



KEY:  talk

 poster presentation

 eligible for student prize

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Salinity and greenhouse: inter-twined natural resource management problems, inter-twined solutions

Two crucial natural resource management issues confronting Australians are the strongly intertwined issues of salinity and climate change. Not only is it estimated that up to 17 Mha of land will be affected by salinity by 2050, but also climate change will result from increased concentrations of greenhouse gases. Apart from damaging land, water supplies and remnant biodiversity, salinization could increase Australia's emission of greenhouse gases, via organic matter decay in soils and remnant vegetation, and possibly methane emissions. Similarly, climate change may affect the rate of salinization and prospects for biodiversity conservation. Responses to both salinization and greenhouse warming are linked. The reforestation of farmland to restore water balances and the revegetation of already salinized land will result in the sequestration of carbon and also substitute for fossil fuels when used for bioenergy. Such sinks may attract investment from those seeking to reduce their net carbon emissions, and this investment could in turn underwrite the massive reforestation and revegetation that is required to tackle salinity.

This paper describes the enactment of this concept in southwestern Australia, a region where up to 8.8 Mha of land may become salinized and 500 species may consequently become extinct. We report on the likely extent and impacts of salinity, estimate the total potential carbon sink from reforestation based on considerations of climate and soils, and describe the social and technical issues that require resolution if wide-spread adoption of trees in farming systems is to occur.

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Invertebrate assemblages associated with habitat features in *Eucalyptus obliqua* in the southern forests of Tasmania

Mature trees are an important part of a forest ecosystem providing a range of unique habitats that are utilised by both vertebrates and invertebrates. In the southern hemisphere little is known about the invertebrates that are associated with living trees. However, in Europe many species of invertebrates associated with old trees are threatened, due to a severe decline in habitat availability.

Forestry practises in Tasmania's native forests are creating a more homogeneous stand age with fewer mature trees. The effect this will have on the saproxylic communities is unknown due to a lack of knowledge of both the species involved and their habitat requirements. This poster details an on-going study into the invertebrate assemblages associated with living *Eucalyptus obliqua* trees represented three different ages: 70 years, 100 years and oldgrowth (>200 years). Invertebrates are being sampled using emergence traps and hand-collection.

As there is a shorter history of intensive native forest management in Australia, there is still time to reduce any potential ecological impacts, through better understanding of saproxylic biodiversity and underlying ecological processes early in this process of landscape alteration.

Hastwell, Graeme and F. Dane Panetta 

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Predicting high impact weeds from seedling growth responses to nutrient supply.

Identifying plant traits associated with high weed impacts will improve our ability to identify potential weeds before they are introduced, and may assist in understanding and managing the invasion process. It has been hypothesised that plasticity (the ability to vary trait expression in response to environmental factors) may contribute to invasiveness. Further, the Fluctuating Resource Theory proposes that invasibility increases as the level of unutilised resources in the environment increases, through processes such as disturbance and climatic variability. We compared the growth responses to nutrient supply of 24 high- and low-impact weed species

naturalised in south-east Queensland. Seedlings were supplied nutrients at five concentrations, and were sequentially harvested over 20 weeks. Overall, species having high impacts showed greater plasticity in growth in response to nutrient supply than low-impact species. However, this trend was not consistent across all plant families, suggesting that plasticity in early seedling growth rates may be a factor associated with weediness among some families, but not others. We surmise that there may not be any simple explanations for high weed impacts. Rather, weed impacts may be associated with sets of plant traits, with some traits becoming important at later ontogenetic stages.

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Accelerated peat formation in upland lakes of northern New South Wales

High altitude lakes of northern New South Wales were cored and their sediments dated by lead-210 methods, thus obtaining an age record of the last 200 years. The lake sediments displayed a sharp rise in plant organic matter from 10-15% before European settlement to over 40% afterwards. A layer of sedge peat up to half a metre thick has developed in many areas as a result of the explosive growth of tall *Eleocharis* spikerush choking formerly open water. This change has resulted from successive land use changes in the lakes' catchments, particularly increase in phosphates from sheep dung and fertilisers, as well as artificial lowering of the lake levels. Severe winter frosts regularly cause dieback, and the resulting detritus has humified to create extensive peat, thus causing extensive changes to the ecology and hydrology of the lake systems.

Hayes, R. Andrew and John Wilson



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Chemical ecology of native rainforest rodents: the influence of predator odours

Australia's small mammals are subject to predation from a variety of sources, including both native and introduced mammalian predators, birds and reptiles. There is an obvious advantage for these species to be able to detect the presence of predators in their environment, enabling them to make decisions about movement and foraging behaviour based on perceived risk of predation. One technique commonly exploited to assess this risk is to use the odours of the faeces and/or urine of predators to assess their presence/absence and the length of time since a predator passed through an area. This study examines the effect of the odours of faeces from native and introduced mammalian predators, and native reptilian predators, on behaviour and ecology of two endemic species of rodent (*Melomys cervinipes* and *Rattus fuscipes*) in the rainforest remnants of the Atherton Tablelands, North Queensland. Chemical examination of the volatile components of the odour sources has also been performed using gas chromatography-mass spectrometry to examine any commonalities between these predator odours. In addition to the effects of whole odours, the study aims to investigate the effects of some of the compounds detected chemically in the predator odours. Preliminary data and its significance will be discussed.

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A framework for understanding salinity effects on frogs in south-eastern Australia

Deleterious effects on Australia's biodiversity are expected through increasing salinity. The exact nature of this threat, when and where it will occur is, however, unclear. While habitat loss is considered the greatest threat to biodiversity from salinity, the physiology of frogs and their use of multiple habitats renders them particularly sensitive to direct effects. This issue has received little research attention. As there are many frog species and environments for which salinity impacts may be examined a conceptual framework for examining susceptibility is a useful starting point. In developing such a framework we identify common ground between frog habitat use and dynamics of salinity at multiple spatial scales. Using salinity outbreak mapping and frog distribution data for the Murrumbidgee as a case study we provide suggestions as to how salinity may be examined from an ecologically meaningful perspective. On the basis of geographic features of salinity outbreaks in the Murrumbidgee not all frog species are likely to be exposed to salinity. Links between habitats with capacity to accumulate and concentrate salts, habitat specialisation, low species tolerance and threatened species status provide a detailed framework for prioritising species susceptibility to dryland salinity in a given area.

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Characterising resistance to insect defoliation in *Eucalyptus grandis*

Leaf chewing beetles, mainly Chrysomelids (*Chrysophtharta cloelia* and *Paropsis atomaria*) and Christmas beetles (*Anoplognathus* spp.), have been identified as major eucalypt defoliators and commonly cause moderate to severe damage on plantations of commercially important eucalypt species. Resistance of some eucalypt genotypes to herbivores has been recognized for some time and phenological, physical and chemical factors could contribute to resistance against insect attack. Chemical factors have been the focus of most studies and have shown to confer resistance against herbivory by Christmas beetles. In this study State Forest genetic field trials of *E. grandis* were assessed for canopy damage to determine heritability of resistance to defoliation (predominantly by *Paropsis atomaria*) and identify “resistant” and “susceptible” open pollinated families. This field damage was then modelled against spectra derived from near infra red reflectance of leaf samples and quantified foliar properties that could contribute to this range of observed resistance. In particular, concentrations of various formylated phloroglucinol compounds (FPC’s), which are known antifeedants, were quantified and modelled against damage indices. This result provides insights into cross-resistance, based on FPC’s, between two economically important insect genera *Paropsis* (Eucalyptus leaf beetles) and *Anoplognathus* spp (Christmas beetles).

Herden, Chris



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Guidelines for ecological resoration projects and inclusion of ecological restoration project in school science curriculum

As a secondary science teacher/professional bush regenerator supervisor and ecological restoration project manager I would like to present a talk on guidelines for community groups, industry, government agencies, conservation groups considering implementing an ecological restoration project.

I would include components for science/geography teachers on how to incorporate an ecological restoration project into a school curriculum, which is designed to satisfy Board of Studies syllabus outcomes.

The ecological restoration guidelines include: conceptual planning, preliminary tasks, installation planning, installation tasks, post installation tasks, evaluation, sponsorship, marketing and funding

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Environmentally induced variation in leaf morphology in *Pelargonium australe* (Geraniaceae): Links between morphology, anatomy and aspects of physiology.

As leaves are the primary sites of photosynthesis, and the most structurally diverse parts of plants, they present a fundamental area to study environmental affects on morphology and associations with function. The ability of a plant to establish in a given environment may be determined by its level of plastic response in leaf traits to environmental variation. We examined patterns of environmentally induced leaf morphological variation in response to water and nutrients, in *Pelargonium australe* and its associated affects on aspects of anatomy and physiology. Responses in aspects of size and shape, which has received less attention in the literature, were expected. Seven provenances were chosen, from coastal and inland N.S.W to a range of habitats in Tasmania, to represent the range of leaf morphological variation in *P.australe*. Leaf length was highly correlated with area, which remained equal or decreased with increased nutrients. Conversely SLA increased with greater nutrients and was, along with leaf water content, greatest under low water. Projection efficiency and dissection index increased with increased nutrients. The patterns in SLA and leaf water content suggested anatomical and physiological plasticity in response to nutrients and water.

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The Influence of Very Large Trees on the Distribution of Smaller Trees in the Rainforests of North Queensland

Using 15, 0.5-ha plots in NE Queensland, I ask whether very large trees (≥ 70 cm DBH) have an influence on the spatial distribution of smaller trees. Very large trees have a spatial effect on allospecifics that is consistent with the Janzen-Connell hypothesis. Surprisingly, allospecifics trees are also less common within 5 m of the nearest very large tree and more common between 5 and 15 m than if they were randomly distributed. Allospecific species that are largely bird-dispersed primarily have a much greater density between 5 and 15 m from the nearest very large tree. Wind-dispersed species show comparatively little deviation from a random distribution. The remaining species, mostly with large seeds, are much less dense near very large trees than would be expected and are more common in the 5 to 15 m range, but less so than the bird dispersed species. Possible explanations for these patterns include that mammalian seed-predators, which prefer larger seeds, forage more intensively near very large trees and that seed dispersal by frugivorous birds may be concentrated under the canopy of very large trees such that they act as recruitment foci.

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Arid Recovery - restoration of arid land

Arid Recovery is an arid zone restoration project based 20km north of Roxby Downs in SA. A 60 square km rabbit, cat and fox free Reserve forms the core of the project and is protected with exclusion fencing. The aims of Arid Recovery are two fold 1) to restore an area of arid land through threat abatement and the re-introduction of threatened species 2) to research the restoration of ecological processes and formulate management protocols suitable for adoption on a landscape scale. The project was initiated in 1997 and has been the focus of over 30 research projects to date. Four threatened species, Burrowing Bettongs, Greater Bilbies, Greater Sticknest Rats and Western Barred Bandicoots have been reintroduced. Due to limited and intermittent productivity cycles in the arid zone, we anticipate that recovery will be a long-term process. However, effects of feral animal removal and the role of the re-introduced species in the ecosystem are already becoming apparent, with significant changes detected in species abundance and plant recruitment within the Reserve compared to outside. An overview of the restoration process documented to date will be presented.

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Exotic plant invasion in an endangered ecological community

Invasive plant species are a significant threat to areas of conservation value, with endangered ecological communities such as Cumberland Plain Woodland (CPW) being especially vulnerable. We assessed the role of different disturbance types in determining the success of exotic plant species in CPW and attempted to determine if changes to soil characteristics that are associated with the different disturbance types have facilitated exotic species success. The 3 disturbance types examined were: (1) land use incorporating clearing, agriculture and grazing; (2) creeks draining a developed catchment; and (3) roads. Remnants that had been cleared and grazed had higher exotic species richness and cover and lower native species richness and cover than all other disturbance types. However, areas that had been grazed did not have greater exotic species richness or cover than ungrazed areas, and did not differ significantly in vegetation composition. We found a consistent pattern of high exotic species richness and cover within 2 m of creek edges. Areas downslope of sealed roads also had significantly higher exotic species richness and cover than areas below unsealed roads. No single soil attribute or combination of soil attributes was consistently able to account for variation in exotic species success under different disturbance types in CPW. Instead it is likely that some combination of factors including soil attributes, propagule availability, changes to grazing and fire regimes and physical disturbance influence exotic species success in this community.

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Effect of drought and fire on alpine and subalpine vegetation in Kosciuszko National Park: Severity of initial impact

Fires in January-February 2003 burnt an estimated 1.75 million ha of the Australian Alps, including 337,000 ha in Kosciuszko National Park. The fires came on top of the worst drought on record in Australia. The initial impact of the drought and fires on tall alpine herbfield, windswept feldmark and subalpine grasslands were documented using photoquadrats and random walk techniques at three burnt and three unburnt sites of each vegetation type.

Results from the random walk technique found that (1) unburnt subalpine grassland was the most diverse community, but also had considerable litter cover of ~12%, possibly as a result of the drought; (2) the vegetation cover was reduced from around 62% for windswept feldmark, 99% for tall alpine herbfield and 83% for subalpine grasslands, to less than 2% in the burnt sites. (3) In burnt sites, the relative proportion of bare soil, exposed root material, burnt litter and rock appear to differ among the vegetation types, partly reflecting differences inherent between the communities, and possibly also reflecting the different impacts of the fire. Sites are likely to experience soil erosion, and frost heave as a result of vegetation loss. At six weeks postfire, there was very limited regrowth (< 2%) or germination of seedlings in the burnt areas. Fire and drought recovery monitoring will continue.

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Practical approaches to regional scale connectivity: Gondwana Link and Nature Links

Gondwana Link is an ambitious program initiated and operated by a partnership of several NGOs and centred in the south-western Australia. It aims to produce an unbroken network of native vegetation stretching for over 500 km from the forests to the inland, connecting up major centres of biodiversity including the Stirling Range and Fitzgerald River National Parks. This project, which involves on and off-reserve activities and major restoration works in agricultural land linking the key natural areas, builds on over 20 years of strong community activity in the area which has included significant Fitzgerald Man and the Biosphere and landcare efforts. Gondwana Link is not about large "pristine corridors" - a key challenge is maintaining a socially and economically "vibrant" landscape that has good ecological connectivity. The concepts that underpin Gondwana Link are also being applied across western South Australia as a part of the NatureLinks program of the SA Dept for Environment and Heritage. The aim is to develop a corresponding network of habitat linkages, built on complementary private and public land management extending from the croplands of Eyre Peninsula, westward through the semi-arid rangelands of the Gawler Ranges to the Great Victoria Desert.

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Crossing the FBT (Fen-Bog Transition zone) - When is an ecological engineer a prerequisite?

The fen-bog transition (FBT) as a process in bog development is well established in the mire literature. The FBT has been attributed to changes in allogenic factors, e.g. climate; the presence of an ecosystem engineer, e.g. Sphagnum species; or to a combination of both allogenic and autogenic factors. In the majority of cases however, the cause of the FBT is not specifically addressed, leaving the mechanism behind the change in individual mire trophic status a mystery to the reader.

Here we propose a model and diagnostics to distinguish between allogenic and autogenic pathways across the FBT. Our model highlights the importance of investigating key environmental indicators of allogenic versus autogenic pathways, in addition to describing changes in community composition.

Although Sphagnum species do occur in Australasian mires, they do not appear to initiate or promote the FBT process here. The only known Australasian candidate for an ecosystem engineer is the restiad species *Empodisma minus*, the 'Sphagnum of the south'. We encourage the clarification of the role of ecosystem

engineers in Australasian fen-bog transitions, through practical experimentation, offering insight into the mechanisms underlying the engineering process.

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Foraging Behaviour of Small Insectivorous Birds in Response to Urbanization.

Bird communities in remnant vegetation of Wyong, a coastal Australian city, demonstrated a change in composition in relation to housing density. Small insectivorous birds typically common in continuous vegetation appeared to be at risk from urbanization. Changes in behaviour can be symptomatic of ecological pressures. I investigated whether five species in urban remnants showed a change in foraging behaviour compared to those in undisturbed vegetation; White-browed Scrubwren, Eastern Yellow Robin, Brown Thornbill, Striated Thornbill, and Grey Fantail. Behaviour was recorded in relation to how the birds used different plant species and foraging substrates. Vegetation structure was significantly different between remnants and continuous vegetation but this difference was rarely reflected in foraging behaviour. Plant species composition in remnants and continuous vegetation was similar but ground foraging birds showed a change in use of plant species. The White-browed Scrubwren, Eastern Yellow Robin, and Striated Thornbill performed more prey attacks per minute in remnant vegetation. Overall the foraging behaviour of birds' in urban remnants was not adversely affected by urbanization. The sensitivity of small insectivores to urbanization may be due to other factors in the urban environment.

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Do canopy and full floristic data show the same species composition patterns?

Species composition is a widely used biological response variable in studies of landscape pattern and environmental impact. There is often a trade-off between the number of samples collected and the detail of data obtained for each sample. For example, in vegetation survey, one may collect more samples if canopy species only were recorded rather than all vascular plants. This study explores the concern that full floristic data may contain information about compositional relationships that could not be detected in the canopy data. Forty-five vegetation survey datasets from NSW were chosen representing a range of vegetation type, location, sample size and species richness. Mantel tests were performed between canopy and full floristic dissimilarity matrices. Comparative tests were performed on classifications derived from full floristic and canopy data using Analysis of Similarity. Canonical Correspondence Analysis was used to estimate the amount of variation in the full floristic data explained by canopy species alone. Full floristic and canopy data do not yield identical patterns in species composition and the discrepancy between the data types varies among datasets. To elucidate the source of discrepancy, we investigated dataset properties such as species richness, gradient length, evenness and sampling intensity using multiple regression.

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Post-fire monitoring and recovery strategy testing of sub-alpine Sphagnum –shrub bogs.

Sphagnum moss-shrub mires in the ACT occur on the ranges on stream sources and along streams down to 1100m. This community is important as habitat for Corroboree Frogs and for its hydrological properties. Almost all the mires have been affected by the January 2003 fires with the burnt area varying from 55-100% of the mire surface. Some regeneration of monocots is taking place. Epacrid shrubs have mostly been killed. The recovery of the mires will be slow and they may not return to earlier structure and floristics. The fires will accelerate the trend towards loss of shrub-moss bog. The intact but dead moss hummocks and preserved rootmats and peat surfaces are a potential valuable resource for mire regeneration. We present our proposed strategy, and early results, to assess the fire damage and recovery process of the mires, and to test simple remedial measures to encourage Sphagnum regrowth. The aim of our studies is to establish minimal but effective techniques for assisting bogs to return the hydrology to pre-fire state. The longer-term aim is to have a better response to fires in sensitive catchments, both in terms of reducing the initial damage and in fostering rapid recovery.

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Building Human Capacity in the Rangelands as a Route to Conservation

About 70% of Australia's landmass is described as rangelands: the lands are extremely varied, and often grazed extensively for the production of meat and fibre. Rangelands today are characterised by very low human populations separated by great distances. The rangelands have suffered substantial loss of biodiversity; some of this is a direct consequence of the grazing activity. So the question is, how do we restore these vast areas where there are so few people to do the work? The EMU Plus project, now in its third year, is an attempt to build the necessary capacity, utilising all the local knowledge, and setting up the essential adaptive management loops. The project is attractive to rangelands managers because of the focus on solutions; in addition there is an option for pastoralists to move to accreditation. The paper explores the dimensions of the capacity building processes, the links with on-going research, and the reasons for the strong policy focus associated with the project.

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Stem decay fungi and their role in habitat formation in *Eucalyptus obliqua* in southern Tasmania

Current native forest management in Tasmania's wet eucalypt forests will alter the stand age structure across the forest landscape, reducing the proportion of old-growth (habitat) trees. Many studies in the Northern Hemisphere have shown these types of changes to have a significant negative impact on communities of wood decay fungi, saproxylic invertebrates and tree-hollow dependent fauna. The succession and diversity of stem decay fungi in living trees in Australia are poorly known, yet these processes are critical for the formation of habitat features such as decayed wood and tree hollows. This poster reports work in progress investigating the communities of wood decay fungi associated with living *Eucalyptus obliqua* trees. Decay columns and their associated fungi were examined in 6 trees in each of three age classes: 70, 105 and >150 years old. Preliminary results show that decay columns were common in living trees older than 150 years, whereas very little decay was seen in 70 and 105 year old trees. To date, ten different types of decay columns have been identified, each with an associated community of wood decay fungi. Fungi associated with habitat features such as hollows are also discussed. The results of this study should inform future forest management in Tasmania by providing information on the likely impact of 80-100 year logging rotations on the diversity of stem decay fungi and the natural formation of habitat trees in *E. obliqua*.

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Integrating ecology and farming systems

In the mixed grazing and cropping landscapes of northern NSW and southern Queensland, there are a number of environmental and production issues needing urgent attention. These include salinity and sodicity, riparian zone management, management of woody weeds, soil fertility decline, loss of biodiversity, and loss of productivity. Also, there are large differences in land type and production potential across the region, with concomitant differences in intensity of land use and conservation values. The aim of this research is to explore the balance between cropping, grazing and conservation in relation to productivity, commodity prices, climate, personal preferences and extent and condition of native vegetation. The project will examine how these factors relate to accompanying changes in the mosaic of vegetation elements that make up landscapes (crop, native pasture, sown pasture, woodland, woody regrowth) and biodiversity status. This raises critical issues regarding production and sustainability, such as the most appropriate combination of landscape elements, the identification of links between biodiversity and landscape function, and quantifying the impact of different landscape mosaics on biodiversity, landscape function, and production. These issues are being addressed through a combination of ecological landscape design principles and farming systems modelling, to develop a range of different land-use and production scenarios

Howell, Jocelyn and Doug Benson



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Surviving by staying put – persistent herbs in western Sydney’s woodland

Persistence is a key characteristic of Cumberland Plain Woodland on the shale soils of western Sydney. Most of the woodland’s species richness is in the ground layer, with herbs and grasses the predominant life forms. Monitoring species abundance over 14 years in a ten-hectare fragment revealed that nearly 80% of native species persisted, compared with fewer than 50% of exotics. Many species have localised patchy distributions, and do not spread quickly in woodland allowed to regenerate, as recruitment from seed appears to be episodic, and most species lack the capacity for long distance dispersal and colonisation. Resprouting is the predominant means of survival and persistence, and most plant species achieve this via a variety of softer-tissued rootstocks, including bulbs, corms, tubers, tuberous roots and thickened taproots. This contrasts with presence of woody lignotubers in the high shrub component in woodland on regional sandstone-derived soil. Circumstantial evidence from experimental fires suggests rootstocks have evolved in the context of seasonal or periodic drought, as seeds of many species appear to germinate in response to bared soil and rain rather than requiring fire as a cue. Current distributions suggest many species may have been able to survive previous periods of much lower rainfall.

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The concept and utility of ‘ecological thresholds’ in biodiversity conservation

Evidence exists in the physical and chemical sciences of rapid changes in the state of matter occurring when a critical point is exceeded. In ecology, scientists are striving to identify conceptually similar discontinuities or ‘thresholds’ in the response of biota to human-generated disturbance. The intent is that this information may lead to more informed and desirably more effective conservation of native plant and animal populations, species and threatened ecological communities. In this paper I re-visit the concept of ‘ecological thresholds’, review the evidence for their purported existence, describe some potential pitfalls in their use, and discuss their role and utility in biodiversity conservation using examples from current Australian research. I deliberately strive to progress the debate on this important topic in landscape ecology, natural resource management, and environmental policy and planning.

Hughes, Lesley¹ and Caroline Lehmann²



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Fire, fertility and vegetation boundaries

Much of the Australian continent is characterized by low fertility soils and frequent fire. Boundaries between different vegetation types, such as those between sclerophyll woodland and rainforest, often correspond to boundaries in soil type. This study addressed the question of how differences in characteristics of vegetation growing on soils of different fertilities influence fire behaviour, and by corollary, how fire behaviour serves to maintain and reinforce vegetation boundaries. We sampled leaf litter from three pairs of adjacent low and high fertility sites in the Sydney region and compared characteristics that contribute to flammability. Litter from fertile sites had higher moisture content, higher turnover and lower bulk mass than litter from infertile sites. Experimental burns indicated that litter from infertile sites was more flammable, in terms of ignitability, maximum temperature attained, and sustainability, than litter from fertile sites, even when moisture content and mass were standardized. We conclude that vegetation on infertile sites produces litter that is more flammable, due to increased bulk mass, decreased water content, and both structural and chemical characteristics that favour the onset and propagation of fire. We discuss the implications of these results for understanding the maintenance of vegetation boundaries and for fire management.

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Large woody debris character and habitat scale hydraulics in the River Murray

Snags (Large Wood Debris) provide important fish habitat in lowland rivers and it is believed that this may be because it provides hydraulic relief. Twenty seven snags within the Yarrawonga to Tocumwal reach of the River Murray were electro-fished immediately before having their hydraulic environment measured with an Acoustic Doppler Profiler (ADP). Multivariate analysis of hydraulic variables revealed several groups of snags of differing hydraulic character. Hydraulic environment was influenced by snag physical factors (piece size, angle to flow, structural complexity and distance from bank) but no single physical factor was pre-eminent in influence. The most hydraulically complex snags were associated with an increased presence of fish. Five snag hydraulic environment variables appeared to be associated with an increased probability of fish presence: low horizontal velocities, positive vertical velocities, positive skewness of velocity distribution, a high range of flow directions and a high standard deviation of flow directions. Native fish partitioned this hydraulic habitat. Trout cod utilised sites with a higher mean velocity whereas Murray cod, Yellowbelly and Carp utilised sites with lower velocities.

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Multiple mothers: evidence for age and mass related changes in reproductive output in possums

The factors which affect the lifetime reproductive success (LRS) of individual animals are of great importance to both the evolution of life-history traits and population growth and dynamics. In mammals, female reproductive success has been shown to be influenced by resource availability, variation in individual mass and condition and maternal age. In this study, we investigate the maternal influences governing the production of a second pouch-young within a year in female common brushtail possums, *Trichosurus vulpecula*. We found that maternal mass was negatively related to birth date, with heavier females giving birth earlier in the season. Multiple mothers were found to give birth to their first young significantly earlier than those females that produced only a single young. There was also some evidence that multiple mothers were both heavier and older than the population average. These findings are discussed in terms of their impact on LRS and life-history theory.

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Shaping biodiverse production systems in collaboration with producers, consumers, and agricultural scientists: a view from North America



Ecologists bring a trenchant set of values, questions, tools and scales of analysis to agriculture, but their influence has been limited. Examples from the United States illustrate two established roles and one emerging role for ecologists with the potential to enhance biological diversity, farm profitability, and long-term productivity for agricultural production systems. "Critics" such as Rachel Carson have measured and publicized the ecological consequences of agricultural intensification. "Agroecologists" have combined ecological and traditional agronomic approaches to find alternatives to inorganic fertilizers and pesticides, thus reducing the indirect effects of agriculture on biodiversity. The newest role for ecologists requires unprecedented collaboration with producers, economists, agricultural production specialists, and ultimately the consumer/taxpayer. "Agroecological restoration" as it might be called, attempts to incorporate native biodiversity and ecosystem processes into profitable production systems. Examples include native pasture restoration, crop-wetland rotations, beetle banks, development of perennial grains, and mutually beneficial arrangements between protected areas and the surrounding agricultural matrix. A comparison of United States, United Kingdom and Australian agricultural policy reveals that progress in this area will depend greatly on favourable public policy and the development of markets for sustainably produced food and fibre.

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Biodiversity monitoring: Impossible dream or future reality?


Many community sectors wish to monitor 'biodiversity' but it is a daunting task to develop scientifically rigorous monitoring programs when the available tools and techniques are mostly inadequate for the task. Biodiversity is an abstract concept and its monitoring requires appropriate and measurable attributes to satisfy monitoring objectives, costs and reporting requirements. We ask, 'How can one identify the minimum necessary set of attributes to measure within a biodiversity monitoring program?' We propose that all reasons commonly given for undertaking monitoring fall into two groups as either supporting management decision-making, or demonstrating environmental performance. These reasons become operational at three principal reporting scales – local (enterprise), regional and national. Using Noss' framework (1990) of compositional, structural and functional attributes of biodiversity gives a 3-dimensional array (reason [n=2] x scale [n=3] x attribute type [n=3]) of possible attributes to classify any monitoring task. Given this general framework, we enlisted recognised experts to identify existing tools and techniques as potential attributes for monitoring rangeland biodiversity, and evaluate them against eight performance and utility criteria. We conclude that ecologists face a formidable challenge to develop robust and reliable procedures if we are to satisfy the full range of biodiversity monitoring tasks.

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Late Holocene vegetation history from a coastal peat in West New Britain, Papua New Guinea

The peat swamp at Garu, West New Britain, has very clearly bedded tephra and peat layers. This coastal peat, in the lowland wet tropics, has developed in a region with a dynamic environmental history. High resolution palynology, dating from around 3,000 yrs BP gives a fascinating picture of an environment coping with periodic catastrophic volcanic episodes, landform and hydrological change, as well as prehistoric human impacts. The fossil pollen assemblages at this site indicate clear changes in vegetation communities occurring between volcanic eruptions. Transformations between tree/shrub domination and fern/sedge domination are not, however, always linked to the volcanic eruptions. Indication of hydrological changes are also evident, and probably influence the dominant communities independently of the periodic volcanic devastation. This pollen analysis is the first for the region, and has generated an initial palaeoenvironmental reconstruction of this tephra-rich swamp. This will be combined with the results of other pollen and phytolith sequences from Garu Swamp and the neighbouring landscape to address the complex relationships between tropical forest, and disturbance ecology, volcanoes and people.

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Impact of secondary salinisation on freshwater ecosystems. Effect of increasing salinity on an intermittent floodplain wetland - water chemistry, macrophytes and diatoms.

Nine mesocosms were placed in a freshwater floodplain wetland, located adjacent to the Goulburn River near Shepparton, Victoria. Salt was added to six mesocosms after flooding - three at 600 mg L⁻¹ and three at 1,800 mg L⁻¹. Three mesocosms were used as controls. Water quality, macrophytes and diatoms were sampled regularly until the wetland was dry.

Conductivity increased ca. 2-fold in the Low and High-salt mesocosms, less than expected on the basis of the ca. 10-fold reduction in water volume. Water column pH in the High-salt mesocosms decreased from 6.9 to a final pH of 4; probably due to release of protons from the sediments by ion exchange reactions.

The dominant macrophytes in the wetland were *Amphibromus fluvitans*, *Potamogeton tricarinatus* and *Triglochin procera*. There was a significant reduction in the total plant biomass, and the biomass and percentage cover of *P. tricarinatus*. Flower production by *P. tricarinatus* was significantly reduced, whereas *A. fluvitans* flowered and set seed freely.

Significant reductions in epiphytic diatom density, species richness, and diversity occurred in experimental High-salt mesocosms, but not in control or Low-salt mesocosms.

These results support the general advice to management that salinity increases above about 1,000 mg/L will cause adverse effects in freshwater wetlands.

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Scaling up from points to catchments: Assessing riparian condition.

Assessment of the condition of riparian zones is important for determining the health of riverine ecosystems, and for prioritising where works could be carried out to rehabilitate degraded sites. My work to date has focussed on assessing riparian condition at the point scale, i.e. defining sites on the ground, usually 200-1000m long stream reaches, and measuring a series of attributes at those sites. This has been useful for determining relationships between riparian condition and on-ground management practices, but has limited potential for determining the overall condition of riparian zones in a catchment. Here I will present some results from work attempting to “scale-up” my condition assessment methodology so that it can be used at the catchment scale. Preliminary analyses suggest that at least 75% of the variance in riparian condition measured on-ground could potentially be determined from remote data. This potential is being explored using satellite imagery. Testing is being carried out in the Goulburn-Broken catchment in Victoria and the upper Murrumbidgee catchment in NSW and the ACT, where on-ground data has already been collected at a large number of sites.

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Genetic diversity, population structure and the current cancer epidemic in Tasmanian devils

Genetic diversity and population structure were investigated across the core distributional range of Tasmanian devils (*Sarcophilus laniarius*; Dasyuridae), the largest and a wide-ranging marsupial carnivore, now restricted to the island of Tasmania. Genetic and allelic diversity is uniformly low in all subpopulations. Across relatively continuous habitat, and in agreement with available recapture data, gene flow appears extensive at scales of 50 km with reduced gene flow but no evidence for isolation by distance at larger (150-250 km) scales. The most substantial genetic structuring was observed for comparisons spanning unsuitable habitat, implying limited dispersal of devils between the eastern, relatively homogeneous populations and a smaller north-western and western population. The implications of these results will be discussed in the context of the current facial tumour epidemic and past population “crashes” in devils.

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Productive Grazing, Healthy Rivers.

Intact riparian zones are essential in the maintenance of healthy aquatic ecosystems, however, within grazing production systems, these zones are often degraded due to vegetation clearing, stock access and grazing. Consequently, streams in these landscapes often exhibit poor water quality and a decline in biodiversity.

The Victorian Departments of Primary Industries and Sustainability and Environment are part way through a four-year project, 'Productive Grazing, Healthy Rivers', to investigate improved on-farm management of riparian zones, more specifically, to improve riparian and in-stream biodiversity. Six research modules addressing key knowledge gaps are either under way or have been completed. These include: the development of a weed expert management system, determining and overcoming barriers to native vegetation regeneration, re-introducing woody debris to agricultural streams, assessing the water quality impacts from dairy cows and quantifying on-farm riparian biodiversity.

The information obtained from these modules will be used to develop a toolkit utilising a range of media that will be extended to natural resource management and industry extension agencies. The project represents an important step towards achieving ecologically sustainable agriculture in the intensive grazing industries through improved riparian management.

Joy, Mike and Rusell Death



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Using neural networks and GIS to predict the spatial occurrence of freshwater fish and decapods

We used stream fish and decapod spatial occurrence data extracted from a national database combined with recent surveys and geospatial data landuse, geomorphologic, climatic, and spatial data in a geographical information system (GIS) to model fish occurrence in the Wellington Region, New Zealand. To predict the occurrence of each species at a site from a common set of predictor variables we used a multi-response, artificial neural network (ANN), to produce a single model to predict the entire fish and decapod assemblage in one procedure. Four evaluation metrics independent of species abundance or probability thresholds confirmed the accuracy of the model. The important variables contributing to the predictions included the spatial and elevational position of the site reach, watershed area, the landuse and vegetation type proportions of the watershed, and watershed geology. The geospatial data available for the entire regional river network were then used to create a habitat-suitability map for all 18 species over the regional river network using GIS. This prediction map has many potential uses including; monitoring and predicting temporal changes in fish communities caused by human activities and shifts in climate, identifying of areas in need of protection, biodiversity hotspots, and areas for the reintroduction of endangered or rare species.

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SALternative land uses: Impacts of using saline mine waste water to irrigate trees on coal mine overburden in the Upper Hunter Valley, NSW

Saline groundwater inflow into open-cut coal mining operations in the Upper Hunter Valley (NSW) produces waste water of moderate salinity (2.5-5.0 dS m⁻¹). A commercial forestry experiment was designed to investigate the response of four species (*Corymbia maculata* Hook, *Eucalyptus botryoides* Smith, *E. tereticornis* Smith and *E. occidentalis* Endl.) to saline mine water irrigation. Substrate chemistry, tree survival, height, salt uptake and internal nutrient cycling were measured two years after establishment. Tree growth and substrate fertility were compared between irrigated and rainfed conditions.

Saline irrigation increased tree survival and improved tree growth responses compared to rain-fed trees. Increases in substrate EC, Na and Cl were detected in irrigated areas and this was negatively correlated with tree growth responses. There was significantly higher Na concentrations in irrigated trees compared to those under rain-fed conditions. While some Na uptake could have been excluded at the root, excess Na that was taken up by irrigated trees was selectively removed through sequestration into senescent foliage. We conclude that saline irrigation application has the potential to improve growth and survival of commercial plantations on mine overburden. However, the accumulation of salts in the substrate and within trees can occur where drainage conditions are inadequate.

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Plant-animal interactions in rainforest restoration

Australian rainforests cover less than 0.3% of the continent but support around half of Australia's terrestrial biota. Following decades of community concern, the remaining areas of rainforest in Australia are now well represented in the reserve system. However, the conservation of rainforests will require more than their formal protection. Clearing and fragmentation have already wrought changes to the abundance of key rainforest fauna, including seed dispersers, and seed and seedling herbivores, in some remnant forests. Due to the complex interactions of plants and animals in rainforest dynamics, changes in the abundance of these faunal groups are likely to affect the composition of remnant forests. Without restoration, these changes are likely to lead to the loss of biodiversity in rainforest remnants. Revegetation is a major form of restoration in cleared rainforest

landscapes. In this presentation, we present data on the use of different types of reforestation by rainforest fauna in tropical and subtropical Australia, and on rates of seed predation in reforested sites. We conclude that plant-animal interactions are likely to exert strong effects on the dynamics of reforested sites, with implications for the design of restoration projects.

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Effect of fertilization on biomass and yield and composition of foliar essential oil of *E. radiata* subsp. *radiata* at Banalasta, northern NSW

A field experiment was carried out to evaluate the influence of nitrogen and potassium fertilizer on biomass, yield and composition of the essential oil of *E. radiata* at Banalasta, northern NSW. Fertilizer treatments included three levels each of nitrogen and potassium in factorial combination. Nitrogen was applied as ammonium sulfate [(NH₄)₂SO₄] at 100 and 200 kg N/ha, and potassium was applied as potassium chloride [KCl] at 50 and 100 kg K/ha. Phosphorus as single superphosphate [Ca(H₂PO₄)₂CaSO₄] was applied at 100 kg P/ha. Nitrogen and potassium were applied at 1, 5 and 10 months after planting while phosphorous was applied at planting. At 24 months after planting, above ground dry matter production was highest in trees treated with the highest rate of fertilizer (N200K100) but not significantly different to the N100, N200, and N200K50 treatments. The highest and the lowest numbers of primary branches were recorded from trees treated with N200K100 and N100K100, respectively. The maximum and minimum production of leaf dry matter corresponded with the N200K100 and N100K100 treatments, respectively. A high rate of fertilizer (N200K100) significantly increased the concentration of oils by 23.4% compared to control trees 24 months after planting. Oil yield per hectare from the fertilized trees averaged 90.3 ± 8.9 kg which was 60.2% more than that of control trees (56.4 ± 7.8 kg) and oil yield was significantly greater in the N200K100 treatment (182.7 ± 14.4 kg/ha). Application of N fertilizers only at 100 kg/ha increased oil yield by 33 kg/ha and 68.5 kg/ha compared with N at 200 kg/ha and controls. Increasing K fertilizer from 50 kg/ha to 100 kg/ha increased oil yield by 17.2 kg/ha over control. Fertilizer treatment did not significantly affect the content of 1,8-cineole. Nevertheless, N, whether used alone or in combination, has a significant positive impact on oil production by young *E. radiata* in plantation when phosphorous is applied as a basal dose of 100 kg/ha.

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Reconstructing a post-colonial environmental history of metal pollution and land-use changes around Queenstown, Tasmania using sediment archives.

Identifying and quantifying historical human impacts on the environment can make important contributions to our understanding of how human activities alter the natural environment – mechanistically, spatially and temporally. In Australia, there are still many unanswered questions about the nature and extent of post-colonial human impacts, and high resolution environmental histories may provide some answers to these questions. One way that historical impacts can be investigated is by retrieving evidence from natural archives, which include sediment records from different types of depositional basins. However, the use of sediment archives is subject to limitations and results should be interpreted with care.

This research aims to reconstruct a detailed environmental history of post-colonial human impacts and to discuss the utility of sediment records as proxy indicators of this environmental change. The fieldwork was conducted in western Tasmania, which has two important features. Lake and moorland sediment repositories make up a significant part of the landscape, and the area has a long history of supporting extractive industries such as mining and logging. Metal pollution data, pollen records, sedimentation rates and fire histories obtained from sediment archives in the Strahan/Queenstown region were used to reconstruct a detailed, 150-year environmental history of the area. Results from this honours research will be presented and discussed.

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Soil seed banks in remnant vegetation: the influence of fire and vegetation types on composition and germination.

Many rural landscapes are characterised by a mosaic of agricultural lands interspersed with isolated patches of remnant vegetation. Such vegetation is likely to be sensitive to any form of disturbance including fire, and the occurrence of persistent seed banks is regarded as one of a number of regenerative strategies that have evolved amongst many plant species. This study proposes two questions associated with remnant patches. The first is to quantify the relationship between the composition of the aboveground vegetation and the store of seeds in the soil seed bank. Five remnant vegetation types were sampled: Bluegrass, Open woodland, Semi-evergreen vine thicket, Ironbark and Mountain Coolibah. The second component of this research is to test the effect of fire on the germination of seeds from the seed banks of each of these remnants. It was hypothesised vegetation types dominated by woody shrubs and herbs were more likely to support soil seed banks with a positive response to fire treatments, while vegetation types dominated by grasses are more likely to have a negative response to fire treatment. Preliminary results do not support this, with significant reductions in germinable seed banks occurring after fire in all five vegetation types.

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A framework for evaluating the effect of increased salinity on freshwater biota

A wide range of freshwater biota exists in freshwater - each with the potential for different salinity tolerance, which may vary both spatially and temporally and be affected by other factors. We are developing a framework for evaluating the effect of likely increases in salinity on freshwater biota. We recognize that only a sub-set of species can be studied. Accordingly we measure the acute lethal tolerance of a sample of invertebrates from several geographic locations, in the laboratory, to estimate their relative tolerances. This allows consideration of the degree to which the tolerance of a species and that of the members of a community vary spatially and temporally; and the variation of tolerance within higher taxonomic groups (e.g. families and orders). Salt will affect species without killing them. The effect of salinity will likely be modified by other factors. Therefore for a sub-set of species we investigate such effects in the laboratory. Finally we compare our laboratory results against natural populations and communities to ground truth the laboratory results. While we are investigating freshwater invertebrates, and to a lesser degree fish, this presentation also examines the potential of using this approach with other biotic groups and in other environments.

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Using small mammals to test ecological processes driving population and community responses to fire in nutrient poor environments.

Patterns of small mammal community responses to fire events are well documented in some regions of Australia. However, these patterns do not occur uniformly across ecosystems and the ecological mechanisms driving such patterns are rarely experimentally tested. We monitored the response of a small mammal community in the eucalypt forests of Fraser Island to prescribed fire events and, using supplementary food and canid exclusion treatments, tested how trophic interactions influenced the community's response to fire. The Bush Rat (*Rattus fuscipes*) was the dominant species in the community and exhibited little immediate change in density as a result of the fire event. Small mammal communities in canid exclusion plots did not differ in composition or density from control plots at any stage in the 12 months after fire but food supplementation significantly increased the density of *R. fuscipes* (no effect on species composition). Top-down processes (predation) have little effect on *R. fuscipes* after fire, whereas resource availability (food) appears to drive the population for at least 12 months after fire. The lack of response by other small mammals in the community suggests that other processes, such as competition with *R. fuscipes*, are influencing their abundances.

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Effect of observer presence and handling on activity patterns in the sleepy lizard (*Tiliqua rugosa*): implications for behaviour studies

In many field based studies the effect of observer presence on reptile behaviour is assumed to be minimal. We report on the influence of observer presence on the behaviour of the Australian sleepy lizard (*Tiliqua rugosa*). Over 17 weeks we maintained continuous records of activity of 10 lizards using lightweight activity loggers recording lizard body temperature and stride frequency every two minutes. At all times of day and throughout the season we recorded the effect of three levels of observer disturbance (Observed, Briefly Handled, and Held for an extended period) on lizards either inactive or active at the time of interaction. Following disturbance stride frequency increased for up to an hour. The extent of this effect was higher for active than for inactive lizards and increased with level and duration of disturbance. Lizards showed no habituation to the observer disturbance in the medium term. We found that the impact of an observer disturbance can be markedly reduced by choosing to work with inactive lizards early in the morning when ambient and body temperatures are relatively low. The results demonstrate that direct observation of reptiles in the field can influence their behaviour both during observation and for a significant time after.

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Land use conservatism results in conservation of grassy ecosystems used for sheep grazing

Burning and stock grazing are two of the most common disturbance events in native grassy ecosystems, most of which are used for pastoral production. We investigated the single and interactive impacts of these disturbances in a variety of grazed grassy ecosystems in Tasmania. Our results indicate that the effects of grazing and/or burning on grassy ecosystems are contingent on vegetation type and grazing regime. Disturbance by grazing can benefit some conservation-significant plant species and communities. Different species and communities prosper under different disturbance regimes. Therefore, an integration of nature conservation with pastoral enterprises requires the spatial and temporal persistence of a variety of regimes – conservatism in use and disturbance patterns results in conservation of plant species and communities.

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Variation in nesting success in Darwin's finches: why are old males better?

This field study presents results of a three year investigation of Darwin's Small Tree Finch (*Camarhynchus parvulus*) carried out on Santa Cruz Island, Galapagos. In this species, males differ in plumage colouration based on age, changing with each annual moult from brown as young males to progressively more black-headed as old males. Complete black-headedness is attained at around age 4-5 years. In this species females choose singing black males more quickly than brown males (2.9±0.9 days versus 9.5±1.8 days respectively). This study examines: i) male song activity, ii) male morphology, iii) parental care, iv) nest-site vegetation, and v) fledging success in relation to male plumage colouration. The results show no difference in male song, morphology or parental care in relation to male colour (a trait correlated with age), yet a significant difference in nest size dimensions and nest-site vegetation cover comparing brown (young) vs. black (old) males. These nest and nest-site variables also predict fledging success, with well-covered small nests suffering lower predation (also in few brown males). The results point to the strong natural selection pressures which may be shaping female preference in this species, and highlight a possible role for conditional learning by males that is driven by female choice for safe nests.

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Grassy woodlands in the New England Tableland Bioregion: Effects of fire season and fire intensity on shrub seedling emergence and survival

While the mechanisms influencing the effects of fire frequency on vegetation communities are relatively well understood, those associated with the effects of fire season and fire intensity have been less well studied. The effects of different fire intensities and fire seasons on the emergence and survival of shrub seedling from grassy woodlands in the New England Tableland Bioregion were examined in a manipulative field experiment over two years. Fires were implemented in two seasons (spring and autumn), at low and moderate fire intensities in experiments over two years. Seeds from 13 species were sown before each fire and seedling emergence and survival were recorded. Fire season and fire intensity were found to influence the emergence and survival of shrub species studied, although, these factors influenced emergence more so than survival of seedlings. Furthermore post-fire emergence was more strongly influenced by fire season than by fire intensity. Fires occurring in spring resulted in the enhanced seedling emergence for most species studied and fires of moderate intensity resulted in enhanced seedling emergence for species from the Fabaceae.

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Tree hollows in *Eucalyptus obliqua* forests and their use by vertebrates.

Tree hollows are an important and potentially limited resource in many forested areas around Australia, particularly those managed for timber production. In Tasmania, a minimum of two habitat trees are retained every five hectares. How adequate is this prescription and how do we know which trees to keep? In this study, the size, shape and abundance of hollows in *Eucalyptus obliqua* will be measured before and after felling on logging coupes around the state. The relationship between the abundance of hollows found and the tree and site variables measured pre-felling will be investigated. This relationship will be extrapolated to the measured structure of the forests to estimate the abundance of hollows in this tree species around the state. The proportion of hollows used by vertebrates will be assessed from secondary evidence such as scats, fur, scratch marks etc. A statistical model indicating the types of *E. obliqua* trees and hollows used by vertebrates will be constructed and supplied to the Forest Practices Board to use when selecting habitat trees.


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Grasstree resprouting: questioning the obvious conclusion


It has been speculated that the roles of fire and herbivory on Australia's vegetation have only recently swapped. In the context of the present vulnerability of the Australian bush to fire, the obvious conclusion to draw from an examination of grasstree morphology and flammability is one of adaptation to its fire-prone environment. However, data concerning resprouting in *X. preissii* suggests a likely, alternative explanation: adaptation to herbivory. *X. preissii* demonstrates a rapid flush of leaf production after fire of up to six times greater than that of unburnt plants. However, experimental exploration of this phenomenon showed that leaf removal alone accounted for the greatest increase in leaf production (26%), above that of three factors (nutrients, water availability and incident light) considered to be important to grasstrees resprouting after fire. *X. preissii* was also particularly resilient to simulated herbivory, resprouting vigorously after total defoliation at varying frequencies (far more frequent than ever possible by fire), confirming this species' plastic responses to crown damage. How quickly would we correlate the biology of grasstrees with fire adaptation if they only existed in more mesic, subtropical habitats regularly grazed by populations of large herbivores and where fires were rare?

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The population structure of spotted-tailed quolls (*Dasyurus maculatus*) on the New England Tablelands

Between 2000-2002 two quoll populations were studied on the New England Tablelands using trapping surveys and radio-tracking. In a total of 12691 trap nights 85 individuals were trapped on 505 occasions. Trapping was male biased (74%) but trappability was the same for both sexes. Adult males (>1 year) were substantially larger than females. Males travelled on average larger distances than females and the maximum distances recorded were 8.1 and 3.9 km for a male and female respectively. Linear distance travelled between trap locations within 24 hours was 3.2 and 1.5 km for males and females respectively. Only females appeared to defend an exclusive home range. Endo- and ectoparasites were observed regularly and many quolls had extensive skin lesions probably caused by skin-burrowing flea larvae. During the study 18 mortalities were recorded, the majority of them caused by starvation (n=5) and predation (n=5). Only two individuals were trapped during all three years of the study and at the beginning of autumn when juveniles had become independent the populations comprised of about 50% juveniles. Overall mortality rates and the turnover in the quoll populations appeared to be substantial and the yearly survival rate was estimated at 41%.

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Can outbreaks of house mice in southeastern Australia be predicted by weather models?

Outbreaks of house mice (*Mus domesticus*) occur irregularly in the wheat-growing areas of southeastern Australia, and are thought to be driven by weather variability, particularly rainfall. If rainfall drives grass and seed production, and vegetation production drives mouse dynamics, we should achieve better predictability of mouse outbreaks by the use of plant production data. On a broader scale, if climatic variability is affected by El Nino-Southern Oscillation events, large-scale weather variables might be associated with mouse outbreaks. We could not find any association of mouse outbreaks over the last 100 years with any ENSO measurements or other large-scale weather variables, indicating that the causal chain linking mouse numbers with weather variation is more complex than is commonly assumed. For the 1960-2002 period we were only partly successful in using variation in cereal production to predict outbreaks of mice in 9 areas of Victoria and South Australia, and we got better predictability of outbreaks from rainfall data alone. Without the detailed specific mechanisms underlying mouse population dynamics, we may not be able to improve on these simple models that link rainfall to mouse outbreaks.

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Potential of high spectral and high spatial resolution sensors for wetland vegetation health and condition mapping

This paper presents the latest technological advancements in remote sensing, including hyperspectral remote sensing, and the potential of these for wetland related work. Examples of the use of Hyperion and Hymap data for coastal wetlands and salt marsh vegetation mapping will be presented. Traditional satellite remote sensing systems have limited spectral and spatial resolutions. Data from these systems are only able to provide restricted information on the condition of wetland vegetation. Broad-scale data for the characterization of individual species and the early detection of changes in the health and condition of wetland vegetation has not been available until recently. Recent technological advances in remote sensing, specifically high spatial and high spectral remote sensing, offer exciting challenges and opportunities to incorporate technical developments into mapping wetland health and condition. Data from Hyperion and Hymap remote sensing systems will be used to illustrate the potential of these new systems.

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The determinants of vegetation pattern in Australian sub-tropical rainforests

Floristic patterns inherent in rainforest communities can be observed at many scales of resolution. At a regional scale, geographical variation in soil typology, topography, microclimate and disturbance can result in high levels of environmental heterogeneity. These variables and processes together produce a set of conditions which will determine the nature of the regional flora and in turn, the direction of conservation and management strategies that may be needed. This project will endeavour to explain regional patterns within the rainforest vegetation communities of southeast Queensland and northern New South Wales, and their association with climatic, geographic and edaphic processes. Remotely mapped environmental layers and vegetation survey data will allow the identification of those factors most responsible for vegetation community variation. This project will also examine the significance of biogeographic history, edaphic compensation and climatic patterns in determining the distribution of selected species. This information will then be used to model the potential distributions of known rare and endemic species within the region and to examine the implications of climate change for these rainforest communities.

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Sulfidic materials in the River Murray floodplain: An emerging issue for the management of saline wetlands

Acid sulfate soils have long been recognised as a significant environmental problem for large sections of the Australian coastline. However, it is now recognised that similar sulfidic materials can also develop in recently salinised inland environments. A survey of nine wetlands covering a range in salinity was made to determine if sulfidic materials are present in the lower River Murray floodplain. Large sections of this environment are currently undergoing salinisation because of decreased flooding frequency, increased discharge of saline groundwater, use of wetlands as disposal basins, and elevated water tables. Reduced S concentration in wetland sediments ranged between 0.002% to 0.97% and tended to be more elevated in permanently flooded or recently drained saline wetlands. In comparable marine environments, soils and sediments with reduced S concentrations above 0.6% are thought to be at significant risk of acidification when drained. Several of the wetland sediments with an elevated reduced S concentration also had a good acid buffering potential, diminishing the risks of acidification if drained. However, one wetland with elevated reduced S had recently acidified to pH < 3 during a draw down event. The presence of sulfidic materials has important implications for the use of water level manipulations to manage wetland salinity in the lower River Murray system.

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Habitat description and transplantation of *Tetratheca juncea*

Tetratheca juncea Smith (Tremandraceae), is a small, endemic subshrub, which grows in disjunct populations. It is listed as vulnerable under both NSW State and Commonwealth legislation. Donaldson Coal operate an open-cut coal mine at Beresfield that is passing through a *T. juncea* population and attempts are being made to incorporate this species onto the mine rehabilitation areas. By identifying the habitat requirement of *T. juncea* it may be possible to successfully transplant it onto mine rehabilitation areas. Vegetation surveys were conducted at five sites to describe the vegetation community in which *T. juncea* exists. No significant plant-plant associations were found. Also studied, was transplantation of this species within its current vegetation community and glasshouse experiments to determine if *T. juncea* can grow in spoil or topsoil overlying spoil. This study has shown that *T. juncea* can be transplanted successfully within its own vegetation community. However, in a shadehouse trial it could not survive or be grown on mine spoil.

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Modifying policy and practice to improve the strategic value of regional lists of threatened plants: a case study from Cape York Peninsul

Listing of species threatened with extinction is a linchpin of legislation aimed at conserving Australia's biodiversity, including identifying priorities for regional conservation planning and management. But how well do current lists achieve this? My experience in reviewing the currently listed plant species of Cape York Peninsula suggests there is much room for improvement. Of the more than 3000 plant species known to occur on Cape York Peninsula, 69 are currently listed as Endangered or Vulnerable under State and Commonwealth legislation. A review of the status of these species revealed some inaccuracies, many biases, and limited strategic value. Inaccuracies arise from three sources: inappropriate listing of poorly collected species, inappropriate listing of naturally rare species that do not appear to be threatened, and inefficient integration of State and Commonwealth listing processes. Biases are apparent in the taxonomic groups listed, the biogeographic subregions where they occur, and the nature of the potentially threatening processes cited as reasons for listing. In this talk I will use examples from the Cape York flora to illustrate these inadequacies, and suggest modifications to current policy and practice that would help overcome them.

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Ecosystem Service Thresholds in a Re-vegetated Landscape

Future scenarios of re-vegetation based on biodiversity enhancement objectives were generated for Sheep Pen Creek catchment in north-eastern Victoria using a spatial multi-criteria analysis approach. These scenarios were evaluated for their potential effect on ecosystem services: climate regulation; regulation of ground water and river flows; provision of shade and shelter; and maintenance and regeneration of habitat. Potential causes of thresholds in these services include: differential response of biophysical processes to change in vegetation; spatial heterogeneity in data; conflicting vegetation rules producing vegetation patterns with critical switch points; and spatial dependency of services on neighbouring vegetation. In this instance the techniques used identified threshold responses due to conflicting vegetation rules and neighbourhood dependencies. Maintenance and regeneration of habitat, provision of shade and shelter provide, and to a lesser extent regulation of river flows provide examples of these spatially dependent ecosystem services.

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Amazon birds and their response to roads, highways and large clearings

In central Amazon, understorey rainforest birds are extremely diverse and highly specialized, unfortunately they are also extremely sensitive to forest disturbance. The movement ability of this community was examined across roads, highways and large clearings through extensive mist-netting and a radio tracking project.

A small road was found to significantly affect the daily movements of 5/6 guilds studied. Rainforest regrowth at some sites facilitated movement of some sensitive species, however one guild were found to be especially vulnerable. Subsequent radio tracking studies found that dispersal movements of target species are probably not affected by small road or highway clearings however larger clearings do appear to isolate populations and can have significant effects on long term survival of birds in a fragmented landscape.

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Rainforests in Crisis: Comparing Threats to Australian, Amazonian and African Tropical Forests

I contrast key threats to tropical rainforests in Australia, Amazonia, and central Africa, and conclude that Australian rainforests may be the most imperiled. Amazonian forests have the world's highest absolute rate of deforestation from cattle ranching, slash-and-burn farming, and industrial soybean farming. In coming decades, they are also likely to be fragmented on an unprecedented spatial scale from ambitious highway- and infrastructure-building schemes that are penetrating deep into the heart of the basin. African rainforests and their

fauna are most threatened by the explosive growth of industrial logging and pervasive overhunting. In marked contrast, the tropical rainforests of north-eastern Australia are largely protected as a World Heritage site, and one might presume that the future of these forests and their biota is secure. However, Australian rainforests are very restricted in their distribution, highly susceptible to edge effects, and appear extremely vulnerable to future climatic change. Given their remarkably high concentration of upland specialists and locally endemic species, Australian tropical rainforests and their biotas are potentially far more vulnerable than are those of the Amazon and central Africa.

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Using Species-Specific Chemicals to Locate Fire Ants

Red Imported Fire ants (*S. invicta*) were discovered in Brisbane in February 2001. An eradication program supported by structured surveillance was begun in September 2001. Part of the surveillance program is concerned with developing tools to assist in locating fire ant nests easily and efficiently.

This poster is concerned with work being undertaken to (potentially) develop an electronic nose or 'sniffer' device using a suite of chemicals, which are ubiquitous to *S. invicta* as an alternate surveillance tool. These species and colony specific chemicals include:

1. Cuticular hydrocarbons, used by the ants to identify nest mates.
2. Trail pheromones
3. Venom alkaloids, the sole constituents of fire ant venom, is unique among animal venoms as it is the only non-proteinaceous venom.

Currently tests are underway to identify chemicals (GC and mass spectrometry), which are unique to and associated with all *S. invicta* mounds. Once these are identified it is planned to explore the possibility of developing a prototype 'sniffer' device such as an electronic nose to detect these chemicals in the environment. Electronic noses are responsive to the shapes and structural features of organic molecules. Once developed a prototype 'sniffer' device will be evaluated against other surveillance methods before further development. A range of odour detectors have been used to locate insects such as termites by searching for chemicals specific to them such as methane gas and hydrocarbons.

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Richness, complexity & condition of remnants in the eastern Darling Downs, Queensland

The Darling Downs region of south-east Queensland is one of the most productive agricultural systems in Australia, yet little is known about habitat quality and condition of remnant and re-growth vegetation in the region, including endangered ecosystems such as bluegrass grasslands and semi-evergreen vine thickets. In this study we compare plant species richness, vegetation condition and habitat complexity across eleven vegetation types. Plant species richness was determined in 500m² quadrats at 43 sites within the study area. A habitat complexity score was derived from data on stand structure (FPC of identifiable strata), cover of litter, logs, rocks etc and other biophysical attributes (e.g. density of standing stages, presence of hollows). Site condition was derived from subjective determination of disturbance (e.g. grazing, clearing, weed invasion), vegetation recruitment (density of juvenile trees) and litter cover. Plant species richness varied from 31-83 species per 500m² with significant patterns evident across vegetation types. Habitat complexity generally showed similar patterns across the vegetation types, with a significant correlation ($P < 0.001$) with species richness. However, condition was not well-related to either richness or complexity. The concept of 'condition' is becoming increasingly important in land management; however, reliably and meaningfully measuring this attribute remains a challenge.

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Habitat use by non-flying mammals and timber harvesting in the Wombat State Forest, Victoria

Silvicultural systems used in Victoria vary between forest types, along with the variety of mammal species and their habitat use. Compared to high elevation Mountain Ash forest, very little research has been conducted on fauna and habitat values in the mixed species eucalypt foothill forest of Central Victoria, where this study is conducted. The research aims to (i) assess the changes to habitat that result from harvesting; (ii) determine the variation in numbers of mammals between sites at different stages of the harvesting cycle; and, (iii) examine the use of retained habitat by mammals in and around harvested sites within the Wombat State Forest. Habitat is described and quantified using measures such as basal area, species richness and cover abundance of vegetation and ground cover. Elliott trapping, hairtubes and nestboxes determine the relative abundance or presence of small mammals, while medium to large mammals are detected using transect counts, soil plots, and cage traps. Preliminary results suggest that some mammals, particularly small ground-dwellers such as *Rattus fuscipes*, are favoured by some stages of habitat development following timber harvesting. The low numbers of arboreal marsupials detected in both logged and unlogged sites make predictions about the impact of timber harvesting on these species difficult.

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The dependence of *Bettongia penicillata* (brush-tailed bettong) on hypogean fungi in the Venus Bay Conservation Park, Eyre Peninsula.

Hypogeous (underground) macro-fungi form mycorrhizal associations with higher plants and provide an important food resource for a variety of mammals. In turn these mycophagous mammals play a vital role in the dispersal of fungi, thus acting as keystone species. The brush-tailed bettong is a mycophagous mammal that was once common in the semi-arid and arid regions of Australia. They have undergone a sharp decline in range and numbers since European settlement, and have been subject to several re-introduction programs in South Australia. This study investigated the diet of a large population of re-introduced bettongs at Venus Bay Conservation Park on the Eyre Peninsula. In particular, we were interested in looking at whether bettongs consumed fungi in this semi-arid environment, which habitats contained hypogean fungi, and the relationship between bettong foraging behavior and fungi.

Analyses of scats have so far indicated fungal consumption to be both seasonal and site dependent. Fungi were only discovered when searches were undertaken in the vicinity of bettong diggings, often in association with the roots of eucalypts. This is consistent with scientific literature that suggests the presence of macro-fungi in sandy soils is rare. Digging activity was higher in habitats where (and when) fungi were available, and was also related to the presence of bulbs and tubers during the summer-autumn period in some sites. Implications of these results will be discussed.

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How does leaf shape relate to temperature? A multi-species study of leaves in the Proteaceae.

Little is known about why plants should have such a wide range of leaf shapes. Theories predict that temperature regulation plays a role in leaf shape evolution. The rate and extent of convective heat loss decreases with increasing size. Thus, we might expect lobed leaves to cool more efficiently than entire leaves of equivalent area. Although predictive and single-species studies exist, the relationship between leaf shape and temperature is yet to be tested in a rigorous, comparative manner. We are investigating the functional significance of leaf shape in the Proteaceae, an ancient Gondwanan plant family containing species adapted to a range of climate types. We studied 41 species from 10 tribes in the Proteaceae at the Mt Annan Botanic Gardens, NSW. Species were selected to represent a wide range of leaf shapes and sizes. For each species, we measured temperature range within a leaf, temperature difference between the leaf and ambient air, water content, leaf mass per unit area, length and width. Shape complexity was assessed via two methods: dissection index and fractal dimension. Temperature range within a leaf was affected by leaf mass, area and shape. The potential adaptive significance of this relationship will be discussed.