Masters Research Project Topics in School of Ecosystem and Forest Sciences

Dr Joe Greet greetj@unimelb.edu.au

Habitat requirements of endangered Leadbeater's Possums in Yellingbo Nature Reserve

An intensive monitoring program has been underway for more than 20 years for the last lowland population of Leadbeater's Possum at Yellingbo Nature Conservation Reserve. The possum population has fallen to fewer than 40 individuals, and urgent conservation measures are currently being implemented. This project, focused on swamp forest vegetation condition, will define the key attributes of foraging habitat for the species at Yellingbo, comparing sites currently occupied by the possum with those that have been abandoned over the past decade. The results will be used to inform the selection of future translocation sites for the species beyond Yellingbo. This project would be jointly supported by Zoos Victoria and the SEFS at The University of Melbourne.

Source: Joe Greet

Prof Stefan Arndt sarndt@unimelb.edu.au

Vulnerability of eucalypts to tree drought mortality

Climatic changes lead to more prolonged droughts in south-eastern Australia and we already observe significant tree death in many forest ecosystems. Eucalyptus is a very diverse tree genus that occurs in every environment in Australia but many eucalypt species have very narrow climatic ranges. This project will investigate if eucalypts with narrow climatic ranges are more vulnerable to tree mortality than eucalypts with broader climatic ranges and assess the potential plant physiological mechanisms for the vulnerability or resilience of the species. The project will focus on plant water relation traits but other methods or traits can be included as the project progresses.

Prof Stefan Arndt sarndt@unimelb.edu.au

Mechanisms of drought tolerance in trees

Tree species have different mechanisms to tolerate drought events. Some species can adjust their water potential and withstand very long periods of drought by a continued water use. Other species close their stomata very early in a drought event in order to conserve water. However, it is still unknown how these different strategies are related to the aridity of the environment and how the different mechanisms are interlinked. This project will investigate if tree species that have a high plasticity in regulating water use have different fundamental mechanisms of drought tolerance compared to species that have a low plasticity of regulating water use.

Prof Stefan Arndt sarndt@unimelb.edu.au

Adaptation of urban trees to environmental stresses

Urban trees provide a large range of important ecosystem services but live in an environment that exposes them to multiple environmental stresses. The many impervious surfaces in cities and recent droughts put many tree species in Melbourne under extreme stress and led to extensive mortality. This project will investigate how different urban tree species adapt to drought and assess their drought tolerance and potential to survive in a drier climate. The project will possibly also assess ways how we can best alleviate drought stress for certain species based on their adaptive mechanisms.

Prof Stefan Arndt sarndt@unimelb.edu.au

Methane uptake of forest soils

Oxidation of the greenhouse gas methane by methanotorphic bacteria is the only biological sink for this potent greenhouse gas and methane oxidation in forest soils is the largest terrestrial sink. However, we still know very little about this important process. This project will investigate the methane uptake potential of forest soils with different soil properties in order to get a better understanding of the fundamental mechanisms that control methane uptake. This project involves measurements of methane flux in different forest ecosystems around Melbourne and Victoria using greenhouse gas measurement systems.

Prof Stefan Arndt sarndt@unimelb.edu.au

Do nitrification inhibitors decrease nitrous oxide emissions from agricultural soils?

Nitrification inhibitors can be effective in reducing emissions of the greenhouse gas nitrous oxide from soils and in enhancing the availability of nitrogen for plants as shown by multiple studies. However, many of these studies have been in the laboratory or on small scales in the field. This project will trial the use of nitrogen fertiliser amended with the nitrification inhibitor DMPP under real farm conditions (dairy pasture, broadacre cropping) in North East Victoria. We will measure the emissions of greenhouse gases under real farming conditions and assess potential changes to the productivity of the system.

Prof Stefan Arndt sarndt@unimelb.edu.au

Methane emissions by termites

Termites can emit large amounts of the greenhouse gas methane from their hindguts but we still only have a partial understand how much of the methane is actually released to the atmosphere. The primary goal of this project is to investigate the extent and magnitude of methane oxidation (uptake) in termite mounds of selected termite species. One key question is how much of termite-produced methane is mitigated in the mound material before reaching the atmosphere. This requires the development and validation of a reliable method for the in-situ quantification of the oxidation potential within a termite mound. In a further step, potential driving factors for methane oxidation in termite mounds will be investigated, together with net methane emissions. The aim is to provide a functional understanding of microbial methane uptake in termite mounds and their dependencies on environmental parameters, leading to a better knowledge base for estimation of the mitigation effect of microbial methane uptake on termite-produced methane.

Dr Virginia Williamson vgw@unimelb.edu.au

Determining the ethylene sensitivity of some Australian cut flower species

Ethylene is well-known for accelerating flower senescence and abscission, which is of particular importance to the cut flower export industry. The student would initially perform ethylene sensitivity assays of Australian cut flower species and cultivars in which the ethylene status is either unknown or uncertain. The next stage of the project would be to examine some of the parameters of protection against ethylene.

Dr Rebecca Miller - miller.r@unimelb.edu.au

Assessing phenotypic plasticity in plant chemical defences above- and below-ground – interactions between plant development and the environment

There is much interest in understanding how plant chemical defence strategies change in response to variation in environmental conditions (e.g. drought, nutrient supply, elevated CO2) because changes in the quality/toxicity of plant tissues can affect herbivores and other consumers, including humans. Recent reviews point to several limitations in the plant defence literature, notably, that (1) ontogenetic (developmental) variation and (2) root defences, are little integrated into current defence theories and studies. This project would contribute to addressing these two limitations. Most studies probing defence theories compare plants grown under different conditions at the same age, but we know that plant defence chemistry varies not only with environment and genotype, but also with plant developmental stage. A few studies report complex non-linear changes in plant defences with plant age/development which begs the question, how might the comparison of plants at a single time point on this trajectory affect our conclusions about the effects of an environmental variable on plant defence? Using important forage species Sorghum, which produces cyanide-containing defences, this project aims to investigate the interaction between ontogenetic variation in plant defence, and environmental effects on plant defence, with particular emphasis on both roots and shoots.

Dr Rebecca Miller - miller.r@unimelb.edu.au

Where and when do plants deploy their chemical defence arsenal?

Unable to flee their predators, plants invest in a diverse arsenal of chemical defences to try and minimise tissue loss to herbivores. There is much interest in how these plant chemical defences change in response to variation in environmental conditions (e.g. drought, nutrient supply, elevated CO2) because changes in the quality/toxicity of plant tissues affect herbivores and other consumers, including humans. Most studies investigating plant defences compare plants grown under different conditions at the same age, but we know that plant defence chemistry varies not only with environment and genotype, but also with plant developmental stage. Furthermore, relatively few studies also consider root chemical defence despite the fact that many species also invest in root chemical defence. Using important crop species that produce cyanide-containing defence compounds as models, this project aims to investigate variation in plant chemical defences in both roots and shoots, and to explore the interaction between developmental variation in plant defence, and environmental effects on plant defence.

Dr Rebecca Miller - miller.r@unimelb.edu.au

Nature vs nurture: population variation in chemical defence of an endemic tropical tree species

This project will contribute to an established large-scale study on variation in the chemical defences of the endemic Australian tropical tree species *Brombya platynema.* The study uses samples from six populations of *Brombya* at sites differing in available nutrients. This species is known to produce cyanide-based defence compounds, but in contrast to other tropical cyanogenic species where all individuals have been found to produce these toxins, cyanide-based compounds are absent from a sizeable proportion of *B. platynema* trees, a proportion that differs between sites. But does this necessarily mean that those individuals are undefended? Plants rarely rely on a single toxin to defend themselves, and indeed cyanide-containing compounds appear to be but one component of a complex arsenal in this species. Variation in other defence compounds may be important, but their relationship to cyanide-based defence and environmental conditions is unknown. This project will investigate how carbon-based defence metabolites vary within and between six *Brombya* populations, found on soils differing in available nutrients. In addition, inheritance of chemical defence traits in seedlings grown from seed collected from parent trees with different chemistry can also be investigated. (minor project)

Dr Samantha Imberger - samantha.imberge@unimelb.edu.au

Effects of urbanisation on groundwater quality and movement.

The effects of urban stormwater drainage infrastructure on water quality and hydrology in streams is well studied, but little is known of the effect of urban land use on the quality and movement of ground water. This project, working as part of the Waterways Ecosystem Research Group's Little Stringybark Creek project, will assess groundwater quality in well-studied catchments across an urban gradient, and use isotopes (such as radon and others) to trace groundwater age, transit times and contribution to stream flow.

Dr Matthew Burns - matthew.burns@unimelb.edu.au

Assessing the baseflows of Melbourne's streams

There is increasing interest in urban stormwater harvesting, but this has also sparked requests to divert water from urban waterways. Such diversions are counter to the objectives of stormwater harvesting, because they typically do not significantly reduce peaks, and instead deplete baseflows. This project will use an analysis of flow data in Melbourne's streams to develop a framework for assessing appropriate baseflows for urban streams, and set extraction limits to protect streams from further depletion of baseflows

Ass. Prof. Chris Walsh - cwalsh@unimelb.edu.au

How do upland stream ecosystem processes respond to urban stormwater runoff?

Small upland drainage lines are important retainers and transformers of nutrients and other contaminants, while they retain their natural form. A number of such drainage lines in the Dandenong Ranges have received different degrees of stormwater runoff over different periods. How does their morphology and ecological structure and function change with increased urban stormwater flows? Depending on the interests of the student, this project could focus on geomorphology (how do drainage lines/channels respond to changes in catchment flow regime?), ecological function (how are biogeochemical processes such as nutrient retention affected by different land practices?), or ecological structure (how is the biodiversity of small drainage lines affected by changes in land practices?)

Prof. Tim Fletcher - tim.fletcher@unimelb.edu.au

Water sensitive farm design

Performance of a range of on-farm water quality treatment systems to protect waterways. Pollutants generated by agricultural land-use represent a major threat to waterways. In this project you will undertake monitoring of a range of flow and water quality management techniques constructed on a farm at Beenak (in the Yarra Valley). The monitoring will look at concentrations and loads of sediments and nutrients (and potentially toxicants). The project will be undertaken in partnership with Melbourne Water and the landholder.

Prof. Tim Fletcher - tim.fletcher@unimelb.edu.au

Restoring the urban water balance in practice: performance of a large-scale stormwater harvesting and infiltration system.

Drawing on the concepts presented above, you will undertake field monitoring of a large stormwater infiltration system (combined with an underground stormwater harvesting system) to understand its ability to (i) reduce peak flows, (ii) infiltrate water to Dobsons Creek and (iii) supply water for harvesting. You will use this to develop and calibrate a MUSIC model of the system and to assess its performance in terms of a range of hydrologic indicators. This project involves a mix of fieldwork (based at the Wicks Reserve Bio-Infiltration systems), data analysis and interpretation.

Prof. Tim Fletcher - tim.fletcher@unimelb.edu.au

Urban environmental flows; restoring urban streamflow regimes in the context of urban runoff

Hydrology is a fundamental driver of stream health. Impervious areas result in total runoff volume being increased approximately fivefold. While there is increasing emphasis on returning more natural hydrology, unless there is adequate stormwater harvesting demand, achieving near-natural runoff volumes is difficult. This project will using modelling (based on flow data from Melbourne streams) to determine whether ecologically important components of the flow regime can be maintained at levels likely to sustain healthy ecosystems, even when total runoff volume remains significantly higher than natural. The project will provide important guidance to Melbourne Water in existing and new urban areas.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

Determining impacts of urbanisation on river channel morphology using GIS

Understanding the link between suburb and city densities and river channel morphology will help us better manage urban stream channels. This project seeks to develop explicit relationships between urbanisation and ecologically important physical aspects of river channels such as bed diversity, hydraulic diversity, cross-sectional complexity and the presence of depositional features such as bars and benches. It will use LiDAR (airborne survey), field verification, and could incorporate hydrodynamic modelling depending on your interests.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

How has urbanisation impacted on sediment sources to streams?

Sediment supplies to streams play a critical role in their morphology, and their potential for recovery following disturbance. In the urban environment, as the impacts of changed hydrology are better understood the changes to the sediment regime delivery need to be considered. This project will monitor sediment delivery (both suspended and bedload sediment) to urban and control streams, and model sediment budget changes.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

Linking urban stormwater runoff to geomorphic change in waterways

Changing land use cover and modifying flow regimes is considered the most effective way in which humans influence geomorphology: urban stormwater runoff and waterways is a prime example. This project identifies the components of the urban flow regime that drive geomorphic changes to desired morphologic attributes (e.g. bars, benches, bedload sediments) using hydraulic modeling.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

A place by the river: How waterway condition affects house price

In conjunction with the Real Estate Institute of Victoria, data on house pricing can be used as a surrogate to ascertain how various attributes of waterways (e.g. floodplain space, stream condition) drive choices to live nearby. This investigation will use GIS (e.g. aerial imagery, LiDAR, River Styles) and statistical modelling, and may incorporate social engagement depending on your interests.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

The role of floods in channel change

Floods can dramatically erode and enlargen river channels, but what this means for physical habitat (e.g. hydraulic complexity, large wood, bars and benches) is poorly understood. Detailed field survey of the Broken River, Murray Darling Basin ¬¬— prior to some major flood events 2010/11 — captured bed morphology and wood in this sand bed stream, and enabled the production of a hydrodynamic model for two sites. The time is ripe for repeat field survey and analysis (using GIS, hydrodynamic modeling) to quantify changes.

Dr Geoff Vietz - geoff.vietz@unimelb.edu.au

A town on the hill: the impacts of urban hydrology on otherwise intact river channels

In Hornsby, Sydney, urbanisation envelops headwater source catchments for a number of streams which then flow into a National Park. These streams are particularly more degraded than those nearby on the other side of the range even though the channels flow through the same intact riparian vegetation and geology: the regime of the hydrologic inputs are likely to be the culprit. This investigation seeks to explain this variability based on field measurements of geomorphic metrics for the receiving channels against the possible drivers of change.

Dr Nick Williams - nsw@unimelb.edu.au

Not all bankers are seedy! – assessing seed banks in remnant vegetation

There are patches of remnant vegetation in golf courses and urban parks throughout south-east Melbourne. These vary in quality and size, but there is potential to restore these to high quality native vegetation with a change in management practice and conservation protection. Making use of the existing native vegetation seed bank would make such restoration efforts more rapid and cost effective. This project will assess the seed banks in high quality, protected patches of remnant vegetation (nature reserves) to that in patches of remnant vegetation in various golf courses of various quality and extent. At the same time the soil properties of these different remnant patches will be assessed for indication of disturbance and change in quality.

Dr Chris Williams – chriscw@unimelb.edu.au

Investigating consumer horticulture products and sustainability

Backyard gardeners buy many horticultural products designed to make plants "thrive". Many of the claims made for these products are untested or are based on agricultural research for broad acre farming and not specifically for ornamental plants or home food growing. Consumers may be purchasing products unnecessarily. This topic may be explored from a variety of perspectives: case studies of consumer spending on horticultural products; testing gardening products for claims made; exploring information sources for these products; or life cycle analysis of one or more commonly recommended horticultural products.

Dr Chris Williams – chriscw@unimelb.edu.au

Community food gardens

Community food gardens are increasingly promoted as ways to provide food growing opportunities for urban residents. These gardens are often established to provide social cohesion or community development outcomes along with food security objectives. This Major Research Project aims to explore the recent growth in community food gardens by asking the following questions, amongst others: Where are these gardens in metropolitan Melbourne? Who runs them? How are they managed? What food is grown there? Who eats it? How do we judge success for community gardens? What issues do community food gardens face? etc

Dr Denise Johnstone – denisej@unimelb.edu.au

Trees in cities - The use of the Urban Crowns image analysis software for assessing crown condition in mature urban eucalypts

Trees provide many benefits for city dwellers including reducing the urban heat island effect and atmospheric carbon and pollution reduction; therefore it is important to maintain the health of urban trees. Visual tree canopy condition has often been used as a measure of tree health and vitality, and to assess the potential benefits of trees in urban areas. However, many visual crown assessment techniques have quite a high level of subjectivity. Imaging technologies are beginning to be used to measure canopy condition as they are quicker, have less observer bias and have a higher degree of reproducibility. The success of imaging technologies for measuring trees with irregular crown shapes has not been evaluated. One such technology is the UrbanCrowns software program

developed by the USDA Forest Service Southern Research Station. Comparing data output from the UrbanCrowns software program with visual vitality indices and objective growth measurements such as tree height and diameter at breast height will enable the successful evaluation of UrbanCrowns for use on urban eucalypts and other trees with irregularly shaped crowns.
Minor Research Project Year long commencing semester 2.

Dr Denise Johnstone – denisej@unimelb.edu.au
Tree biomass modelling in urban trees - correcting for wood decay
Algorithms that are used to quantify the benefits of trees to the environment, including carbon sequestration, are reliant on estimating tree biomass. Current ways of modelling tree biomass are based on tree height and diameter at breast height and a "species factor" based on wood density. These models do not take into account the amount of decayed wood in the stems of trees. Wood loss due to wood decay is high in urban trees due to high rates of mechanical injury, abiotic stress factors and the urban heat island effect. Practical methods for assessing wood decay that do not require felling the tree are now being developed, including acoustic methods. In this study decay will be estimated in selected species of urban trees using an acoustic instrument. Comparing tree biomass equation estimates with and without decay estimations will estimate the current error due to wood decay in trees and enable more accurate estimations of tree biomass in the future.

Dr Chris Williams – chriscw@unimelb.edu.au
Public open space systems/networks; management and maintenance of public open space
The Victorian Environment Assessment Council (VEAC) recently released its report on public open space in metropolitan Melbourne. VEAC has recommended all levels of government takes more seriously issues around quantity and quality of public open space in Melbourne, especially in the light of urban consolidation and populations increases. At the same time responsibility for management for public open space still mostly resides with local government with maintenance done either through contracted services or via horticultural teams. This project will develop case studies of public space management and maintenance in Melbourne at the local government level and explore issues relating to the challenges of providing "quality" open space in the 21st century.

Prof. Tim Fletcher - tim.fletcher@unimelb.edu.au
Measuring impacts of stormwater management approaches on soil moisture
Urbanisation results in an increase in impervious areas and thus in drying out of the urban landscape. This has impacts on factors such as the urban microclimate. New sensors have been developed to measure soil moisture profiles and there is potential to use these to assess the impacts of alternative stormwater management scenarios on soil moisture. You will be involved in testing the feasibility of testing soil moisture profiles and their interactions with stormwater management.
Major / Minor Research Project - Semester Long

Dr Trent Penman - trent.penman@unimelb.edu.au
Koalas and fire: A bad mix?
Koalas are an iconic species and as a result conservation management of these species attracts a great deal of public scrutiny. Prescribed fire is a commonly applied management tool in forested systems in an attempt to reduce the risk of future fires on assets. In this project, you will compile information on the potential direct and indirect impacts of fire on koala populations. These data will then be used to test various management strategies and identify a safe set of management prescriptions for the species. Major / Minor Research Project - Semester Long

Dr Trent Penman - trent.penman@unimelb.edu.au

Can we improve fire risk modelling

Fire simulation modelling is a growing field. As a consequence, it is increasingly being used in fire risk analysis at a wide range of scales. Many of the methods that are being applied fail to consider key aspects of the fire risk equation. One key area missing is the likelihood of ignition. In this project, you will learn to apply Phoenix RapidFire using two different approaches – the current DELWP and a revised approach accounting for ignition likelihood. Results of the study will be presented to DELWP to further enhance their risk modelling approaches.

Major / Minor Research Project - Semester Long

Dr Trent Penman - trent.penman@unimelb.edu.au

Fuelling the fire or just the debate?

There is considerable debate around the value of prescribed burning for changing the risk to assets. One of the key areas of contention is around the role of fuel loads and fire extent. In this study, you will use fire simulation tools to examine how the patterns of fuel treatments affect fire extent and fire severity. Results of the simulation study will be compared with empirical data. The results are expected to vary between a ecosystems and there is scope for several complementary projects in this area. Major / Minor Research Project - Semester Long

Dr Sue Murphy - smmurphy@unimelb.edu.au

Vegetation selection and assessment of performance in urban landscapes

Despite some spectacular examples to the contrary, most designers of public open spaces seek to achieve sustained high quality performance of vegetation. This project seeks to better understand the selection of herbaceous species by landscape owners and managers, particularly in relation to the resources needed and available for their ongoing maintenance and management. This will be achieved by a combination of assessment of urban landscape plantings, matched to nursery or field trials of the same species. Both aspects of the project will explore the use of assessment criteria (either existing, or newly developed).

Students may undertake this as a 25- or 50-point project; the trial component is more suited to a 50-point project.

Dr Gary Sheridan – sheridan@unimelb.edu.au

Extreme water supply contamination in bushfire burned catchments

Bushfire poses an immediate threat to the water supplies of cities and towns because the key water treatment facilities are designed to treat relatively clean water from unburnt forested catchments. Our research has linked the largest post-fire water contamination events observed in south-eastern Australia in the last decade with *debris flows*, a high magnitude soil erosion process. Our current research aims to quantify the fire, landscape, and channel properties that predispose catchments to post fire debris flows. We are seeking a high-achieving and motivated student to develop a research project that would combine field-based research in Victorias forested water catchments, with analysis and modelling of field results. The selected candidate will work with doctoral and post-doctoral researchers who are global leaders in this field and will be provided with the necessary support to develop and implement their chosen research project.

Dr Gary Sheridan – sheridan@unimelb.edu.au

Fuel moisture: Improving bushfire prediction in a drying climate

In many south east Australian forests fire activity is limited by the moisture status of the fuels. In a warmer and drier climate these forests will experience more intense and longer periods of drying, which will change the probability and severity of fire. However there are many complex interactions and feedbacks between vegetation, topography, fuel structure, fuel moisture, and fire frequency. In this project the student will help unravel some of these complex interactions and contribute to our

understanding of how fire regimes may change in response to a warmer and drier climate. The student, in collaboration with a post doctoral researcher, to will develop and implement laboratory and/or field experiments to explore the interactions between fuel moisture and the above factors. This project would suit an enthusiastic student who would like to combine field research with a strong conceptual and theoretical understanding of forest and fuel dynamics.

Dr Gary Sheridan – sheridan@unimelb.edu.au

Understanding scaling and connectivity; the key to improved hydrologic predictions

Understanding the scaling behaviour of physical phenomena remains one of the key research challenges for physical scientists in the 21st Century. Nowhere is this more true than in hydrology, where model predictions continue to be constrained by our poor understanding of how the key hydrologic processes and properties of systems change depending on the scale of observation or interest. In this project the student will work on the problem of scaling of hillslope surface runoff, helping to understand how and why surface runoff changes with spatial scale. The research project will build on a number of experimental research sites established in south east Australian forests. The results will help our industry partners (e.g. DELWP and Melbourne Water) to understand contamination risks to reservoirs and water supplies.

Dr Rebecca Ford – fordr@unimelb.edu.au

Community beliefs about weeds and weed management on the Mornington Peninsula

Management of species considered environmental weeds, such as Sweet Pittosporum and English Ivy, is a top priority for community Landcare groups on the Mornington Peninsula. Anecdotal evidence suggests residents views of these species vary, with some people sharing the Landcare view, but others seeing them as attractive plants and adequate habitat for native fauna. The Red Hill South (RHS) Landcare Group would like to partner with a student who can conduct photo-based interviews with residents to understand their beliefs about local weeds and their management. With assistance from the RHS Landcare Group, the student will collect photographs, conduct interviews, and develop specific recommendations for a weed communication program that can be implemented at community level by the Group. The student must have completed the Social Research Methods subject or have equivalent background in social research. Other subjects that provide good background for this project are Community Natural Resource Management, Sustainability and Behavioural Change and Human Behaviour and Environment. The student will need their own car transport. This project works best as a 50 point project over a full year.

Dr Greg Moore - gmmoore@unimelb.edu.au

The economic value of services provided by urban trees:

The aesthetic value of trees in the avenues, parks and gardens of Australian cities is often widely appreciated, but their economic value is often under-valued. Trees provide services and fulfill functional roles in cities. They are significant components of urban infrastructure and have a real and calculable economic value. This project focuses on valuing shade in prolonging the life of building materials, the reduced cost of litter collection as a result of reduced water flow speeds due to the presence of trees along rivers and other environmental services.

Dr Greg Moore - gmmoore@unimelb.edu.au

Hybridization of urban and remnant urban trees.

This project looks at whether hybridisation between planted and remnant species of urban trees is happening and if so should there be concern? Are the planted specimens contaminating the gene pool of indigenous species? The project would focus on specific species such as Eucalyptus camaldulensis, Acacia dealbata and perhaps A. melanoxylon. Depending on student interest there are a few other posssible candidate species. The project aims to improve arboricultural management practices (Major / Minor Research Project)

Dr Greg Moore - gmmoore@unimelb.edu.au

The impact of retained bark on urban tree growth

Trees have a layer of retained bark at the interface of the trunk and soil at ground level. The height and thickness of the retained bark varies for species and individual trees. There has been very little work done on the role of retained bark in urban trees, whether it constitutes a hazard and whether it is an indicator of past tree growth and health. This project would attempt to explore some of these matters. (Major / Minor Research Project)

Dr Virginia Williamson – vgw@unimelb.edu.au

Assessing plant sensitivity to drought by examining anatomical traits

This project will examine the xylem anatomy of nine species of eucalypts within three groups: those that are sensitive to drought, those that are drought-tolerant and those which inhabit mesic environments. What are the differences in pit membrane structure of the plants? Is there a link between the thickness of pit membranes and the ability to withstand drought? The student will collect eucalypt stems and examine them under the Transmission Electron Microscope. Measurements of pit membrane thickness will be calculated and statistical analysis will reveal whether there are any significant differences between the species. This project is suited to a student with an interest in xylem anatomy and an eye for detail.
Major research project, year-long.

Dr Virginia Williamson – vgw@unimelb.edu.au

Determining the ethylene sensitivity of some Australian cut flower species

Ethylene is a simple hydrocarbon (C_2H_4) gas that is produced by some plants during flower senescence, fruit ripening, wounding and leaf abscission. Ethylene is well-known for accelerating flower senescence and abscission, so is of particular importance to the cut flower export industry. Although the ethylene sensitivity of several Australian cut flowers of export interest is known, the response to ethylene (both exogenous and endogenous) of many other species is unknown. This information is vital to the handling, successful export and reputation of Australian cut flowers. We do not know why some species or cultivars within a genus are ethylene-sensitive, whereas others are not. Working on species for which the ethylene status is unknown, the student would initially perform ethylene sensitivity assays and determine the response to different ethylene protectants. The next stage of the project would be to examine some of the parameters of protection against ethylene, e.g. ethylene is known to inhibit stomatal closure. Does this mean that those species and cultivars which exhibit ethylene sensitivity have shortened vase lives because their stomata are unable to close and thus conserve water despite the increasing water stress condition in the vase?
Major or minor research project.

Dr Virginia Williamson – vgw@unimelb.edu.au

Development of Leptospermum spp. for potted plants

The student would work with one of Australia's top cut flower exporters to develop Leptospermum spp. as potted plants for the nursery industry. The project would continue on the work of a previous RIRDC-funded project in which initial selections were made from wild-grown plants. The selected plants are now growing in a commercial cut flower field at Longford (a three hour drive east of Melbourne), so the student would need to stay overnight during field work. It is envisaged that two days per week at Longford would be required during the flowering season (mid-late August until late December) to record data on various floral characteristics. Selections for commercially viable plants will be determined in conjunction with the exporter and will be based on flower form, colour and flowering times. Accommodation and travel costs will be covered by the exporter.
Major research project, commencing in semester 2.

Dr Rebecca Miller - miller.r@unimelb.edu.au

Variation in plant chemical defences above- and below-ground – interactions between plant development and the environment

Unable to flee their predators, plants invest in a diverse arsenal of chemical defences to try and minimise tissue loss to herbivores. There is much interest how these plant chemical defences change in response to variation in environmental conditions (e.g. drought, nutrient supply, elevated CO2) because changes in the quality/toxicity of plant tissues can affect herbivores and other consumers, including humans. Recent reviews point to several limitations in the large body of plant defence literature, including for example, that (1) developmental variation and (2) root defences, are little integrated into current defence theories and studies. This project would contribute to addressing these two limitations. Most studies probing defence theories compare plants grown under different conditions at the same age, but we know that plant defence chemistry varies not only with environmental conditions and genotype, but also with plant developmental stage. A number of recent studies report complex changes in plant defences with plant age/development. Using important crop species that produce cyanide-containing defence compounds as model species, this project aims to investigate the interaction between developmental variation in plant defence, and environmental effects on plant defence, with particular emphasis on both roots and shoots.

Dr Rebecca Miller **-** miller.r@unimelb.edu.au

Environmental effects on growth and nutritional value of garden food crops

A high proportion of food crops contain toxic secondary metabolites which function as anti-herbivore defences. This is because humans have domesticated naturally pest-resistant food plants over time. Although the toxin may not necessarily be present in the tissues we consume (e.g. the leaves may be toxic and we consume the fruit), that is not always the case. Environmental variation affects not only growth and yield, but can also affect the balance of nutritional (protein and other nutrients) and anti-nutritional (plant defence toxins) compounds in plant tissues. For example, under drought stress conditions it is well known that leaves and tubers of cassava become more toxic with increased concentrations of cyanide-containing defence compounds under water deficit. As part of research into crop choice for home and community food gardens, this project would investigate the effects of environmental factors relevant to urban food production, for example nutrient supply and water supply, on the growth, yield and chemistry of novel garden food crops. Candidate species for this project include species popular with, and sold by, diverse ethnic communities in Melbourne but which are not yet mainstream such as cassava (Manihot esculenta), katuk (Sauropus androgynus) and tree spinach (Cnidoscolus aconitifolius). Differences in chemistry between plant varieties or cultivars could also be investigated.
(Rebecca Miller and Chris Williams)

Dr Rebecca Miller **-** miller.r@unimelb.edu.au

Conservation and propagation of Australian Proteaceae

One common hurdle for restoration and revegetation projects is recalcitrant seed. Some native species end up being under-represented in restoration activities due to extremely low germination rates. Sometimes this dormancy or recalcitrance reflects an adaptation to regeneration post-fire, as demonstrated by the effectiveness of smoky water treatments which break dormancy and enhance germination in some species. In other instances, the triggers to break dormancy remain unknown. A range of endemic Australian Proteaceae in the genus Persoonia are known to be difficult to germinate. This project aims to investigate limitations to germination focusing on Persoonia species. The project may involve tissue culture propagation, and standard germination and viability tests as well as more detailed chemical analyses of potential germination inhibitors and triggers.
(Rebecca Miller and Sue Murphy)

Dr. Julian Di Stefano juliands@unimelb.edu.au

How do animals respond to fire management in fragmented landscapes?

Species living in fragmented landscapes face multiple threats, including fire. For example, the inappropriate use of fire may reduce habitat suitability and restrict animal movement, increasing the risk of local extinction. In theory, however, fire can also be used to enhance movement capacity. A key knowledge gap is how the characteristics of fragmented landscapes (e.g. patch size and isolation) interact with the characteristics of fire regimes (e.g. fire size, patchiness and spatial distribution) to influence animal conservation.

The broad objective of this research is to determine how both fragmentation and aspects of the fire regime influence the occurrence and movement potential of

- Reptiles
- Mammals
- Birds
- Invertebrates

Several masters/honours projects are available, each focused on a different group of animals. Data will be collected from sites already established in Western Victoria as part of our ongoing research program. The successful applicants will be part of a research team investigating the effects of fire and fragmentation on a wide range of species.

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Project 2015-5 Non-Urban Food Systems: Investigating food chains as part of reconceptualising production and supply

There is a need for diversity in non-urban food systems but regional and rural areas, while the sites of most production, are notoriously low on diversity and are frequently food security poor. Food system reform is needed. In thinking about food supply and availability as a regional system (production, distribution, consumption and waste), we can examine both what exists and the possibilities for reform Using a social-ecological systems perspective, the researcher will select a small town or village or regional area and investigate either a part or the overall food system. Those interested in food policy can analyse this issue from a policy level, including food security and water provision. Those interested in local food producers operating at a non-export/commercial level, can analyse the social-ecological contribution of gleaners, farmers' markets, backyard and community gardens associated with creating new options. The research question will be shaped by the spatial boundaries selected.

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Urban, Peri-urban and Small-scale Agriculture

This is a generic heading for students interested in pursuing research associated with community gardens, urban agriculture, greenbelts, guerrilla gardens, water and the urban food gardens, or similar. The student will use social and ecological systems thinking (resilience and vulnerability) as a theoretical basis for examining the social engagement with urban agriculture. This is a fast paced, rapidly growing research area and specific interest topics can be discussed. Students undertaking this research are advised that NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes are both relevant.

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Agricultural Land Abandonment and Biodiversity (Land Use Change)

The Strzelecki Ranges, Lismore and Swan Hill are possible site for investigation—but there are others-- in considering the kinds of land use change underway and its implications for social and ecological outcomes. Salinity, weed invasion, fire and drought have all impacted on these sites. There is significant restoration or planned change underway and land management history is detailed at all sites. Students undertaking this study need some basic botany and plant identification skills. NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes are relevant.

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Wetlands, Sea Rise and Inundation in Coastal Victoria

The fate of migratory birds, and the habitat for many flora and faunal species is threatened by the likely inundation of known protected sites associated with coastal reserves. As the sea rises, these species may be able to relocate inland, but the existing or potential wetlands are on private rather than public lands. Understanding the social and ecological impacts of sea rise in these regions suggests we need to better integrate private and public land management, and conservation and production goals. Interested students need either social science or ecology backgrounds and preferably NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes.

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Defend or Retreat? Coastal Community Responses to Sea Rise

The fate of many local coastal towns depends on the kind of planning decisions that are being made now with regard to coastal change. A study of two or three responses with a focus on water and food supply, or on tourism and local economies would provide insight into current understandings of predicted change and local social and ecological vulnerabilities. Students with planning, policy and legal backgrounds would benefit from a close-up investigation of how global scientific assessment of climate impacts are understood in these locations. NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes are both relevant.

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The Fate of Protected Area Management in the 21st C

The Victorian National Parks Association and others are lobbying for a new, disaggregated form of protected area management in 2018. A study that considers the longer-term issues and reasons for protected area management and the models in play, globally and locally, would be a very relevant contribution to current debates. Social-ecological systems analysis can be used to frame this study. NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes are both relevant.

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Flood, Fire, Drought and other Disasters

A study of multiple shocks to communities and places in the landscape will consider how communities and places 'recover' or reconstitute themselves post disaster. These responses will involve a close analysis of the stories and practices that locals engage in, in order to make sense of events. NRMT90003 Social Research Methods and NRMT90014 Sustainable Landscapes are relevant.

A/Prof. Alan York alan.york@unimelb.edu.au

Fire and the ecology of flying insects in the Otway Ranges

Flying insects (e.g. butterflies, moths, beetles, flies) are an important part of forest ecosystems. They contribute to ecosystem function through services such as pollination, provide a large food resource for vertebrate fauna, and are extremely interesting in their own right. This project will examine how fire affects the abundance and community composition of flying insects. Fieldwork will be conducted in the beautiful Otway Ranges and is part of a larger project examining fire impacts on micro-bats.

Dr Cristina Aponte caponte@unimelb.edu.au

(How) Are our trees dying?: Patterns of tree mortality

Research related to tree mortality has increased rapidly over the past decade, with studies reporting a significant increase in various aspects of forest tree mortality, from partial crown diebacks and increasing rates of background tree mortality to extensive forest die-off. Because forests provide innumerable ecological, societal and climatological benefits, understanding the natural patterns of tree mortality and how this might be affected in under climatic stress is of increasing importance. This project will analyse spatial and temporal patterns of tree mortality in different forest ecosystems in Victoria. The results will help our partner the Department of Environment, Land, Water and Planning of Victoria to understand forest mortality risks in ecosystems across the state.

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Large on the outside but hollow on the inside: internal tree wood decay

The development of internal wood decay and hollows in Australian forest trees is key to their role as wildlife refugia. Furthermore, the hollows and decayed wood inside living trees can considerably influence estimates of stem biomass in old-growth forest, a critical parameter in determining forest carbon sequestration capacity. However, knowledge on the internal decomposition rates and hollow development in Australian forests is still limited. This project will assess the occurrence and development of internal hollows in old-growth forest trees in the Central Highlands using a Resistograph ®. The project will focus on Eucalyptus regnans and Lophozonia cunninghamii.

Dr Cristina Aponte caponte@unimelb.edu.au

Direct and indirect effects of prescribed fire on wildlife

Prescribed fire is extensively used to manage fuel loads in southeastern Australia. Many studies have evaluated the direct impact of different fire regimes on faunal diversity and abundance. However it is more likely that fauna will respond to fire-driven changes in their habitat (i.e. indirect fire effects) than to the fire event itself. Despite this fact, few studies have attempted to quantify the relative importance of both direct and indirect effects of prescribed fire on faunal community composition. This study will jointly analyse fire-driven changes in forest structure and fauna to identify the key factors driving changes in fauna composition.

Dr Cristina Aponte caponte@unimelb.edu.au

Fire flammability feedback in the wildland-urban interface

Prescribed fire is most intensively used in the wildland-urban interface, as managing fuel loads is critical to reduce the intensity of unplanned fires that may jeopardize communities. However frequent burning could select for fire-prone species, making vegetation in this areas more flammable that they otherwise might have been. This study will examine changes in plant community composition and its flammability associated with repeated prescribed fires. The study will involve site selection (basic GIS skills), field measurements (plant id skills), laboratory traits measurements and data analysis. The study will provide insight into the effectiveness of fuel management practices and its impact on the fire flammability feedback.

Kate Lee kate.lee@unimelb.edu.au

The perceived barriers and benefits of green roofs

Supervisors: Kate Lee, Kathryn Williams and Nicholas Williams

We are looking for a motivated student with some experience in qualitative analysis techniques to be involved with research on the perceived barriers and benefits of green roofs. We have conducted interviews with a range of green roof experts- clients, installers, policy makers, designers, and horticulturalists. This project will involve analysing these interviews and identifying implications for the Australian green roof industry. It is the first of its kind in Australia and is an opportunity to be involved with social research aiming to inform healthier and more liveable green cities.

Joe Greet greetj@unimelb.edu.au

No eye deer? Developing revegetation techniques to outsmart introduced deer in Australia.

Introduced deer species cause considerable damage to native vegetation. Attempts to restore through revegetation are often hampered by deer, and excluding them through fencing etc. can be cost-prohibitive. Alternative methods have been proposed in Australia and overseas, such as reduced plant nutrient levels, deer repellents and co-planting of palatable and non-palatable species. However there is considerable uncertainty around their success and cost-effectiveness. Next year, Greening Australia will plant 100,000s of plants at sites across Victoria that are deer-affected as part of the high-profile Twenty Million Trees restoration project. Greening Australia are keen to improve the science of restoration in the presence of deer. This project will work with Greening Australia to improve revegetation outcomes in the face of browsing pressure from deer.

Joe Greet, greetj@unimelb.edu.au

Making rivers great again! Assessing the potential of environmental flows to restore native riparian plant communities

In partnership with DELWP's Arthur Rylah Institute, we are seeking student/s to investigate the potential of environmental flows to restore native riparian vegetation. Flow regime is the primary driver of riparian vegetation dynamics. Many of Australia's rivers are degraded due to water extraction, flow regulation and other anthropogenic pressures. Increasingly, water is being returned to rivers via environmental flows to improve their health, including the restoration of native riparian vegetation. Better knowledge of the relationships between river flows and riparian vegetation dynamics is required to best target environmental flows. To inform Victoria's Environmental Flows Monitoring and Assessment Program, we are seeking student/s for a range of projects investigating vegetation flow-ecology relationships via a combination of nursery and field-based experiments, and/or interrogation of a large existing dataset. A student proficient in R and GLMMs is preferred but not essential. This project is jointly supported by ARI and SEFS at The University of Melbourne.

Joe Greet greetj@unimelb.edu.au

The potential for natural regeneration following weedy shrub removal (*Kunzea leptospermoides*)

In partnership with Zoos Victoria, we are seeking a student to investigate the potential to restore areas heavily invaded by the shrub, *Kunzea leptospermoides* (Yarra Burgan). Approximately 75% of the Coranderrk Bushland Reserve (adjacent to the Healesville Sanctuary and managed by Zoos Victoria) is heavily invaded by Burgan. This invasion is linked with overbrowsing by macropods and altered fire regimes. Burgan invasion is associated with reduced understorey vegetation diversity and cover, and dieback of overstorey trees. A program is currently underway to remove Burgan from large areas of the reserve. We are seeking a student to assess the potential for recovery via natural regeneration following Burgan removal using both field-based (vegetation surveys) and nursery based (soil seedbank assays) studies. This project would be jointly supported by Zoos Victoria and the SEFS at The University of Melbourne. Please contact Joe Greet to discuss

Joe Greet greetj@unimelb.edu.au

Saving our critically endangered fauna one planting at a time?

Revegetation is a common approach to restoring habitat for our native fauna. However, plantings and vegetation trajectories are often compromised such that the resulting vegetation community may not provide appropriate habitat. Hundreds of thousands of dollars have been spent (and will be spent) revegetating Yellingbo Nature Conservation Reserve in the Yarra Valley to provide habitat for the critically endangered Helmeted Honeyeater and lowland Leadbeater's Possum. A range of factors affect the success of these plantings, including weed control (or lack of), protection (or lack of) from browsers (deer, wallabies) and other environmental factors (shade, flooding, etc.). There are a range of potential projects to assess the effectiveness of revegetation efforts at Yellingbo that could contribute knowledge to aiding the preservation of these species.