percentage reduced with increasing temperature from 80 ^{O}C to 120 ^{O}C. Seed germination was also shown to be favoured by light, indicating that buried seed will remain in a dormant state until disturbed. However, after one year of burial, the percentage of viable seeds declined to 39%. This suggests that, in undisturbed field conditions, the problem with Carpet Weed might be able to be controlled in the long-term. Seed germination was sensitive to water stress which was greatly reduced in solutions with osmotic potentials below -0.2 MPa (45 %), and completely inhibited by a potential of -0.4 to -1.0 MPa. Further, Carpet Weed was moderately tolerant of salinity. Over 50% of seeds germinated at a low level of salinity (60mM NaCl), and moderate germination occurred even at 120 mM NaCl (48.67%). When the Carpet Weed seeds were exposed to a range of pH levels, the highest percentage (83%) of seed germination was obtained in an alkaline medium (pH 10), with 79 % germinating in an acidic medium (pH 4). These outcomes suggest that Carpet Weed seeds are capable of germination and surviving in a range of environmental conditions. The results of this study may assist us in developing tools and strategies for the management of this noxious weed in Victoria and other parts of Australia.

Life on the edge. Bryophyte and lichen communities associated with the Ferntree Waterfall and fern gully, Mt. Buangor, Victoria, Australia.

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Abstract

Ferntree Waterfall lies on Middle Creek, which drains the eastern portion of the Mt. Buangor uplands and its south-eastern slopes. The falls are 11 km from the Western Highway, north-west of Beaufort, Victoria. They contain three steps, two plunge pools and a largely unrecognised biological treasure: moisture-dependent bryophytes and lichens, which exist in a complex habitat mosaic. The site in Mt. Buangor State Park attracts many visitors, who admire the falls and the surrounding ferns. The bryophytes and lichens that occur in the vicinity of the waterfall and in the adjoining fern gully have been recognised as a significant component of the flora, but tend to be overlooked by visitors, biologists and managers. They have scarcely been documented and their significance or management requirements have not been analysed. This study aims to rectify this situation.

Most watercourses in the Ballarat region cease flowing over the warmer months and their waterfalls dry up. At these times, Middle Creek still flows but the falls are reduced to a curtain of trickles. The plunge pools at the base of the vertical steps still retain water and seepage continues to flow. Splashing from the rocks and in the undercut precipice bases reduces but persists. Humidity remains high and temperatures relatively mild, thanks to the deep, narrow gully, its south-eastern aspect and its dense vegetation.

The granite boulders and soil patches in and around the falls are largely occupied by bryophytes, with liverworts dominating the wet areas. The sheltered, humid fern gully contains two broad bryophyte/lichen communities. Those on logs, tree and tree-fern bases and exposed roots are moss-dominated. Epiphytes on shrub and tree branches are dominated by lichens. The 73 cryptogam species detected include 52 not in the regional flora list. Some xeric species inhabit open patches in the fern gully. This study identified 31 species of moss, 18 liverworts, 1 hornwort and 22 non-crustose lichens, as well as a carpet of Common Filmy-fern (*Hymenophyllum cupressiforme*). The cryptogams exhibit horizontal zonation: zone I (semi-aquatic species within or near the water-flow), zone II (hydric species in the splash zone or areas with seepage) and zone III (humidity-dependent or mesic species on the outer side of the splash zone). There is also vertical zonation. Mesic and xeric species largely replace more water-dependent species in the upper falls, which are less sheltered from sun and wind. Some semi-aquatic and hydric species are unknown in nearby highlands and isolated from similar habitats in the Grampians Ranges, 30+ km to the west.

Bryophytes and lichens from permanently damp environments cannot survive prolonged drought. Surrounding charred eucalypts and the lack of old-growth trees and their characteristic epiphytes in the surrounding forest suggests that previous severe fires have desiccated the site by removing most or all larger trees. Severe droughts, and perhaps historic tree felling, may also have had an impact.

The inability of most riparian cryptogams to recolonise over longer distances is assumed to have resulted in relict, depauperate communities. Nevertheless, the site makes an important contribution to local biodiversity and warrants further study. Care needs to be taken in siting tracks and slashing in their vicinity. Fire mitigation policies are important to maintain the sheltered environment. Anticipated reductions in rainfall with climate change place this flora at risk of further depletion or even extinction. After all, these communities live on the edge.

Vegetation of Strzelecki National Park, Flinders Island, Tasmania: mapping and floristics.

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Abstract

Strzelecki National Park was first proclaimed as a Scenic Reserve in 1935, with land added to the park in stages up until 2003 (total 7631 ha). The park comprises largely rugged terrain created by peaks of a Devonian granite range, extending from the north-eastern Tasmania mainland to Wilsons Promontory (Vic). The vegetation within the park had not previously been mapped and surveys of the flora were limited to infrequent collections from 1893–1995. We undertook systematic vascular plant surveys and vegetation mapping in spring 1997–1998 (179 plots) and bryophyte surveys in spring 2004–2006 (22 plots). Bryophyte survey sites were located with the intent to sample the range of vegetation types. Vegetation types were mapped using a combination of aerial photograph interpretation and site surveys; boundaries were then digitised from field mapping. The survey resulted in a census of 313 vascular plant taxa and 137 bryophyte taxa. Nine vascular taxa are listed as threatened under the Tasmanian *Threatened Species Protection Act* 1995. Eleven vegetation communities are defined, the park being important for the reservation of several of these in Tasmania. The park is characterised by rainfall and evapotranspiration extremes with a predicted 1490 mm annual average in the mountains—where there is reduced evapotranspiration because of frequent cloud cover and mist—to the coastal area at Trousers Point, where the predicted annual average is as low as 468 mm. The flora retains an interesting rainforest and wet forest element that shares floristic similarities with rainforest gullies in mainland south-eastern Australia, the Tasmanian north-eastern highlands and even with western Tasmania. There are also some affinities with the dry Bass Strait and southern Australian floras. A rare example of temperate cloud forest for southern Australia is found at higher elevation within the park.

Emergency Summit for Threatened Mallee Birds.

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Abstract

The Murray Mallee provides habitat for six nationally-listed threatened species: Mallee Emu-wren (Endangered), Black-eared Miner (Endangered), Regent Parrot (eastern) (Vulnerable), Red-lored Whistler (Vulnerable), Malleefowl (Vulnerable) and Western Whipbird (eastern) (Vulnerable).

Fire is a major threat to many of these species as they require relatively long unburnt mallee. Large wildfires in 2014 burnt out 90 per cent of Bronzewing Flora and Fauna Reserve (VIC) and Billiatt Conservation Park (SA). The Bronzewing fire wiped out the 'insurance' population of the Black-eared Miner and a significant population of Malleefowl. The Billiatt fire resulted in the global population of the Mallee Emu-wren now being confined to one contiguous area that covers Murray-Sunset and Hattah-Kulkyne National Parks. Mallee Emu-wren and Black-eared Miner are now highly vulnerable to a reserve-scale fire extinction event. In addition, fires have recently destroyed large tracts of habitat for other nationally threatened mallee species including the Red-lored Whistler, Western Whipbird (eastern) and Regent Parrot (eastern).

In response to this, over the past 12 months BirdLife Australia has hosted the 'Emergency Summit on Threatened Mallee Birds': a series of workshops attended by fire and mallee species experts from universities, zoos, non-government organisations and representatives from State and Federal governments. The aim of these workshops has been to identify urgent actions needed to prevent these six mallee species from becoming extinct. Key outcomes of the summit have resulted in the ongoing development of a Conservation Action Plan for a number of species, captive breeding and translocation feasibility studies for Mallee Emu-wren and progress on finalising a national Threatened Mallee Bird Recovery Plan and the formation of a Recovery Team.

Is woodland reconstruction bringing back the birds?

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Abstract

South-eastern Australia's grassy woodland ecosystems support a unique and diverse flora and fauna. However, millions of hectares of these ecosystems have been cleared, including more than 90% of Cumberland Plain Woodland in western Sydney. To restore some of this woodland, a thousand hectares were planted with locally native trees and shrubs between 1992 and 2002. The aims of our study are to: (a) compare the bird communities in revegetated woodland with those in remnant woodland and untreated pasture; and (b) examine which factors influence any differences, including age of plantings, vegetation structure, patch size and connectivity, invasive species, remnant trees, grazing and fire. We surveyed sites in each of 35 patches, comprising 25 revegetated patches (10-21 years old), five remnant patches, and five pasture patches. Two independent observers visited the sites three times each in spring/summer of 2013, and again in winter of 2014. On each visit, one point count survey (centred on a 20 x 20 m vegetation quadrat) was conducted per site for 20-min within 3.5 hours of sunrise. A total of 107 species was recorded in the surveys. The avian communities of revegetated and remnant woodland both differed from those in untreated pastures. There were also some differences between revegetated and remnant woodlands. The results suggest that, within 20 years of establishment, plantings of native flora help to restore some of the avifauna characteristic of remnant woodlands. Our findings on how the composition varies with stand and site attributes should help to improve the outcomes of restoration projects.

Butterfly behaviour at plantation and farmland edges explains population dynamics in a fragmented landscape.

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Abstract

Many animal species exist in landscape mosaics consisting of native vegetation patches and uninhabitable areas: the 'matrix'. The behavioural response of animals to patch and matrix edges can critically influence population dynamics and species persistence in fragmented landscapes.

We investigated the potential for behaviour at edges to explain population dynamics in the butterfly *Heteronympha merope* by releasing individuals at 5 m and 30 m from the edges of patches or matrix and recording flight behaviour. We examined flights in three combinations of patch and matrix: 1) native woodland patch adjacent to pine plantation, 2) native woodland patch adjacent to farmland and 3) pine plantation adjacent to farmland. Our study was conducted in Nanangroe, south-west New South Wales, Australia.

We found butterflies avoided pines. They were less likely to approach pine plantation edges, unlikely to cross the edge, and, in cases where they did cross, they always returned to the area from which they were released. If released within pine plantations, individuals departed quickly. Farmland appeared to be intermediate in suitability for movement compared with woodland and plantation. Butterflies crossed from native remnants into farmland substantially more often than from native remnants into pine, but not as often as butterflies crossed from the matrix into native remnants.

The behaviours of *H. merope* towards pine plantations explain abundance patterns in the fragmented landscape studied. Pine plantations appear to impose fence effects on these butterflies. As resource requirements of butterflies overlap with many other insects, replacing farmland with extensive forestry plantations (including pines) may have negative impacts on a range of taxa. The biodiversity conservation potential of plantations may be improved with a few small land-use modifications. These include; adopting earlier thinning schedules in traditionally designed plantations, reducing spatial density of trees in future plantations, and preserving corridors of native trees or understorey vegetation, which, in turn, should increase edge permeability, movement and matrix use by many taxa.

Does broad acre agricultural land contribute to conserving native invertebrate biodiversity?

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Abstract.

Invertebrates comprise over 95% of all species, excluding microrganisms and Protista. Consequently, a focus on these taxa is essential when examining to what extent agricultural lands contribute to conserving native biodiversity. In order to investigate this question, invertebrates were sampled on pairs of sites at three localities in different climatic zones in southern Australia. One site of each pair supported long term trials of intensive wheat cropping under both direct drilling and conventional cultivation. The other site of the pair carried intact, remnant, native vegetation. One locality was in the mallee belt of South Australia (Walpeup), one in the wetter eastern area of Victoria (Rutherglen) and the third in a drier part of southern New South Wales (Wagga Wagga). Collembola were chosen as focus of study as they are abundant and fairly species rich in and on the surface of agricultural and native soils. Moreover, they include a number of introduced species that are largely restricted to disturbed, modified habitats such as agricultural land and they have been shown to be valuable as indicators and surrogates for other invertebrate taxa.

Pitfall traps and soil cores collected at all seasons on these sites over two years contained 43 Collembola species. Most were native species but over a quarter introduced, exotic species. The wheat fields carried almost entirely only exotic species, while remnant vegetation carried predominately native species. The only exception found was on the semi-arid site (Walpeup) where native *Folsomides* species were found in wheat field soils.

Cotton fields also have been shown to carry more exotic species and fewer native species than remnant vegetation but a few native species are able to colonise improved pastures, although adjacent native grassland carried predominately or only native species. Even shelter belts of *Eucalyptus* species set in an agricultural matrix only carried exotic species. The conclusion from these studies is that broad acre agricultural land and improved pastures do not contribute to native collembolan biodiversity and this conclusion is likely to apply to other invertebrate taxa.

Values shape the way ecological information influences people's attitudes towards urban wetlands.

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Abstract

Urban wetlands are important for wildlife conservation and valued by people. However, wetlands that are beneficial for wildlife are not necessarily aesthetically pleasing to people. This is important in human-dominated areas where people's preferences influence the design and management of wildlife habitats. We investigated people's preferences towards urban wetlands that benefit insectivorous bats, the effect of ecological information on people's preferences, and the role of underlying values for wildlife in mediating this process. Residents (n = 1,200) living around wetlands in Melbourne, Australia were posted a photo-booklet containing images of 27 wetlands and a questionnaire that was used to rate their preferences and their wildlife value orientations. To test the effect of ecological information, half the participants also received information about insectivorous bats and the ecological quality of each wetland for these cryptic mammals. We hypothesized that this information would change people's preferences for some types of wetlands, and that this effect would be mediated by their wildlife values. People generally preferred urban wetlands that were beneficial for insectivorous bats. Somewhat surprisingly, people who received ecological information did not have higher preferences for wetlands that provided good habitat for bats; instead, their preferences were lower for wetlands that were less beneficial for insectivorous bats. This effect was mediated by high wildlife value orientations. Results of this study suggest that wetlands with high quality habitat for bats can be enjoyed in an Australian urban context. More importantly, results show that preferences for landscapes can be influenced by the provision of ecological information when that information is consistent with people's value orientations.

An interactive tool for managing wildlife fear responses.

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Abstract

Management of deleterious processes affecting wildlife is ideally based on sound scientific information. While relevant information is often absent, when it is available, land managers struggle to access or contextualise the data to the extent that it can be readily applied to their specific purpose. We describe an interactive online tool that enables land managers to estimate the distances at which birds respond to humans fearfully, a process known as 'disturbance', and which has been implicated in population declines. This tool was created with an Australian focus but, as data from other regions become available, the scope of the on-line tool will be expanded. Managers can either select the species assemblage at the site in question, or a single focal species, and determine the distance above which birds are not overtly responding by fleeing humans. They can also nominate the bird diversity they wish to maintain (% species retained) at a site to determine the 'coexistence distance' or nominate a specific coexistence distance to obtain an estimate of the maintained biodiversity. The dataset is based upon multiple measures of flight-initiation distance (the distance from a stimulus at which a bird initiate escape behaviour; FID) from 251 Australian species. FIDs (n = 2191) are mostly derived from standardised experimental pedestrian approaches to birds (89.4%, while others are in response to groups of walkers [0.9%], cars [3.2%], buses [1.5%], bicycles [1.0%], canoes [0.6%], joggers [1.6%], and dogs [1.8%]). Managers could conceivably use the coexistence distance to construct buffers (spatially or using visual obstructions), develop codes of conduct or site prescriptions on the types of human activity permitted. By optimising coexistence between people and birds, this tool will help balance the growing need for biodiversity conservation in areas where humans can experience nature.

Combining genetic and non-genetic techniques to evaluate the ability of wildlife crossing structures to restore population connectivity for arboreal marsupials.

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Abstract

Roads can create barriers to animal movement, reducing access to habitat resources and restricting gene flow. Crossing structures are often installed to maintain or restore movement and genetic connectivity between wildlife populations isolated by roads. While many studies evaluate the extent to which wildlife crossing structures facilitate animal movement, few include genetic approaches. We investigated the effect of retrofitting wildlife crossing structures (canopy bridges and glider poles) to a 30-year-old freeway based on movement, dispersal and population genetic structure of the squirrel glider (*Petaurus norfolcensis*), a threatened arboreal marsupial in south-east Australia. We used both genetic and non-genetic techniques to evaluate effectiveness, including the analysis of spatial genetic structure, parentage analysis, radio-tracking, motion-triggered cameras and PIT tag readers. Genetic sampling and radio-tracking were conducted before and after crossing structures were installed, at mitigated and unmitigated freeway sites, as well as non-freeway control sites. Radio-tracking and genetic analysis of squirrel gliders before the crossing structures were installed revealed that, while large gaps across the freeway (>50 m) restricted daily movements, it was rarely a complete genetic barrier. Within five years of their installation, the wildlife crossing structures increased movement and genetic connectivity between squirrel glider populations on either side of the freeway. Cameras regularly detected squirrel gliders using canopy bridges and glider poles to cross the freeway. Furthermore, parentage analysis revealed that some of the individuals that were detected using the structures to cross the road (i.e. through radio-tracking and PIT tag readers) had reproductive success on the other side. This study confirms that wildlife crossing structures are an effective method of reducing the negative effects of fragmentation caused by roads. Genetic techniques offer a powerful approach to evaluating the effect of crossing structures on connectivity and are an invaluable complement to non-genetic approaches, particularly when applied as part of a before-after comparison.

A non-invasive method for identifying individual striped legless lizards *Delma impar*.

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Abstract

The ability to identify individual animals provides wildlife managers with the capacity to glean information about the status of populations of interest and the individuals within those populations. The striped legless lizard *Delma impar* is a nationally threatened species that occurs in temperate grasslands throughout south-eastern Australia. The cryptic behaviour and physiological features of this species has made it difficult to identify individual animals, and therefore to understand basic life-history traits and the status of remnant populations. Individual identification requires a method that is able to uniquely distinguish one individual from another, as well as being humane, simple, accurate, durable and inexpensive. The method should not interfere with behaviour, growth, survival, or probability of recapture. This study developed a non-invasive method for identifying individual striped legless lizards based on the arrangement of dorsal head scales. The method was found to be reasonably accurate, did not alter over time or with ontogenic development, and repaired to the original pattern when damaged. The method is currently implemented manually but lends itself to an automated system of individual identification.

Why don't they do their weeds?

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Abstract

Considerable time and money has been invested in many places, by many people, including agencies and landcare groups, encouraging residents to remove and/or manage their environmental weeds. But do we know what works and what doesn't and why?

After a Weed Busters week one year, the Weed Management Officer of the Cardinia Shire Council and the President of Johns Hill Landcare Group Inc. were comparing thoughts on this matter over a glass of wine and realised, apart from their own perceptions, they had no evidence as to what worked and why.

Cardinia Council had also undertaken a major program to eliminate three target weeds on Council roadsides in four townships. They and the Landcare Group were keen to know if that was an incentive for neighbours to remove their weeds.

Cardinia Shire Council and Johns Hill Landcare Group formed a partnership to explore these issues. Using the Doug Mackenzie-Mohr Fostering Sustainable Behaviour methodology, the partnership selected a target audience: those who wanted to do their weeds but didn't; a locale: Emerald (Vic) and environs, and then did a mail survey to every household, a follow-up phone survey of those who fell into the target group, as well as two focus groups with this audience. The main barriers to this target group acting on their weeds were time, cost and inappropriate information. The main incentives were financial, visit from a 'community facilitator', and working in neighbourhoods.

A pilot was run to test the findings and four neigbourhoods of blocks less than two hectares were chosen. Independent evaluation concluded that appropriate information, working in groups, and providing incentives, was very likely to change residents' behaviour to remove and/or manage their weeds.

This is an ongoing project and the partnership is now working with residents on blocks greater than two hectares as well as follow up with the above four neighbourhoods.

How does matrix management influence connectivity for herpetofauna?

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Abstract

To maintain biodiversity in agricultural landscapes, millions of dollars are expended annually on habitat restoration and corridor establishment. However, the effectiveness of these expensive conservation actions hinges on unconfirmed assumptions about how animals move through these landscapes. With growing pressure to increase agricultural production, it is a national priority to discover the connectivity and habitat needs of fauna in these complex and changing human-natural systems. Our project aims to significantly advance ecological concepts about the matrix (non-habitat areas) by examining what type of changes in the matrix can promote or limit animal movement and if we can manipulate the matrix to encourage movement. Here I present findings from our primary surveys, which aimed to understand which patch-dependant species are likely to thrive within a particular matrix treatment and under what circumstances. Movement patterns, abundance and survivorship of targeted herpetofauna species were examined using transects extending from the remnant native vegetation patch into four contrasting matrix treatments (planted native vegetation, added course woody mulch, rested from cropping or pasture, cropped). Most research examples have generally focused on the value of plantings for woodland birds, but evidence of use by other faunal groups, particularly reptiles, is greatly underestimated. By understanding how matrix structure and quality affect movement, our findings would assist in better planning and implementation of plantings and inform land-use planning, policy development, restoration and stewardship payments that help maintain an ecologically sustainable agricultural sector while reducing isolation of preferred habitats.

Cool Temperate Rainforest dominants: a physiological investigation.

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Abstract

Standing tall above the tree ferns in sheltered gullies of Victoria, *Nothofagus cunninghamii* (Hook.) Oerst. and *Atherosperma moschatum* Labill. dominate Cool Temperate Rainforest, ancient vestiges of a Gondwanan forest. These species, and the forests they inhabit, evolved in a stable climate of high rainfall and mild temperatures and persist in pockets of the state that are sheltered from harsh climatic conditions. Victoria is set to experience marked changes in climate in the coming decades. Therefore, there is a strong need to investigate the physiological thresholds of these species in the field to better understand their ecology, to monitor the impacts of climate change, and to inform best practice management. Physiological acclimation of *N. cunninghamii* and *A. moschatum* was investigated by taking *in situ* measurements of photosynthesis, transpiration, and stomatal conductance from shade leaves of mature individuals under a range of light and temperature regimes. This was used to determine their competitive ability to persist in the ecosystem. To date, this research represents the largest sample size in research of the physiological ecology of these species and in studies on photosynthetic ecology, with a total of 3,240 photosynthetic measurements taken. Light and temperature influenced physiological response of both species. *Atherosperma moschatum* favoured shaded conditions of low irradiance and low temperatures, as was demonstrated by higher photosynthetic rates under those conditions. *Nothofagus cunninghamii* exhibited much higher photosynthetic rates than *A. moschatum*, and photosynthesised faster under low irradiance and high temperature conditions. Water-use efficiency was significantly higher in *A. moschatum* than *N. cunninghamii*. These findings highlight the sensitivity of *A. moschatum* to high temperatures, and the direct limitations of light and indirect limitation of low water use efficiency placed on photosynthetic rate of *N. cunninghamii*. Climate projections for Victoria predict hotter, drier conditions that will threaten the resilience of Cool Temperate Rainforest. Further monitoring of these species, particularly in relation to a changing climate, is strongly recommended.

Above- and below-ground effects of the invasive shrub *Acacia longifolia* subsp. *longifolia* on open eucalypt woodland in south-eastern Victoria.

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Abstract

Acacia longifolia ssp. *longifolia* is an aggressive invasive species native to southeastern Australia. *A. longifolia* invades a wide variety of vegetation communities globally and is a transformer species that has significant impacts on the above- and below-ground processes and functioning of ecosystems. Globally there has been extensive research on the species. However, within Australia, until recently little was known about this species' impacts on native vegetation. The overall aim of the project was to understand the relationship between the above- and below-ground vegetation within communities invaded by *Acacia longifolia.* More specifically, this work aimed to quantify the effects of *A. longifolia* on herb-rich woodland of southeastern Victoria, and to determine the potential for restoration of the community. Overall, the results of this study revealed that, above ground, increasing cover of *A. longifolia* is gradually transforming diverse open herb-rich woodland to densely populated closed shrubby woodland with limited diversity. Below ground, by contrast, the soil seed bank indicated that, although there were some minor changes from the original state, overall the seed bank consisted largely of ruderal annual and short-lived perennials, particularly graminoids and forbs, indicating that this community has significant resilience and thus restoration of the woodlands may be possible.

Can replanted woodlands develop remnant characteristics?

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Abstract

Clearing and degradation of ecosystems has occurred at the landscape scales across much of Australia. In conjunction with restoration focused on improved management of remnant vegetation, it is imperative that revegetation projects continue to buffer, expand and connect remaining vegetation patches to improve their long-term viability. Equally important is ongoing monitoring to understand and improve restoration techniques.

Former agricultural lands, the Western Sydney Parklands today comprise a mosaic of pasture, regrowth remnants and revegetation in the middle of the Cumberland Plain. Plantings to re-establish native vegetation and link remnants were established between 1992 and 2002 assuming that tree planting would facilitate entry of other species into the community. The development of revegetation patches was monitored four times between 2001 and 2013. Revegetation patch age ranges from one to twenty-three years across the four censuses. To provide references for the ecological character of the revegetation time series, adjacent patches of pasture and regrowth remnants were also sampled.

Earlier analyses based on a single census in 2002 showed that over the first ten years the revegetation had begun to develop structurally. However, floristic composition showed little evidence of convergence with the reference remnants in the ten years. The causes of this response were inconclusive; the trajectory to ecological restoration is either a slow process, or is interrupted by an ecological barrier.

Re-analysis based on a longer time series showed that planted stands continue to develop structurally and there is some evidence of recruitment of native species from both planted individuals and off-site sources.