



KEY:  talk

 poster presentation

 eligible for student prize

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The Hunter Rare Plants Database: Identification and Listing of Regionally Significant Flora for the Hunter Region, New South Wales

The Rare Plants Committee of the Hunter Region Botanic Gardens was established in response to the need for a collaborative approach to identify the regions' rare and threatened plants. The committee has developed a register of regionally significant plant species, populations and vegetation communities. This register has been compiled by reviewing published and unpublished data on significant species, together with the field knowledge of several regional botanists. Formal assessment of each of the entries on the register is undertaken through committee consensus using several assessment methods, including techniques used to identify rarity or assign threat codes. Assessment of regional significance includes consideration of the following categories: distributional limits; endemism; regional rarity; regional threat; and regional reservation level. The register will inform Regional Vegetation Committees, government departments and councils, researchers and the wider community and should contribute to better land management decisions. The list is available in preliminary format on the internet, and is being increasingly referred to by a range of studies and impact assessments. Importantly, the list highlights those taxa which warrant nomination to threatened species legislation at the state and federal levels, and hence is likely to lead to enhanced legal protection for taxa in the Hunter region.

Pennay, Christopher 

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The Costs of Vegetation Sampling on Public and Private Land

The accuracy and efficacy of any vegetation map is dependent on the adequacy and representativeness of sampling undertaken within the area mapped. With the greater proportion of most regions in South Eastern Australia being privately owned land, access to private land is imperative to the success of regional scale vegetation maps as tools for the management and conservation of native vegetation. Regional vegetation surveys traditionally avoid private lands because of perceived logistical and socio-political difficulties. The maps produced from these projects therefore have inherent biases in sampling and map reliability.

In a survey of the Greater Illawarra and Southern Highlands native vegetation region, which aimed for balanced sampling across all tenures, we quantified the organisational costs and compared the operational costs of sampling on private and public lands. The results provide an understanding about the differences in cost and effort and also provide insights into community attitudes towards the collection of Natural Resource Data.

Pollard, Thomas  

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Dry Rainforest in Tasmania: limits on its distribution

The factors influencing the distribution of dry rainforest were analysed for approximately 200 patches in the eastern half of Tasmania. Six geomorphic situations were identified, with gully situations being by far the most numerous. Most sites were found to occur on dolerite-derived soils receiving an annual rainfall of between 600 and 1300 mm. This study examined the hypothesis that the distribution of dry rainforest in Tasmania is controlled predominantly by fire. As most fire-fronts advance from a northwesterly direction in Tasmania, dry rainforest should be confined to localities that have protective topography in the northwest direction. The hypothesis was supported by the results of the study. A separate question the study aimed to answer was what factors determine the inherent characteristics of the dry rainforest pockets such as shape and size? The observed shape and size characteristics of individual patches were poorly related to the environmental and topographic

variables that this study examined. Initial field observations support the suggestion that in addition to these environmental and topographic variables, rock barriers are important in determining patch boundaries, and thus in influencing the shape and size of patches.

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Seed bank dynamics in an arid zone saline wetland

Australian arid zone wetlands are complex habitats, with extreme spatial and temporal variability that supports high biodiversity. Aquatic plant communities underpin important ecosystem functions and abundant wetland fauna populations yet in saline lakes are poorly known, with few previous studies. In unpredictable wetland habitats where there is a high probability of failure to produce seeds, aquatic plant populations survive by producing, (1) large numbers of seeds when they do reproduce, (2) seeds that can remain viable for many years in the soil, and (3) seeds with a high degree of dormancy where only a small proportion of the total germinates in any one event.

Changes in seed bank structure in relation to time and depth in the sediment of an arid zone saline lake were measured during a flooding and drying event. Both non-dormant and dormant components of the seed banks were measured, enabling the total seed bank to be described. Species richness was low and the seed bank was dominated by three species: *Lamprothamnium papulosum*, *Ruppia tuberosa* and *Lepilaena preissii*. Seed abundance and species richness varied significantly with depth (but not time), with 80% of total seed abundance and 60% of total species richness in the upper 5cm.

Possingham, Hugh



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Setting biodiversity conservation priorities at a national scale – a matter of hotspots, threats and economic efficiency

Possingham, Hugh



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Putting processes in to conservation planning

Theory and tools for conservation planning have developed rapidly over the past decade and are now impacting across the globe on the land and sea. A limitation of the theory has been our inability to include ecological and biophysical processes in to the definition of the conservation planning problem. We will look at how processes like: spatial population dynamics, flows of water, and propagation of catastrophes, can be incorporated in to the conservation planning problem. We do this in the context of posing a very general conservation planning problem.

Potts, Joanne




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A population viability analysis for a vulnerable plant: *Leonema ralstonii* (F.Muell.)

Leonema ralstonii (F.Muell.) is an open, woody shrub growing to about 2m high, and is restricted to dry, rocky habitats of southeast New South Wales. It is listed as a vulnerable plant species by the NSW Threatened Species Conservation Act, due to its limited habitat range and small population size: approximately 32,000ha occupied by 18,000 individuals across 65 distinct populations. It is now the subject of a recovery plan. Predictions of species abundance were determined from currently known records, using a two-step modelling process: firstly, species presence was modelled using logistic regression and secondly, species abundance was modelled conditional on species presence using a quasi-likelihood distribution. Predictive accuracy was assessed using a repeated cross-validation technique. A population viability analysis (PVA) for the species was developed with RAMAS_Metapop using a stage-based, matrix population model to simulate population dynamics. A sensitivity analysis investigated the implications of parameter estimation, initial abundance, and management options.

Results from the abundance modelling, the PVA and the corresponding sensitivity analyses are presented. The implications for ongoing monitoring and management of the population given these results will also be discussed.

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Conservation planning for biodiversity processes: five ways of keeping time in space

We review five broad approaches to incorporating biodiversity processes into conservation planning:

1. Incidental incorporation. Even if not explicitly considered, some processes requiring small areas are likely to continue in systems of conservation areas. Others, however, unlikely to persist.
2. Generic design criteria. Design criteria include size, shape and connectivity. Generic criteria are those applied in planning as preferences (e.g. larger is better) but without explicit parameters. Their limitation, by definition, is their lack of “tuning” to the requirements of specific processes.
3. Process-specific design criteria. Given adequate information, any of the generic design criteria can be parameterised with estimates of quantitative requirements for persistence of specific processes. Fixed spatial features associated with processes. Planners have also identified physical components of regions associated with processes of interest.
5. Moveable conservation areas. Some aspects of spatio-temporal dynamics can be protected by shifting temporary conservation designations.

Our presentation focuses on the third approach. We discuss several ways in which models of persistence requirements of selected species can be used to inform planning decisions. We also analyse data for the larger mammals in the Cape Floristic Region of South Africa to show the spatial implications of incorporating quantitative design requirements for their persistence.

Price, Jodi and John Morgan  

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Factors influencing patterns of shrub encroachment in species-rich Red Gum woodland

Native species encroachment has become an increasingly important problem for conservation management in Australia. An emerging threat to species-rich woodlands in western Victoria is shrub encroachment by *Leptospermum scoparium*, a species native to the area which has been shown to reduce species diversity. This study examined factors that may affect encroachment in Red Gum woodlands throughout the Grampians National Park in areas that have a similar management and disturbance history. Environmental factors and plant traits that might be expected to influence encroachment were examined. Results indicate significant within-site and across-site variability in shrub density and age structure. Some areas exhibited encroachment whilst others suffered from dieback and lack of ongoing recruitment. The species exhibits variability in seed production and this was found to be positively correlated with shrub density. Further, the plant is capable of reproducing vegetatively via root suckers in some sites and not in others. Whether this represents genetic control over invasion versus site-specific controls remains to be determined. This study concludes that site-specific factors affect local encroachment patterns.

Price, Richard 

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Continuing Challenges in Salinity Management: Findings of the NDSP 1993-2003

The National Dryland Salinity Program has been investing in dryland salinity research, development and extension activities since 1993. The second phase of the program was completed in June 2003, and a number of its key findings present a challenge to the current policy regimes dominant across Australia. These conclusions include: salinity costs continue to rise despite massive public investment; the nation must be much more strategic in what it invests in in future; profitable options for managing salinity are still lacking; catchment management should only be seen as one investment strategy and is highly problematic when viewed as the main strategy; caution needs to be exercised when planning and implementing large-scale perennial vegetation treatments; and capacity building is an important but second order issue in managing of dryland salinity. These conclusions will

be the focus of considerable public debate over the next few years, and this paper will discuss their implications in light of prevailing attempts to manage salinity across the nation.

Prober, Suzanne, Kevin Thiele and Ian Lunt



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Understorey restoration in grassy White Box woodlands

Sustainable management of any ecological community should include an adequate component maintained in near-original condition. In grassy White Box woodlands of the western slopes of NSW, a range of species is lost and weeds invade even under low levels of livestock grazing, thus the amount of these woodlands remaining in such condition is exceedingly low (<0.05%). We must look to restoration to enhance the amount of high quality woodland, but this is not straightforward because few remnants recover simply by removal of livestock grazing. We are using a state-and-transition approach to help understand the ecological changes that have occurred during various degradation pathways in grassy White Box woodlands, and hence guide us in restoration efforts. Replicated comparisons of topsoils across two pristine and eight degraded understorey states showed seasonally enhanced soil nitrate on all types of degraded remnants, and increased soil compaction and depletion of other nutrients on two types. Current restoration trials are targeting reduction of soil nitrate and weed seedbanks, and re-introduction of original native perennials. To date, repeated carbohydrate applications and spring burns have each successfully reduced weeds and enhanced Kangaroo Grass establishment, and carbohydrate applications have, at least temporarily, reduced soil nitrate to original levels.

Radford, Jim and Andrew Bennett



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Landscape level thresholds in habitat cover for woodland bird diversity: empirical evidence for an effect of habitat configuration.

Significant progress in conserving biodiversity could be made if thresholds in native vegetation cover, below which there is a rapid decline in species richness or abundance, could be identified. Computer simulation models and analysis of wildlife atlas data suggests that disproportionate declines in animal populations may occur when total habitat in a landscape decreases to between 10-30%. However, there is scant empirical evidence collected at the landscape level that test for ecological thresholds. In this study, woodland birds were surveyed in 24 landscapes (100km²) that were carefully selected to sample a gradient in tree cover from <2% to 60%. Thus, the unit of replication was at the landscape level, as opposed to inferring landscape attributes from a patch-based survey. There was strong evidence of a threshold, with a marked decline in species richness of woodland birds in landscapes with less than 10% tree cover. Further, there was a significant interaction between habitat configuration (aggregated versus dispersed) and tree cover on woodland bird richness. The threshold in species richness appears to occur at higher levels of tree cover in dispersed landscapes but more sophisticated tools for describing threshold relationships are needed to better understand ecological processes underlying the observed patterns.

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Inbreeding avoidance maintains gender dimorphism in *Wurmbea dioica* (Colchicaceae)

Inbreeding avoidance has been proposed as a key factor in the evolution and maintenance of separate sexes in flowering plants, but requires the controversial coexistence of high selfing rate and high inbreeding depression in hermaphrodites. Subdioecy (males, females and hermaphrodites in populations) provides an ideal system for exploring the role of inbreeding avoidance because the 3 sexual morphs can be compared. In subdioecious *W. dioica* populations, we examined selfing rates, inbreeding depression and relative performance, using open-pollinated and experimentally pollinated hermaphrodites (selfed and crossed) and females (crossed). Open hermaphrodites produced 62% fewer seeds and exhibited higher selfing rates than females (0.60 vs. 0.25). Hermaphrodite inbreeding depression was high (> 0.85) and parental inbreeding coefficients were zero, indicating that selfed progeny are unlikely to reproduce. Relative performance of open hermaphrodites to females (0.27) was sufficiently low to maintain females at observed frequencies in populations, assuming nuclear genes control male sterility. By experimentally increasing outcrossing, we improved hermaphrodite performance (0.80) to levels that should exclude females from populations. Our findings demonstrate that

intermediate selfing rates and high inbreeding depression reduce hermaphrodite fitness, and confirm the role of inbreeding avoidance in maintaining gender dimorphism in *W. dioica*.

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Ecology of yellow-bellied gliders (*Petaurus australis*) in small fragments

Decline and extinction of biodiversity worldwide can be attributed to changes in natural landscapes due to habitat loss and habitat fragmentation. Species most likely to become extinct as a result of habitat fragmentation are those that depend entirely on native vegetation, require large territories and those that exist at low densities. This project investigated aspects of habitat use, social structure and home range of the rare and threatened yellow-bellied glider (*Petaurus australis*) in small fragments, and compared this to data from groups inhabiting a large, continuous forest area. Due to specific habitat requirements, their low population densities, low breeding potential and requirements for large home ranges, yellow-bellied gliders are particularly vulnerable to habitat modification. An understanding of how gliders use fragments is important as much of the habitat through the range of the species is now fragmented to various degrees. This study will increase our understanding of how groups are organised when there are limited opportunities for dispersal and whether groups expand their home ranges in small patches to take up all the available space, which will aid in the management of the species.

Rees, Gavin N., Darren S. Baldwin, Alison Mitchell, and Garth Watson



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Acute effects of salt on sediment biogeochemistry and microbial community structure.

We examined the relationship between ecosystem processes and microbial community structure by exposing anaerobic sediments from a non salt-impacted wetland to NaCl from 0 to 10 000 EC and studied the effect on aspects of the C, N, P and Fe cycles and microbial community structure. Increased salinity caused ammonium release from sediments, decreased phosphorus in the water column, resulting in a shift in the N:P ratio in the water column. We suggest that these responses are a consequence of changing the ionic activity co-efficient of the relevant compounds and hence changing the solubility of sediment mineral phases. Increased salt did not affect carbon dioxide production in the sediment but salt inhibited methanogenesis. DNA-based methods and phospholipids analysis showed that overall microbial community structure was not affected by the salt addition, but that salt addition caused a shift within the methanogen community. Studies on acute effects of salt are providing us with a basis for ongoing work looking at chronic effects of salt on sediment biogeochemistry in aquatic ecosystems.


Reid, Allan and Peter Catling



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Predator and Critical Weight Range Species Monitoring in the South-east Forests

We monitored the distribution and abundance of exotic predators and native ground-dwelling mammals in baited (1080 poison) and unbaited eucalypt forest in south-eastern NSW. The aim was to establish if predators were being removed and kept at low abundance and whether native species were increasing in distribution and abundance following the removal of predators. After 4 years of baiting, the distribution and abundance of the red fox was substantially lower in the baited area compared to the unbaited area. This has led to an increase in the distribution and abundance of some native species in the baited area. For example critical weight range species including bandicoot, potoroo and possum. The distribution and abundance of the feral cat was markedly higher in the baited area than the unbaited area and was of concern, whilst wild dog/dingoes were scarce in both baited and unbaited areas. The study clearly indicates that by controlling exotic predators, ground-dwelling mammal populations can be influenced in a positive way. Habitat enhancement through the use of fire to improve forest structural complexity will be considered in the future to further assist native species. Feral cat reduction is urgently required perhaps through the release of a cat virus.

Reid, Julian¹, Vanessa Bailey², Justin Costelloe³, Michael Good⁴, Peter Hudson⁵, Joan Powling⁶, Janet Pritchard⁷, Jim Puckridge⁵ and Russ Shiel⁵ 

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Drivers of Aquatic Biodiversity in the Lake Eyre Basin: hydrology and other environmental factors

Compositional and abundance data on five biotic groups were gathered systematically at 56 waterbodies across five reaches on three rivers in the Lake Eyre Basin. Algae, zooplankton, macroinvertebrates, fish and waterbirds were surveyed on seven occasions over a three-year period which commenced with one-in-ten year floods (early 2000) and ended in severe drought. Extraordinary boom-bust dynamics were exhibited by components of all assemblages, although the timing of peaks in richness and abundance varied across groups. Hydrology interacts in complex ways with other key ecosystem drivers ? principally geomorphology, season and salinity ? to generate diverse patterns of richness, abundance, trophic dominance and assemblage composition through time and space. Intermittent connections and disconnections between waterbodies longitudinally, and laterally between primary channels, secondary channels and their floodplains, contribute greatly to the generation and maintenance of the shifting spatio-temporal mosaic of assemblages. At a higher level of spatial organisation, biogeography exerts strong control on assemblage compositional differences between rivers, but this filter acts differently for each group. Our observational data suggest predator-prey interactions are, at times, crucial determinants of assemblage structure and composition. Management of the few deepwater refuges in each river system will be critical to the longer-term maintenance of biodiversity in these rivers.

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Causes of Eucalypt Tree Decline in the Namoi Valley, NSW

The crown health of many floodplain and riparian eucalypts has declined in the Murray Darling Basin. A well-known example occurs in the Gunnedah area where decline has been evident since the early 1990s, chiefly affecting *Eucalyptus populnea* and *E. camaldulensis*. We developed hypotheses to explain the decline. Some 25 hypotheses for *E. populnea* and 29 hypotheses for *E. camaldulensis* were formulated, relating to water stress, insect damage, pesticides, contaminants and several other factors. These hypotheses were evaluated using existing information, key informants and information from a survey that examined tree health in relation to land use and site factors. Some hypotheses were dismissed, others were considered implausible and still others, such as dryland salinity, affected trees at a local scale but could not account for widespread tree decline. There was insufficient evidence to dismiss many of the hypotheses (11 for *E. populnea* and 18 for *E. camaldulensis*). The most likely proximate explanations for the decline of both species relate to moisture stress, insect damage, pesticide drift and (in the case of *E. camaldulensis*) grazing. The most likely ultimate causes relate to land and water use (e.g. habitat fragmentation, intensive farming, water abstraction) and drought.

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Value-adding. The relationship between native trees and populations of beneficial insects on cotton farms.

The planting of native trees, particularly ones indigenous to the region, is being encouraged in agricultural areas. Native trees add value to agricultural enterprises by sheltering and shading stock, mitigating salinity damage, reducing erosion from wind and water, acting as spray-drift barriers and by providing resources and shelter for native biota. In this presentation we discuss the patterns of abundance of generalist insect predators on native, crop and weed plant species on cotton farms in northern NSW. We have found that several species of common generalist insect predators are more abundant on native tree species than other vegetation types. This suggests that maintaining native trees on-farm provides resources that will help to maintain populations of predatory

insects. Other studies have found that maintaining populations of beneficial insects (including generalist predators) on-farm can increase cotton farmers' profit margins, so by including factors that help to maintain beneficial insects might be of financial advantage to cotton farmers. This adds another aspect to the value of native vegetation in cotton-growing areas and provides an incentive for land-owners to retain and plant native plant species.

Renshaw, Adrian and Shelley Burgin



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Banksias are like sunflowers in 3-D

The *Banksia* inflorescence is composed of two flowers subtended by two floral and one common bract (the unit inflorescence). Multiples of unit inflorescences are arranged on and around a central woody axis to form three line patterns; vertical, and both sinistral and dextral spirals (George, 1981). Other than general reference to flowers forming vertical rows George's above brief description has been the most comprehensive in terms of arrangement of unit inflorescences. The vegetative and reproductive phyllotaxy of four *Banksia* species with contrasting life histories were compared. Leaf phyllotaxy was highly variable and differed between and within species. Inflorescence phyllotaxy varied only slightly within specific developmental constraints. Unit inflorescences formed quadrilaterals (the basic unit of arrangement) and these were arranged in four line patterns corresponding to sinistral and dextral spirals (parastichies (m and n)), vertical rows (orthostichies) and horizontal rows. Horizontal rows were either the result of whorled arrangements or spiral arrangements with low pitch screws that ran in either anti- or clockwise directions. When in whorled multijugate arrangements the number of parastichies were equal ($m/n = 1$) and always totalled (m+n) to the even numbers of orthostichies. Spiral arrangements of varying pitch resulted in a twisting of orthostichies which was proportional to and opposed to the pitch and chirality of the genetic spiral. The sum of the parastichies (m+n) in spiral arrangements where $J = 1$ always totalled to the number of orthostichies. Relationships between the line patterns, variation within and between the species and implications of the arrangements are discussed.

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Grassy vegetation: the effects of agricultural management on plant species richness

The effects of agricultural production on plant diversity need to be considered in the management and conservation of grassy vegetation on-farm. The focus of this 3-year study was to determine how grassy vegetation is affected by grazing, fertilizer and cultivation management. Sampling of plant species incidence at 373 sites (6 x 5m) within a 60 km radius of Armidale, NSW, was completed over two growing seasons in 2001 and 2002. Management history and environmental variables regarding each site were also collected. Management variables are often confounded, therefore interpretation of their influence on species richness must be considered in respect to other management variables. This was overcome by the large number of samples and stratified sampling, which enabled comparisons controlling for other management influences. Findings indicate that seldom-grazed sites had higher native species richness compared to grazed sites. In at least some situations planned rest areas had lower native species richness than comparable continuously grazed sites. Increased fertilizer application resulted in reduced native species richness, as did recency of cultivation, although the results are dependent on lithology.

Rhodes, Monika and Grant Wardell-Johnson



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Tree roost characteristics determine use by *Tadarida australis* (Microchiroptera, Molossidae) in suburban Brisbane

Many native vertebrate species depend on tree hollows for shelter. In Brisbane many of the hollow-dependent vertebrates still persist in a suburban environment, yet little is known about their roost selection. *Tadarida australis* (White-striped Freetail-Bat) is one of the largest insectivorous bat species found in Brisbane. With its large, narrow wings it is specialised to forage in open areas, usually in high altitudes. A suburban setting will probably suit this bat species. To understand if roost availability is the limiting factor for the survival of this microchiroptera, 34 roost trees were compared with 170 control trees with similar diameter, height, tree

senescence and land tenure. Various bio-physical tree and vegetation attributes have been measured and analysed with multivariate analyses and additionally compared with mean values of attributes. The results showed that roost trees used by *T. australis* had significantly higher numbers of hollows in trunk and branches, were more likely to contain a big cavity inside the tree trunk, and harboured significantly more hollow-using species than control trees of the same size (height, diameter) and tree condition.

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Tree roost characteristics determine use by *Tadarida australis* (Microchiroptera, Molossidae) in suburban Brisbane

Many native vertebrates depend on tree hollows for shelter, and some persist in urban environments. However, for these species, little is known of their roost selection. *Tadarida australis* (White-striped Freetail-Bat) is one of the largest insectivorous bat species found in Brisbane. With its large, narrow wings it is specialised to forage in open areas, usually in high altitudes. Therefore, a suburban setting will probably suit this bat species. To understand if roost availability is the limiting factor for the survival of this species, 34 roost trees were compared with 170 control trees with similar diameter, height, tree senescence: two control trees on each roost site and three control trees on 34 replicate sites with similar land tenure and tree attributes. Various bio-physical tree and vegetation attributes have been measured and analysed with multivariate and univariate procedures. We found that roost trees used by *T. australis* had significantly higher numbers of hollows in the trunk and branches, were more likely to contain a big cavity inside the tree trunk. These trees also harboured significantly more hollow-using animals than control trees of the same size (height, diameter) and tree condition. Our data showed that roost availability is the limiting factor for *T. australis*. Unfortunately many of these roost trees are in danger of being removed in the future with ongoing urbanisation and health and safety issues.

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Australian peat miners: burrowing crayfish in peatlands

Freshwater crayfish are generally associated with open waters, or swamps, but a significant number of species create burrows away from surface waters. Because of their requirement for calcium to strengthen their exoskeleton, crayfish are not common in acid waters, but in Australia, particularly in the sedgeland of western Tasmania, burrowing crayfish are widespread and abundant (<1m² in Tasmanian peatlands), excavating burrows in ion-poor, acid peats. This paper describes the Australian peat-dwelling crayfish fauna and discusses their effects as ecosystem engineers. Root growth and microbial activity are enhanced at the burrow walls and for 5-10mm into the soil, but experiments to eliminate or create burrows produced ambiguous effects on plant growth. The burrows support an assemblage of aquatic invertebrates from various crustacean and insect groups.

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Conservation planning at the local government level: the Wyong Shire Conservation Strategy

Systematic conservation planning in New South Wales has thus far been largely confined to Federal and State Government processes such as the Regional Forest Agreements. A limitation of these processes is that they have been restricted to public tenure, whereas depleted and threatened vegetation types and species in New South Wales occur largely on private land. Local government has a significant role to play in the conservation of the State's biodiversity through its potential to constrain important threatening processes on private tenure. This is particularly pertinent in areas facing unprecedented levels of development pressure, such as Wyong Shire on the central coast of New South Wales. We have recently applied systematic planning methods, initially developed for regional assessments, to the design of a local environmental plan for Wyong Shire. We describe the kinds of biodiversity features for which data were available; the derivation of conservation targets for these features; the use of the C-Plan conservation planning system to lay out options for new conservation areas; and the resolution of these options by a group of Shire planners and biodiversity experts. We also outline the potential for

systematic conservation planning methods to play a wider role in local government in New South Wales and interstate.

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Sexual segregation in a tropical macropod, the antilopine wallaroo (*Macropus antilopinus*)

Sexual segregation is a behavioural phenomenon in which males and females separate into single sex groups during the non-breeding season. This behaviour is common in many ungulate species, and several hypotheses have been proposed to explain its ecological and evolutionary basis. Sexual segregation is less common in marsupial species and has received little research attention. The antilopine wallaroo (*Macropus antilopinus*) is a large, tropical macropod and regularly displays this behaviour. This paper documents the occurrence and observed rates of sexual segregation in *M. antilopinus*, and suggests which hypotheses may explain the behaviour. Continued study of sexual segregation in *M. antilopinus* will test the validity of these hypotheses. This study of sexual segregation in *M. antilopinus* is the first to be conducted on a marsupial restricted entirely to the tropics, therefore providing a vital comparison with research focussed on sexually segregating species in temperate areas.

Roth, Guy



Australian Cotton Cooperative Research Centre, PO Box 59, Narrabri, NSW, 2390

Integration of native biodiversity research in the Australian Cotton Industry

The journey to preserve or enhance biodiversity needs to begin with simple achievable goals, and become more complex and consolidated over time. Scientists have raised awareness of the importance of biodiversity, but there are more questions than answers when it comes to practical and local information for regional areas. Another gap to be bridged are the expectations of policy documents and the lack of biodiversity information 'down on the farm'. Cost effective techniques are needed to recognize and measure on-farm biodiversity using robust indicators that, where possible, capture the hearts and minds of landholders. Cotton farms generally occupy less than 5% of catchments. This economically productive land could also be highly productive in biodiversity outcomes. On many cotton farms, biodiversity could be conserved or enhanced on the 20-30% of land not used for cotton production. Recent industry investments include a review of biodiversity research in cotton growing areas, the benefits of native vegetation as habitat for predators of crop pests, a biodiversity audit of the Moree Shire, and projects focusing on ecosystem services. The cotton industry will invest further in biodiversity research, with outcomes implemented by growers through the industry's Best Management Practices Program (an environmental management system).

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Population dynamics of the brush-tailed rock-wallaby in the Hunter Valley, NSW

Trapping was undertaken in summer and winter between 1997-2001, at two brush-tailed rock-wallaby colonies in the Hunter Valley/Hawkesbury region of NSW. This study was part of a larger program examining the effect of fox control (1080 baiting) on wallaby abundance. A total of 20 wallabies were trapped at the Broke (baited) colony (10F:10M) and 35 at the Watagan Mountains (unbaited) colony (17F:18M). Demographic data collected and analysed included: age class, sex ratio and reproductive rates, while recruitment and survivorship estimates were generated from models. Sex ratios at both colonies changed from male bias at the beginning of the study to being biased towards females at the end. Concurrent monitoring of pellet plots at these colonies showed a decrease in pellet abundance throughout the study, suggesting declining colony size. Breeding was evident at both colonies, and appears to be continuous in this area, with births recorded in 9 months of the year. This study provides detailed population data for brush-tailed rock-wallabies and contributes to the broader question of managing this vulnerable species.

Rumpff, Libby



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The nature of the edaphic influence on vegetation succession in Tasmania

Transitions between buttongrass moorlands and forest exist over a wide range of environmental conditions in Tasmania, including different climatic, topographic, edaphic and geological zones. It is thought that rainforest is the climatic climax community in high rainfall areas of Tasmania, yet the current overall distribution is a mosaic of rainforest, mixed forest, eucalypt forest and buttongrass moorland. Gilbert (1959) and Jackson (1965; 1968) claimed that without disturbance by fire, succession should occur from open vegetation to a climax of temperate rainforest. Fire disrupts this process so that sclerophyll and open moorland communities will often occupy areas that are better suited to rainforest. This research examines Jackson's (1968) idea that soil fertility of buttongrass moorlands is lower than forest soils (due to leaching from frequent burning and the lower nutrient content of the moorland vegetation), and that this causes a delay in succession from moorland to forest. The aim of this research was to investigate the nature of the edaphic influence on moorland-forest boundaries in Tasmania, to determine whether the nutrient status of organic soils varies consistently between forest and moorland, and to discuss the implications of my results in terms of boundary stability.

Rymer, Paul



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Does the level of genetic variation and structuring influence the distribution and abundance of *Persoonias* (Proteaceae)?

A comparative approach provides a powerful means of understanding the causes of rarity in groups where some species are widespread and abundant while close relatives are spatially restricted and in decline. To explore the possibility that rarity is a result of differences in underlying genetic diversity and hence the capacity to respond to environmental change, I carefully selected two pairs of fire sensitive *Persoonia* taxa (widespread versus restricted): *P. mollis* subsp. *nectens* versus *P. mollis* subsp. *maxima* and *P. lanceolata* versus *P. glaucescens*. I genotyped 20-40 plants randomly selected from 4 populations across the range of each taxa using 3 AFLP primer pairs. This revealed approximately 200 polymorphic fragments and high levels of polymorphisms within and between populations of all taxa. I will present an analysis of the data to address the following questions: Do common and rare taxa differ in the amount of genetic variation found within populations? and What is the level of genetic structuring within and among populations? These data will be combined with ecological data collected on pollen and seed dispersal to provide important information on the level of gene flow within and between populations.

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Why am I rare? Because I can't have sex with myself OR I can't find enough mates?

To gain insights into the causes of rarity we conducted a comparative experiment between closely related common and rare species. I selected two pairs of *Persoonia* taxa (widespread vs. restricted), *P. mollis* subsp. *nectens* vs. subsp. *maxima* and *P. lanceolata* vs. *P. glaucescens*. Controlled hand pollinations indicated that both common and rare taxa are self-incompatible, preferring out-crossing at two locations. The common species had similar levels of fruit set in the open (0.38 and 0.41) and cross treatments (0.25 and 0.31). However the level of fruit set in the rare species was significantly less in the open (0.18 and 0.17) compared with the cross treatment (0.43 and 0.40). The European honeybee (*Apis mellifera*) was the most common floral visitor to both common and rare taxa. Native bees (*Leioproctus* sp.) were observed 3 to 10 times less frequently than the honeybees. There were significantly more native bees observed on the common taxa, which visited fewer flowers and moved greater distances between plants than honeybees encouraging out-crossing events. Even though honeybees were the most frequent floral visitors they maybe inefficient pollinators compared with native bees.

Salter, Jacqueline¹, Kay Morris¹, Paul Bailey¹ and Paul Boon²



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Interactive effects of salinity and water regime on the performance of *Melaleuca ericifolia* Smith, the swamp paperbark.

The likely interactive effect of increasing salinity and altered water regimes on wetland vegetation is poorly quantified. We hypothesised that the growth and survivorship of swamp paperbark (*Melaleuca ericifolia*) seedlings are compromised by increasing salinity (1.3 g/L, 27g/L, 33 g /L) and water level (exposed, 10 cm below sediment; waterlogged, at sediment surface; submerged, 7cm above initial plant height). Moreover, we anticipated a strong interaction between salinity and flooding depth, with tolerance to flooding being reduced as salinity increased. As predicted, responses to flooding depth were altered by higher salinities. All seedlings survived at 1.3 g /L regardless of flooding depth. In contrast, at 33 g/L less than 20% of plants survived in the submerged or saturated treatments, whilst > 87% of plants survived in the exposed treatment. The findings indicate that exposure of surface sediment benefits the growth of *M. ericifolia* seedlings and becomes more critical as salinities increase.

Sanderson, Brian and Kobayashi, Tsuyoshi



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Conflicting Plankton Models

The 'carrying capacity' formulation of the logistic equation is argued to be inappropriate for describing resource limitation of phytoplankton populations. Problems, such as the 'enrichment paradox' that have been studied using the 'carrying capacity' form of the logistic dynamic are argued to be more appropriately studied using formulations that describe mechanisms by which a source flux of resource is transformed between trophic levels. A variety of different formulations of resource limitation are considered in the following work and their relationships to recent formulations of Droop nutrient kinetics are derived. The 'enrichment paradox' is analysed in terms of grazing mechanisms that cause instability when phytoplankton growth is not resource limited. Given that resource limitation stabilizes an otherwise unstable system it is important to ensure that the former mechanism is correctly modeled. Relationships between commonly used models are examined with a view to bridging gaps, exposing weakness, and promoting experimental measurements that are useful for plankton modelling. Making the continuum assumption imposes constraints when using Droop nutrient dynamics to model heterogeneous environments.

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The distribution of small mammals in relation to snow cover in Kosciuszko National Park: a landscape approach.

Kosciuszko National Park contains a large area of unique alpine and subalpine ecosystems and is one of 20 of the 440 UNESCO Biosphere Reserves that have been included in a pilot program to monitor the effects of global warming. With this threat and increasing pressure from winter recreation activities, it is important that we better understand the role of snow in these ecosystems. Small mammals including the common bush rat, *Rattus fuscipes*, the dusky antechinus, *Antechinus swainsonii*, and the threatened broad-toothed rat, *Mastacomys fuscus*, remain active beneath the snow throughout the winter. A few studies have attempted to consider the role of snow in their ecology, but have been limited to small scales or have used indirect methods. In this paper I present part of my PhD research in which I investigated the distribution of small mammals using a newly developed hair tube technique. This technique permitted sampling beneath the snow at a scale that considered the range of snow conditions occurring in the subalpine zone and across a number of different habitats and topographic positions. Small mammal presence is negatively correlated with snow cover, but where they do occur, habitat structure, in particular, shrubs and boulders, play an important role in the development of the subnivean space in which they over-winter. Subnivean space development is also influenced by other factors both human induced and natural. Comment will be made about the immediate and likely longer term effects of the 2003 fires on subnivean space development and the implications this may have for small mammals.

Scarff, Fiona¹ and Stuart Bradley²



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Identifying conservation priorities – the fusewire species concept

When a fuse blows in an electrical circuit, the circuit is broken and electricity ceases to flow. In the same way the loss of key species can cause important ecosystem functions to be lost, so that flow of material, energy, or information is disrupted. This battery-powered poster presents data from an analysis of a forest avifauna to illustrate how this analogy can help inform the way we partition scant conservation resources. Observations on ecosystem architecture, summarised in the layout of a circuit, indicate which species occupy pivotal 'fusewire' positions, warranting priority attention.

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Ecosystem robustness in the face of species loss: data from a forest avifauna

Sometimes the loss of a single species is sufficient to cause fundamental changes in an ecosystem. Such species make some unique and pivotal contribution to the ecosystem's natural processes. A method for determining the robustness of ecosystems to such local extinctions is suggested. A computer model was used to scan ecological data sets for instances of ecological uniqueness. The output also suggest priority taxa for research and management attention. Data from an analysis of a forest avifauna are presented.

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Life on the edge – habitat requirements of the barking owl in south-eastern Australia.

The scarcity of Barking Owls *Ninox connivens* in southern Australia is proving an enigma to conservationists. The species' general habitat of dry woodland and forest combined with its catholic diet of medium-sized mammals and birds, including common species like rosellas and rabbits, would suggest a relatively abundant distribution is possible, yet the owls are rare and sparsely recorded. As a species willing to use forest edges, Barking Owls would not seem as hampered by recent forest clearing and fragmentation as are many Australian owls, yet it is one of the rarest, and continuing to decline throughout its range. Clearly, an important management issue is to determine the habitat requirements of this species, and how this corresponds with available habitat left within their distributional range.

Data on home range have been collected for 13 owls (7 pairs) in north-eastern Victoria using whole-night radio-tracking observations. The ranges of these owl pairs spanned 550—3000 ha, composed of equal proportions of closed woodland and open pasture, with all ranges abutting large stands (>10,000 ha) of continuous woodland. These data formed the basis for calculation of characteristic-ranges. These ranges were then applied to the 20 owl pairs residing in the area and used to develop a regional scale model of habitat requirements. Model validation consisted of playback surveys at predicted owl and non-owl sites. Playback surveys are known to be highly effective for this species with a small probability of type II error. The accuracy of these predictions compares favourably with similar studies of better known Australian owls; however greater resolution could be obtained with more information about seasonal effects, diet-switching and large-scale movement patterns such as those used in Northern Hemisphere equivalents.

These models provide a valuable asset to management of this endangered species in the southeastern portion of its range. Furthermore, these models may also be applicable elsewhere, and may assist in species recovery efforts at the national level.

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Re-establishing *Eucalyptus* forest in south-eastern Tasmania.

The slow natural re-establishment of native vegetation on cleared land has led to a growing interest in developing techniques that accelerate recovery and restore biodiversity. One such technique is the reintroduction of species that might otherwise recolonise a site slowly. Since the goal in the long term is not revegetation alone

but to restore ecological functions and natural communities to their biogeographical ranges, it is important to identify the competitive abilities and natural distribution of the individual species which are to be reintroduced. To provide a basis for re-establishing sclerophyll forest on agricultural land in south-eastern Tasmania, a field experiment was conducted to compare weed control treatments on three weed communities and the consequent effect on the seedling survival and growth of four *Eucalyptus* species and *Allocasuarina littoralis*. Analysis of data collected two years after the seedlings were planted indicate that soil properties and individual species distribution range had a greater influence on seedling survival and growth than competition from exotic weeds.

Schell, Christopher B. and Shelley Burgin



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It really sucks! Observations of frog egg predation by leeches

Limnodynastes tasmaniensis is active and able to breed year-around and have relatively large clutches (174-1550 eggs). These clutches are deposited within foam nests which provide protection from many egg predators (eg. fish, insects and birds). However, we observed that the leech, *Bassianobdella fusca*, which is common throughout much of New South Wales, has the ability to circumvent these defences and consume *L. tasmaniensis* eggs within the foam nest. We observed *Bassianobdella fusca* engulfing whole eggs within the foam nest. All previous observations of feeding of this leech have indicated that it is a 'blood sucker'. It is known to feed on other leeches, and a related species in Queensland feeds on earthworms. There is apparently no previous published data on predation by *B. fusca* on frog eggs. In this presentation we provide observations on the potential impact of these leeches on *L. tasmaniensis*.

Scherrer, Pascal and Catherine Pickering



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Recovery of alpine vegetation from grazing and drought as shown by data from long-term photoquadrats in Kosciuszko National Park.

Recovery of vegetation from former livestock grazing, as well as from a drought in the 1960s, were examined over a period of 43 years using data from permanent photoquadrats established in 1959 in tall alpine herbfield. Slides of thirty 0.6 × 0.9 m quadrats taken in 1959, 1964, 1968, 1978 and 2001 were analysed visually using a 130 point grid to measure vegetation cover and species diversity. For the 12 quadrats located near Mt Gungartan, where grazing had ceased the year before the study commenced, there was a pattern of increasing vegetation cover as bare areas were colonized by native cudweeds and the naturalized herbs *Acetosella vulgaris*. Native grasses and other herbs, or the lateral expansion of existing shrubs then replaced these species. For the 18 quadrats near Mt Kosciuszko, vegetation cover remained high (around 94%) in all years except 1968, at the end of the six-year drought. This drought caused an increase in litter as graminoids cover declined in both locations. Initially herb cover increased, possible due to decreased competition from graminoids and a nutrient spike from decaying litter, but as the drought became more severe, they too declined. Graminoid cover reached pre-drought levels by 1978. Herb cover declined with time after peaking during the 1960s drought.

Seed, Leahwyn, Glenda Vaughton and Mike Ramsey



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Hybridisation in bladder ketmia weeds (*Hibiscus trionum*, Malvaceae)

Hybridisation, particularly in plants, has been recognised as a potentially creative evolutionary process. In weeds, introgressive hybridisation between introduced and native species can result in various forms of hybrids that are more vigorous and potentially more invasive than parental types. This project examines hybridisation between two *Hibiscus* taxa that are major annual weeds of cultivated and disturbed sites. These taxa are sympatric over part of their range in central NSW and southern QLD. We investigated components of fitness in introduced *H. trionum* var. *trionum*, native *H. trionum* var. *vesicarius*, and their reciprocal F1 hybrids under glasshouse conditions. We compared the four cross types and found that seed set was significantly less for the reciprocal crosses compared with the within variety crosses. Seed germination did not differ, although early seedling growth of hybrids has been more vigorous. We will also examine vegetative growth at later stages and sexual reproduction. The results will be discussed in terms of the potential of the hybrids as weeds and the genetic erosion of the native taxa.

Seddon, Julian, Sue Briggs and Stuart Doyle



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Bird species richness in remnant woodlands in the Little River catchment, NSW: The importance of considering vegetation communities when defining ecological thresholds

Species-area relationships are frequently used to define ecological thresholds that inform management recommendations for conservation activities. For example many studies in agricultural landscapes in Australia have used the habitat requirements of birds to define minimum remnant sizes for prioritising conservation activities and providing guidelines for re-vegetation. To date, many of these management recommendations have not considered habitat type when defining minimum remnant size.

We present recent survey result from the Little River catchment in central NSW that demonstrate the importance of vegetation communities in influencing the relationship between bird species richness and remnant size. Even small riparian remnants had high bird species richness but richness did not increase strongly with area of remnant. In contrast, small remnants of box woodland communities had moderate richness of woodland birds but richness increased rapidly with remnant size. Care should be taken when using these relationships as thresholds or cut-offs in management recommendations. Management activities that seek to protect birds in riparian remnants should include even very small remnants. Management actions seeking to conserve birds in box woodland should first be targeted at protecting medium and large box woodland remnants, while encouraging enlargement of small box woodland remnants through regeneration and active planting.

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Sphagnum-dominated peatlands in the central highlands of Victoria: floristic patterns across the region and the factors responsible

The central highlands region is dominated by tall wet sclerophyll forests. Wet heathlands containing Sphagnum communities are also present in headwater streams that drain the region. Gentle slopes, impeded drainage, high annual precipitation (>1500mm), and cold-air drainage inverted tree-lines create conditions appropriate for Sphagnum-dominated plant communities and peat formation. Variations in floristic composition within the region are due to altitude-related factors, aspect effects, slope and degree of canopy cover. Subalpine sites exhibit generally similar within-site composition and affinities to subalpine areas further east. Montane sites are much more variable and appear to be, in part, a consequence of time since last fire. Composition ranges from canopy free *Carex appressa*-*Richea victoriana* sites to more enclosed *Nothofagus cunninghamii* dominated sites. Floristic patterns across the entire region have been shaped by landscape scale fires and spatial variation in their intensity. It is likely that *Nothofagus cunninghamii* and *Leptospermum grandifolium* presence was greater within some sites prior to fires of the early 20th century. The condition of peatlands in the central highlands is generally better than similar systems in subalpine and alpine areas of the north-east. Introduced species are rare, erosion minimal and peat depths often exceed two metres.

Sharma, Ajay and Ashwath, Nanjappa



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Ground flora composition can be used as an 'alert system' in effluent irrigation

Floristic composition of the groundcover vegetation varies with the soil moisture, salinity, compaction, grazing and other factors. The reliance of this composition on soil moisture can be used as a 'tool' to regulate irrigation management in effluent irrigation systems. A field trial was established at Yeppoon (Qld, Australia) to maximize effluent use via designing cropping systems comprising of trees, bamboo and grasses.

The floristic composition of the ground cover was monitored in winter and summer in effluent irrigated plantation through using 46 and nine one-meter quadrats inside and outside the plantation, respectively. The number of species and the number of individuals of each species were counted. Total biomass yields were weighed. The ground flora species-mix and the ratio of sedges to grasses and forbs were then related to soil moisture and chemistry. The results indicated good relationships between soil moisture changes and the ground cover species compositions as well as the ratio between sedges and grasses. Generally, sedges were more abundant in high moisture zones than in low moisture zone, and grasses were dominant in dryer zones. In contrast, the broad-leaved species were dominant in medium moisture zones. The species such as *Sporobolous*, *Cyperus*, and *Crotolaria* spp. were abundant in high soil moisture zones and the species *Chloris* and *Setaria* were common in dry zones.

Since excessive effluent irrigation can deteriorate soil properties and regular monitoring of soil moisture as well as chemistry could be very expensive, the composition of ground flora can be relied upon for monitoring irrigation and related associated soil degradation.

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The development of a regional habitat significance assessment model

A model that simulates broad habitat significance across a region was developed in response to a request from the Wyndham City Council, Victoria. The model uses buffers around features, such as the presence of remnant vegetation, proximity to waterways, pest plants and animals and rare or threatened species, to create a matrix of conservation significance across the landscape. The Analytic Hierarchy Process was used to develop a weighted hierarchy of criteria that contribute to habitat significance. The data inputs to these criteria were then ranked to give an indication of their relative importance. The nature of the hierarchy is flexible, allowing the model to be adjusted, if needed, when used at different locations in the future. ArcView 3.2 Model Builder was used to incorporate this hierarchy into a GIS environment, allowing the outputs to be displayed spatially. The output maps were produced at 1:100,000 scale and give an indication of the range of habitat significance across the Local Government area and the factors that influence this distribution. The model was developed in collaboration between State Chemistry Laboratory (Department of Primary Industries) and Arthur Rylah Institute (Department of Sustainability and Environment), Victoria.

Silberbauer, Letitia^{1,2}, Nick Reid^{1,2} and Gabrielle O'Shea¹ 

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Biodiversity and the Australian Cotton industry: a Literature Review

We undertook a literature review for the Cotton Research & Development (R&D) Corporation to describe the biodiversity of cotton growing regions and its role in cotton production, identify research gaps and opportunities, and suggest ways in which the industry could embrace a biodiversity stewardship role. Although cotton farms occupy a small percentage of inland eastern Australia, they occupy a disproportionate amount of the most productive environments. Remnant floodplain and riparian ecosystems on cotton farms are usually threatened and poorly protected in conservation reserves. Biodiversity underpins 10 ecosystem services that are essential inputs to irrigated cotton production, and cotton research has demonstrated the utility of natural pest control in reducing inputs (insecticides) and increasing profits. Agricultural R&D is responsible for most of our knowledge of the biodiversity of terrestrial invertebrates and soil biota in intensive farming zones, and further R&D investment should generate attractive returns. The industry needs to invest further in the impacts of pesticide drift, surface and ground water abstraction, deep drainage, greenhouse gas emissions and irrigation scheduling of river flows, in order to clarify its environmental duty of care. Some cotton growers are already undertaking a wide range of stewardship activities to enhance on and off-farm biodiversity.

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Threshold or continuum: an experimental investigation into the effects of secondary salinity on benthic community dominance

Secondary salinisation can lead to the loss of the submerged plant community from aquatic ecosystems. Understanding the mechanisms behind this loss has important implications for the restoration of salinised ecosystems. This paper describes experimental investigations into the effects of increasing salinity on the germination of two aquatic plant species (*Ruppia* sp. and *Lamprothamnium papulosum*) from natural wetland sediments. Increased salinity generally resulted in a decrease in plant number and size, although growth was slightly stimulated at low salinities. No plants germinated at greater than 45 ppt salinity. Increased salinity also inhibited reproduction. These results go some way towards explaining a mechanism for the switch from aquatic plant dominance to benthic microbial community dominance in secondarily salinised aquatic ecosystems. Future

experiments will explore the synergies between salt concentration and other physico-chemical factors in an attempt to demonstrate how thresholds for community change may be dynamic.

Simpson, Christopher, Michael Bedward and Karen Ross



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How do I know if my simulation model is any good?

Land management and conservation agencies use simulation models of species population dynamics, habitat distribution, disturbance processes and land use change to provide input into local management, regional planning and higher level policy development. These models are often the result of very lengthy and costly development efforts. Our experience is that the higher the cost, the greater the degree of importance (or at least hope) placed on the modelling results, while the chance that alternative models are compared or that any single model is validated against real world data diminishes. In this poster we explore simulation model validation in the context of research on conservation planning in the New South Wales sheep-wheat belt.

Simpson, Simone



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***Thesium australe*, a vehicle of discovery: travelling the road to interpreting plant fitness in a fragmented landscape.**

Habitat fragmentation and decreasing population sizes are often correlated with decreases in plant fitness. But are reductions in plant fitness intrinsic to small population size or should we be addressing other aspects inherent to the population itself? Is reduction in fitness a reflection of density-dependent factors? *Thesium australe* (Santalaceae) is a rare hemiparasite endemic to Australia. Its historical range, which has undergone significant contraction since European settlement, was from southeast Queensland through to Tasmania (where it has gone extinct). The species currently perseveres in disjunct mainland populations. The contemporary distribution of *T. australe* therefore provides ideal circumstances for the investigation of parameters that contribute to reduction in fitness as a consequence of habitat fragmentation and that arise when populations become small and isolated. Additionally, the plant's reproductive ecology, habitat quality, host specificity and attachment, demographics and allozyme variation within and between populations, will be examined. The outcomes from this work will reassess current information on the parameters that influence fitness in small populations. In addition, the conservation ecology of *T. australe* will be evaluated and the results will contribute to its management.

Slee, Conrad and Eddie van Etten



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Timber harvesting as a factor influencing cryptophyte abundance and composition in the northern Jarrah forest of Western Australia.

The northern Jarrah forest of south-west Western Australia is a unique ecosystem with considerable biodiversity. There are many species of perennial plants that regenerate from buds below soil level (cryptophytes) that are rare or restricted in distribution. There is little known about the effects of timber harvesting on cryptophytes. Opening up of the forest canopy by timber harvesting increases light penetration, drying of organic litter, reduces available soil moisture and increases fire intensity, leading to further losses of organic matter. The removal of trees also reduces the input of new organic material to the soil environment. Cryptophytes are likely to be the class of plants most influenced by these changes in the forest environment. Cryptophytes were investigated to see whether abundance and diversity were affected due to timber harvesting, while controlling for other environmental variation. The distribution of cryptophytes appears to be positively related to the depth of the litter, percentage of soil organic matter, the size and abundance of decaying logs, and presence of large trees. Some niche environments required by cryptophytes seem to be reduced by timber harvesting, which is a factor that must be considered for improved management of sensitive plant species in the Jarrah forest ecosystem.

Smith, Geoff¹ and Doland Nichols²



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Rainforest stand dynamics and diversity was related to disturbance intensity over 35 years.

Eight silvicultural treatments were applied to subtropical rainforest in northern NSW in the mid-1960s. The treatments were typical of systems applied in tropical countries around the world. The basal area remaining after logging in the treated plots ranged from 58 to 12 m²ha⁻¹. Tree growth in the plots and ingrowth into the 10 cm dbh category was measured over 35 years. The time taken for patterns of diversity, mortality, recruitment and growth to return to levels similar to the unlogged controls was related to the intensity of logging. Recruitment generally increased as the retained basal area decreased. Post logging mortality increased as retained basal area decreased except in the two heaviest treatments. In the less intense treatments basal area, basal area increment, species diversity, mortality and recruitment had returned to similar levels to the unlogged plots after 35 years. Management implications are discussed.

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Monitoring attributes for hollow-nesting birds of production forests

Managing 'biodiversity' in production forests will among others also involve developing monitoring programs. This is an enormous task as programs need to be scientifically rigorous, meet management objectives, costs and reporting requirements. We selected hollow-bearing trees as an appropriate and measurable attribute of an important habitat for 'forest-dependent' biodiversity. We then ask the question what attribute types describing habitat structure, hollow-bearing trees, tree-hollows and forest management histories predicted the abundances of hollow-nesting birds and the number that nested in dry sclerophyll production forests. Data were collected on species abundance, the number of nesters, habitat structure, hollow-bearing trees and tree-hollows at 36 sites with known logging and fire histories. Sixteen obligate hollow nesters that used either small (<10 cm diameter) or large (>18 cm diameter) tree hollows were recorded. Results suggest that a combination of management history attributes habitat structural attributes and specific attributes of hollow-bearing nest trees were appropriate and measurable attributes for monitoring changes in the breeding habitat of forest-dependent bird species. Monitoring the density and basal area of hollow-bearing nest trees alone would be inadequate as these attributes accounted for little independent variation in species abundances. Implications for forest management are presented.

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Comparison of connectivity between North America and Australia

In many ways, Australia and North America are characterised by different ecologies and land use histories. These influence the kinds of management and planning needed for the long-term conservation of their biodiversity. There are of course the obvious taxonomic differences due to the continents' isolation from each other over geological time scales. Less commonly appreciated is the difference in persistence of large predators and their role as trophic regulators. Another critical, but poorly quantified factor, is the space/time variability in climatically-driven primary production, how these photosynthates are allocated to different plant tissues, and the implications for higher order trophic levels and food chains. Among the latter is the need to maintain the potential for regional/continental scale movements during and after periodic droughts in Australia. In this paper we compare the ecologies of the Australian and North American in terms of these factors and consider their implications for large scale, long term landscape permeability for ecological processes, including migrating fauna.

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Integrating biodiversity conservation and agricultural production in a degraded landscape

Property planning, and some lateral thinking, coupled with innovative management are working well to enhance conservation and production values of our mixed enterprise 450 ha property 35 km south of Tamworth. We replaced the traditional management of set stocking and repeated clearing with holistic grazing, and managing regrowth for timber production, grazing and biodiversity conservation. Rotational grazing maximises production from native and exotic pastures and encourages regeneration of native plants. Areas of like conservation value have been zoned and are managed according to the objectives of each zone. Adaptive management will respond to pending threats, such as exotic weed invasion. Small areas are excluded from grazing to encourage regeneration of significant wildlife food sources and provide drought refuge habitat. Artificial habitats are used to supplement habitats and encourage fauna diversity in regeneration areas. Logs and litter are retained in areas zoned medium to high conservation value. Woodlots and corridors of trees and shrubs have been planted to provide shelter for stock and habitat for native fauna. Dams have been fenced to provide aquatic refuges for frogs and waterbirds and improve water quality. Stock have been excluded from access to the river. Fencing timber and firewood come from sustainable use of immature trees; hollow trees are protected to provide habitat. Considering biodiversity conservation by working to a simple property plan has not been an expensive exercise. Not only is it affordable, but it will provide significant timber income in the future and will improve the longterm sustainability of land.

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Historical land-use impacts on roadside vegetation condition in woodlands of southern NSW

The development of agriculture in temperate woodland areas of Australia has resulted in a patchwork of cleared, cropping and grazing paddocks, usually bounded by a narrow road network. Some roads originated from trails of previous indigenous inhabitants, tracks of early explorers, or travelling stock routes (TSRs); others were surveyed from the 1870s to the 1940s. In this study, archived pastoral and parish maps were used to determine the extent that historical land-use may explain roadside vegetation condition in the Lockhart region of southern NSW. Analyses showed that road reserve survey age and reserve width were significant predictors ($P < 0.01$) of roadside vegetation condition (RVC). A higher percentage of wide road reserves were classified as 'high' RVC ($> 60.4\text{m}$: 43%) than narrow roads (20.1m: 15%). Similarly, a higher percentage of older road reserves were classified as 'high' RVC (1870's: 40%) than reserves surveyed more recently (1900-1970's: 22%). Roads were significantly wider on pre-1870s roads, County or Parish boundaries and TSR's. In summary, wide old roads generally had a higher conservation ranking than narrow, more recent (post-1900s) roads. These results have important implications for predicting fauna habitat, setting nature conservation priorities and for rapid assessments of roadside conservation values.

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Silent But Deadly - Bats As predators Over Cotton Crops

The air above cotton crops is a war zone. Each night, foraging insectivorous bats patrol the air space. Using radar-like ultrasonic sonar the bats seek out and home in on their flying insect prey. *Helicoverpa* moths are a prime target – but these moths can detect bat sonar and they take evasive action as bats approach. *Helicoverpa* caterpillars are the major pest of cotton crops in Australia, and are the target of the majority of insecticides applied to cotton. We are using ultrasound sensors and infrared video to quantify the impact that bats have on *Helicoverpa* moth flight, mating and egg laying behaviour in cotton crops at Narrabri in northern NSW. Bats directly reduce insect pest densities by predation of flying adult moths – including egg-bearing females. Just the presence of bats and their ultrasonic sonar over cotton causes havoc and disturbance to moths that would otherwise busy themselves seeking nectar, mates and cotton plants upon which to lay their eggs. From a cotton farmer's perspective, bats are out of sight, out of hearing, and out of mind. However, insectivorous bats are common over cotton fields, and are providing a valuable ecosystem service.

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Conservation biology of the Giant Burrowing Frog: habitat use in a modified environment

The giant burrowing frog *Heleioporus australiacus* is listed as vulnerable under the NSW Threatened Species Conservation Act 1995. In the Sydney Basin, the frog predominantly inhabits ridge tops and plateaux where habitat destruction and fragmentation through housing development are major threats. Even in the reserve system, roads are generally placed in the upper parts of the topography and have thus become part of giant burrowing frog habitat. This situation raises several interesting ecological questions and poses dilemmas for managers.

I am investigating habitat use by this species, focusing on the road environment. I present mark – recapture data collected over 18 months as part of an ongoing program, and provide an insight into associations of this frog with both natural and artificial habitat features. The outcomes will help with the design of guidelines to maintain genetic diversity within the species, and to recommend or prescribe ameliorative measures for activities with the potential to impact these frogs.

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Role of foliar chemistry in avoidance of a putative hybrid eucalypt by *Mnesampela privata*: implications for breeding

There is increasing interest in the development of hybrid *Eucalyptus*. Breeders are developing these hybrids with little understanding of how native biota may respond to them. In four recent studies, F1 hybrids have been found to be either intermediate or more susceptible to native biota; no hybrid was reported as avoided. We studied the responses of *Mnesampela privata* to a putative hybrid (the result of natural cross-pollination of *E. g. pseudoglobulus* possibly by *E. cypellocarpa*) because it was avoided in the wild. In bioassays, female *M. privata* laid more eggs on leaves of a half-sibling than on leaves of the hybrid. Solvent extracts of foliar oils indicated that the hybrid and a half-sibling had comparable quantities of major monoterpenes. Headspace samples of leaf volatiles differed in the minor monoterpenes; these differences were detected by female moths (using electroantennographic detection). Hybrid leaves were glossy and almost devoid of C20-C30 benzyl esters and C20-C26 phenylethyl esters compared to half-sibling leaves. Female moths could be made to reverse their oviposition preference if the wax layer on waxy half-sib leaves was physically abraded. These results indicate that differences in the monoterpene and wax odours of the hybrid's leaves are inducing the avoidance.