School of Ecosystem and Forest Sciences

Research Prospectus
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About the School

The School of Ecosystem and Forest Science embraces a wide range of disciplines in the study of ecosystem processes and ecosystem management. Staff and students work in urban, rural, and wildland settings in Australia and across the world.

Disciplines within the School have a long history in Victoria, with teaching and research in horticulture at Burnley Campus extending back to 1891 and forestry at Creswick Campus back to 1910.

The School has a breadth of experience and capacity to address environmental issues such as climate change, bushfires, urban sustainability, biodiversity conservation, sustainable forest management, invasive species and biosecurity threats.

School staff are located on three University campuses, Parkville, Burnley and Creswick, with excellent facilities for study and research, in the heart of Melbourne and in rural Victoria. The School’s research is conducted with integrity and respect, and embraces diversity and inclusion in the community.
Australia has a large amount of land that is marginal for cropping. I would like to develop sizeable areas of highly water-use efficient mallee eucalypt plantations for natural product and biomass production.

Plants produce a huge array of chemicals (natural products) many of which are of commercial value as pharmaceuticals. My research involves identifying valuable plant natural products, mapping their biosynthetic pathways, and developing methods for large scale production using plantations.
Our research centres around the question of how plants and entire ecosystems cope with changes in environmental conditions and with climate extremes like drought or heat stress. We investigate plant performance under environmental stress, and this allows us to predict which plant species will be best suited to survive and thrive in a future climate in forests, revegetation projects or urban areas.

Ecophysiology and plant adaptation

The response of plants to environmental conditions will determine their chance of survival. In this research area, we study the mechanisms that plants employ to adjust and adapt to environmental stresses, especially drought and heat stress. Studying plants along environmental gradients and under stressful conditions to determine how they survive and why they fail, we consider plant responses on a whole plant level and relate expression of plant functional traits to mechanisms and processes. We also study to what degree plants can actively respond to a change in environmental conditions and to what degree their response is genetically determined. Our research identifies the variety of mechanisms that enable plants to grow and thrive in their environment.

Applied ecophysiology

Selection of plant species that can thrive and survive in future climates is a challenge. We develop and test novel approaches for plant selection in future forests, revegetation and urban areas, determining plant performance based on ecophysiological parameters and traits and testing plant performance in challenging conditions. Working in native forests, areas of revegetation and reforestation, in urban forests and in novel ecosystems such as green roofs or woody meadows, our research identifies plant species, provenances or cultivars that are best adapted to a future climate.

Ecosystem ecology

We investigate how entire ecosystems respond to changes in environmental conditions and how the cycling of carbon, nitrogen and water is influenced by climate. We measure how much carbon is absorbed by ecosystems and quantify, how climate variation influences ecosystem growth, and the uptake or release of greenhouse gases. Key study areas are the Wombat Forest and the Whroo Nature Conservation Reserve in Victoria, where we operate eddy covariance flux towers and automated greenhouse gas measurement systems.

Our research leads to a better understanding of the impact that climate and climate change has on key ecosystem processes.
The world needs forests — for biodiversity, for water, for wood and wood products and for climate mitigation. I try to understand how best to manage today’s forests, which have been shaped by yesterday’s decisions, to meet tomorrow’s objectives.

My research focuses on understanding how native forests develop, how they change over time, how they respond to disturbances and climate, and how this knowledge can inform better forest management. An important component of this research is the use of tree rings to quantify past changes in forest structure and composition and provide important historical context to contemporary forest dynamics.

An old, fire-scarred snow gum in Kosciuszko National Park, Australia.

Exposed root mound of a canopy tree in evergreen forest in Trang Province, southern Thailand.

Relicts of landscape-scale fire in the early 20th century, Moonlight Ridge, southwest Tasmania.

Professor Patrick Baker
Forest ecology
Silviculture
Climate change
Dendrochronology

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I am fascinated by Australia’s natural ecosystems. I’m particularly interested in the ecology of plants: what determines where they grow, and how do they persist in our often-harsh Australian environment? My research interests encompass a range of environments, from semi-arid grasslands to coastal woodlands to montane forests, and a diversity of fields, from plant ecophysiology and fire ecology to soil science and carbon cycles. I’m focused on using our knowledge of natural ecosystems to support their sustainable management, and where needed, their effective restoration.

**Forest carbon**

Most land carbon is stored in natural ecosystems, particularly forests. Maintaining the health and growth of natural ecosystems is critical to stabilising and reducing concentrations of carbon dioxide in the atmosphere. Our research group assesses where carbon is stored in forests and evaluates how those stores vary with forest type, soils, and climate. Our work has highlighted the importance of both biodiversity and climate to forest carbon patterns, and the importance of carbon stores in forest soils, which are often higher than previously estimated. Quantifying patterns in forest carbon stores helps with meeting international carbon reporting commitments, identifying those carbon stores that are most vulnerable under changing climate and fire regimes, and designing the best management options for conserving land carbon to mitigate climate change.

**Wildfire environmental impacts**

Fire can renew ecosystems, but too frequent and severe wildfires — like those in south-eastern Australia in recent years — can have negative environmental impacts. We are improving the ways to monitor fire impacts on ecosystems using a suite of integrated methods based on field and remotely-sensed data. Our assessments include a diversity of ecosystems from mallee to tall forests, and a range of fire conditions, including planned burns, fires combined with drought, and multiple wildfires in quick succession. Our recent analyses confirm a trend of increasing wildfire severity in south-eastern Australia and provide evidence of persistent impacts of high-severity wildfires, particularly multiple severe fires, on the structure and composition of even the most fire-tolerant forests. We are using these understandings to develop complex landscape-scale models to better predict the effects of changing climate and fire regimes on ecosystem persistence, and to support decisions relating to effective forest management, including conserving species, communities, and carbon stores.
Trees are among the largest and longest-lived organisms on our planet — defying gravity, the elements and attack through pests and diseases, often over centuries. Our research aims to shed light on how hormonal and molecular control mechanisms have enabled trees to dominate terrestrial ecosystems and how this knowledge can be harnessed for natural forest management and the sustainable production of this renewable resource.

**Tree developmental biology**

About 37% of the world’s land area is covered by forests, and yet compared to agricultural crops, little is known about molecular mechanisms behind tree development and wood formation. This is surprising given the role of trees and forests as ‘lungs of the earth’, contributing to the composition of our atmosphere through the release of oxygen and the conversion of carbon dioxide into biomass. Reasons behind this lie in a tree’s large size and long generation times making them difficult objects to study.

Central to our investigations is a cylinder of actively dividing cells in a tree’s trunk, found just under the bark: the vascular cambium. These cells produce wood towards the inside of a stem and bark towards the outside, giving rise to much of the planet’s forest biomass in the form of wood, one of the world’s most important renewable resources.

At a whole tree level, we use molecular, genetic and genomic approaches to uncover causal links between gene structure and function and their relevance for patterning genetic diversity in natural (native forests) and artificial (breeding populations) ecosystems, with respect to physical and physiological attributes also in relation to biotic and abiotic stress tolerance.
I am a teaching specialist, which is my main focus.

I also maintain research in the following three areas:

**Kangaroo management for sustainable populations**

I investigate the use of sound to minimize conflict between kangaroos and humans in road and agricultural contexts. Any successful sounds must not disadvantage kangaroos if applied at landscape scales.

**Sustainability in education**

I research structural, conceptual and behavioural mechanisms that may empower and activate practices that facilitate sustainability, such as establishing a database of sustainability-related experiences or the perceptions and role of hope in producing action for sustainability.

**Bringing interdisciplinary practice to social-ecological systems research**

My third research area involves exploring practices and frameworks that work to integrate social and ecological knowledges, with the aim of more holistic analysis and management of social-ecological systems.
My aim is to improve the health of urban waterways through improved management of water.

I help to understand the impacts of urbanisation on waterways, with a particular focus on hydrology. I also help understand ways that urban impacts can be alleviated through the application of Water Sensitive Urban Design and better urban planning.
Dr Jane Cawson
Fire behaviour
Flammability
Fire ecology
Fire management

Eucalypt forests are one of the most flammable vegetation types in the world. Fire is extremely important to their ecology but can also pose a threat. To better manage fire regimes in eucalypt forests we need to understand what drives their flammability. Through my research, I strive to provide this knowledge and thus help to improve fire management.

My research focuses on bushfire behaviour, particularly the role of vegetation as fuel in a bushfire and how it contributes to landscape-level flammability. Spanning multiple scales from leaves to whole forests and involving a combination of laboratory and field-based methods, I work closely with fire managers to design and implement field and laboratory research that contributes to improved fire management.

Measuring fuel at Healesville Sanctuary.

Field ignition experiments in eucalypt forests.
My research focuses on how we can use plants in green infrastructure (green roofs, facades, rain gardens and woody meadows) to make cities more liveable. Urban greening can provide wide-ranging benefits for human health and well-being, biodiversity, stormwater mitigation and cooling. By understanding how plants function and selecting plants which can both tolerate and thrive in urban landscapes, we can create green and resilient cities.

My work aims to improve liveability in cities through the use of green infrastructure. As a plant scientist, much of my research has centred on understanding plant tolerances to improve survival and stormwater retention in green roofs, walls and urban plantings.

For green roofs, my research has transformed Australian green roofs and internationally has contributed to broadening plant selection beyond succulents and developed green roof substrates for hot and dry climates. This research has been published internationally, and key recommendations have influenced policy and practice. In recent years, my research has moved down from rooftops and into streetscapes and parks. In the Woody Meadow Project, I’m researching how naturalistic plantings of Australian shrubs can improve the appearance, resilience and function of low maintenance landscapes.

This research draws on an ecological understanding of how Australian shrubland communities respond to disturbance and how plant traits relate with drought resistance strategies.
We want evidence-based decisions, policy and practice to be based on the most reliable scientific evidence possible. Problems with reproducibility and publication bias and an underinvestment in error detection and peer review leave that evidence base vulnerable. My work is about building structures to ensure justified confidence in the scientific evidence base for end users and the public.

Science is often considered ‘self-correcting’, but what makes it so? Replication, error detection and systematic criticism are all important in maintaining self-correction mechanisms, but they are also undervalued activities. They typically don’t win awards or attract lots of funding. I’m interested in ways to boost those activities through introducing new incentives and by improving existing structures like peer review. I’m interested in culture and norms in scientific practice and how methodological change happens. This research includes projects like evaluating how specific interventions (eg open data mandates, preregistration) impact scientific practice and the quality of related outputs.

I’m also interested in how statistics education can reduce the rate of questionable research practices (like p-hacking and selective reporting) in ecology and other fields. I am also interested in statistical controversies in science, for example, ongoing debates about null hypothesis significance testing and between frequentist and Bayesian inference frameworks. I’m also interested in applying social science methods to assist conservation decision making and have worked on several risk assessment and behaviour change projects.
The ways people value, experience and act in forests are diverse and changing. Forests are also changing with climate change and increased fire frequency. Understanding these complex social ecological dynamics is important for enabling responsive and adaptative forest governance.

People and governance in forest systems
People, forests and governance agencies interrelate in complex dynamic systems. Our research group studies people’s interactions with forests by examining their values, experiences and practices. We study relationships in forest governance among government and non-government organisations, researchers and communities by investigating institutions, decision making and representations of forest management.

Dr Rebecca M Ford
Forest management
Social values
Climate change

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I really enjoy being a researcher and working with plants and people. My hope is that my research will help land and water managers better maintain and protect our native vegetation.

I am a wetland ecologist with a love of plants. A member of the Waterway Ecosystem Research Group within the School of Ecosystem and Forest Sciences at the University of Melbourne, I like working in partnership with Melbourne Water, DELWP, Parks Victoria and other land and water management agencies to restore our wetland environments.

My current research is focused around three projects:

1. The restoration of the wetland forests at Yellingbo, the last refuge of the Helmeted Honeyeater and lowland Leadbeater’s Possum
2. Determining appropriate environmental watering of Birrarung’s (the Yarra’s) billabongs in partnership with Wurundjeri’s Narrap (Country) Team, and
3. Mitigating the impacts of feral deer on our native vegetation.
My research focuses on the knowledge gaps and barriers that constrain our ability to create cities that support biodiversity for the benefits to both people and nature.

**Impacts of urbanisation on biodiversity**

Cities and towns represent challenging environments for biodiversity, yet they also support a high diversity of plants, animals and microorganisms. My research group seeks to understand how different organisms respond to urban impacts such as chemical and sensory pollution (light, temperature, noise), altered disturbance regimes, human activities and altered habitats. We use a combination of methodological approaches, including remote sensing and spatial data, gradient analyses and field surveys to understand biodiversity responses in terms of taxonomic, phylogenetic and functional assemblages and traits. This research has revealed three key pathways of response to urbanisation: species that are pre-adapted to urban conditions and persist in urban landscapes, species that are maladapted to urban conditions and become locally extinct, and species that display an eco-evolutionary adaptive response, such as a change in behaviour or strategy. Understanding the ecological impacts of urbanisation is a critical step in identifying how cities can be designed and managed for people and nature.

**Urban landscapes for people and nature**

Cities and towns are complex systems of ecological, social, cultural, technical and constructed elements. My research group has a heavy emphasis on providing an urban ecology and biodiversity voice to a diverse range of projects through interdisciplinary and cross-sectoral projects. Examples of projects include collaborating with landscape architects, planners and other professionals to develop best practice guidelines and other resources for practitioners; providing evidence to help prioritise urban forest and landscape connectivity actions across metropolitan Melbourne and Singapore; co-designing biodiversity interventions in urban green spaces and evaluating their effectiveness; understanding the relationships between biodiversity and human health and wellbeing; and using an evidence-based approach to identify urban-nature indicators that can be used to connect local actions with global frameworks, such as the Sustainable Development Goals and the Post-2020 Global Biodiversity Framework.

**Disentangling local and global contexts using a comparative approach**

Every city or town reflects its unique history, culture and tradition, as well as the biogeographic region, climate, and social and economic contexts they exist within. My research employs a comparative approach to help disentangle these complex influences and begin identifying general principles that apply to most cities around the world. This will also help us to understand the unique factors at the local scale that need to be considered to ensure that the understanding of impacts on biodiversity and efforts to ensure urban landscapes can support people and nature are sensitive and responsive to that particular place. I have a large network of collaborators from around the world. In particular, I am interested in flipping the dominant paradigm and finding out what the Global North can learn from researchers and practitioners in the Global South.
Healthy streams support thriving individuals and liveable communities and cities, by providing ecosystem services including clean drinking water, contaminant removal, fishery production and recreational opportunities. The health of our streams is being rapidly degraded by land use change, including agriculture and urbanisation. The ecosystem services provided by streams and the health of future generations is thus currently being put at risk. My research aims to identify, understand and measure land use impacts on streams, with the aim of finding new management approaches and policies which support the restoration and protection of streams into the future.

Investigating the structure, function and hydrology of small ephemeral headwater streams around Melbourne

Headwater streams, where catchment runoff first accumulates sufficiently to create overland flow paths, represent a dominant part of the river network by length. These smallest streams are primary sources of streamflow, important sources of organic matter to downstream waters, and act as ‘hot spots’ for retention and transformation of nutrients such as nitrogen and carbon. Their contribution to regional aquatic biodiversity has also been shown to be disproportionally large. While small headwater streams are likely to be extremely important for maintaining downstream river and bay health, they are particularly vulnerable to degradation or loss in rapidly urbanising cities such as Melbourne. Despite this recognition, we still lack a clear understanding of their ecological structure and function, and hydrologic behaviour.

Investigating linkages between flow, sediment, organic matter and instream vegetation

Instream vegetation provides habitat and refuge for instream biota, engineers biogeomorphic processes, increases hydraulic complexity, influences sediment and chemical fluxes and contributes to primary production in streams. Research has shown that urbanisation alters stream hydrology, increasing coarse sediment export and reducing organic matter storage, diversity and abundance of instream vegetation. Despite these broad scale patterns, we still lack a clear understanding of which components of the flow regime are most significant at influencing sediment and organic matter dynamics, and how they interact to influence instream vegetation retention, germination, emergence and persistence.

Investigating the potential for integrated water management to protect streams from urban development

Urbanisation degrades stream health. However, recent research has shown that retrofitting perri-urban catchments using water-sensitive urban design (WSUD) can restore some elements of stream ecosystem structure and function. The success of these WSUD approaches is dependent on sufficient space for larger systems and demand for captured water — requirements that are difficult to meet in existing urban areas, but far simpler when designed into new greenfield developments. This research investigates the potential to protect urban stream structure and function in the face of new urban development planned and occurring around the Sunbury region, west of Melbourne, Australia.
My mission is to provide the empirical, peer-reviewed evidence that underpins the conservation and management of Victoria’s forest ecosystems and the biodiversity these forests support. Through my teaching and supervision of research higher degree students, I hope to show that research and academia can be a rewarding career and that it provides the opportunity to work on what inspires you.

**Forest biodiversity and community dynamic**

Key risks to Australia’s forested ecosystems are changes in fire regimes (natural and managed) and climate change. These changes can translate to changes in forest productivity, changes in forest regeneration, increased drought stress and changes in fire frequency and intensity. Bushfire, forest management practices (including planned burning, timber harvesting and reserve design) and changing climate may interact to affect forest biodiversity, leading to significant impacts on the distribution of forest-dependent species, changes in the composition and structure of forest communities and the disruption of ecosystem services.

Our work is focused on empirical research that lays the foundations for improved understanding of the key ecological processes responsible for the response of forest biodiversity, such as threatened species and plant community composition to compounded disturbances, including altered fire regimes, changing climate and forest management practices. This work is critical to the management of forested ecosystems for improved biodiversity outcomes and the ecosystem services they deliver.
I want to make the world a better place by understanding and improving the relationships between forests and people.

I work on forests, trees and people as a social-ecological system, exploring the relationship between these and the climate system and opportunities for more sustainable management of forests, agricultural lands and natural resources. I use techniques from forest science, ecology, economics and social science to investigate challenges from global to local scales.
I enjoy contributing solutions to global conservation problems. My research interests are in ecology and evolution, biodiversity conservation and environmental decision making. Much of this work focuses on understanding animal and plant responses to fire, landscape modification and climate change. This includes doing a mix of field experiments, ecological modelling and scenario analysis.

I lead the Biodiversity Dynamics Research Group or ‘biodynomas’. Our team researches ecological and evolutionary dynamics. We primarily use field data and experiments to explore links between biodiversity and environmental change. We also build models to forecast changes in animal and plant populations, which in turn help us develop strategies to conserve biodiversity. We focus on three main areas of research:

**Plant evolution and global change**

We work in Mediterranean-type ecosystems in Australia and Spain to determine whether plant populations can successfully evolve through key traits to keep up with the rate of environmental change. Recently we have been incorporating genomics and glasshouse experiments into our work on rapid evolution, climate change and novel fire regimes.

**Fire ecology and management**

A common goal of fire management is to avoid population extinctions due to inappropriate fire regimes. Our work on this front aims to determine what mix of fire-driven variation (pyrodiversity) will promote biodiversity and how desirable levels of pyrodiversity can be achieved over time.

**Animal ecology and conservation**

We undertake field studies of fascinating mammals, birds and reptiles in southern Australia. Through learning about animals, we develop and test ecological theory and do practical things like identify critical habitat and determine the best way to manage invasive predators. We support conservation decisions by developing approaches for monitoring biodiversity and exploring how different management strategies perform under possible futures.

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I do research designed to have impact, to change government policy on various biosecurity measures, such as effective border quarantine and post-border surveillance measures, as well as policy responses to climate change.

My research specialises in biosecurity, large-scale computational modelling, climate change, and natural resource and environmental economics. I work on estimates of the potential economic damages from climate change across different temperature settings for over 120 different countries and over 50 commodity sectors, as well as emissions reductions pathways. I also do work on the economics of biosecurity for plant, animal and human health. This involves work on optimal post-border surveillance for the early and cost-effective detection of pests and diseases to protect agriculture and the environment.

Left: Along with 'flattening the curve' for COVID-19, there's an urgent need to address potential damages from climate change.
At the Forests and Water Research Group, we seek to improve our ability to understand and predict the hydrologic impact of climate variability, forest growth dynamics and forest disturbances. This research is aimed at improving water resource planning in Australia by researching the biophysical processes driving hydrologic change to underpin the development of models for real-world application to forest and catchment management problems.

**Forest hydrology**

My research interests include the impact of forest growth dynamics and disturbance on evapotranspiration and streamflow, the impact of fire on erosion and water quality and the biophysical processes underlying the catchment responses. The effects of fire and climate change is a particular focus of my research.

Measuring forest transpiration.

Measuring post-bushfire water quantity and quality.
I am motivated to develop methods that can make our environment better for both humans and the natural world. I enjoy my research because it combines two primary interests: ecology and mathematics, a combination of abilities and interests that seems relatively rare, so I seek to assist better environmental management through novel insights and the development of useful methods.

Quantitative and applied ecology

I am interested in developing, evaluating and applying models to assist ecological management. My research spans many areas, including detection of invasive and rare species, population dynamics, fire ecology, synthesis of ecological data and environmental risk assessment. The common theme is using quantitative methods such as mathematical analysis, simulation modelling and statistical analysis to help synthesise information so as to inform ecological management.

Combining quantitative methods with ecology can provide insights that might otherwise be overlooked. Much of my research involves the development of novel quantitative methods, leading to an expanding program focused on the evaluation of models. I work across numerous ecological systems and with a range of species, including plants, vertebrates, invertebrates and micro-organisms. I have worked on projects related to marine, freshwater and terrestrial environments, from arid regions to tall forests.

Eucalypt tree. Hollows in eucalypt trees are a key resource, but how do we detect them (and the species that occupy them) most reliably? My research on imperfect detection in ecology addresses this question.

The mountain ash forests of Victoria. The mountain ash forests of Victoria provide much of Melbourne’s water, they are harvested for wood and have extremely high environmental values. They also burn at unpredictable intervals. My research aims to help predict the impacts of unplanned fires on the range of values of these and other forests.
Aboriginal peoples have been caring for and nurturing this place for tens of thousands of years. There exists a deeply reciprocal relationship between Aboriginal peoples and country that nourishes not only the natural world, but provides for complex cultural practice and rich community relationships. As a Darug researcher, my aim is to respectfully work alongside community to embed Aboriginal country care into contemporary applied ecology.

Ecological knowledge of Country

The interconnectedness of Country, culture and community for Aboriginal and Torres Strait Islander peoples is at the centre of our world views. The health of any one of these elements relies on the health of the others. As Aboriginal people, we share a kinship with Country and nature which is expressed through our continued cultural practice. This relational ontology dictates that country is to be cared for and to be loved, and that Country is capable of caring and of loving in return. My research seeks to find ways to bring together ways of knowing country in land management.
Urban environments are growing around the world as more and more people move to cities. Urbanisation brings many benefits but also impacts natural systems in many different ways. My research is motivated by a love of nature and a desire to make cities better places for all their inhabitants — both the human and the more-than-human.

**Urban ecology and conservation**

My research focuses on the ecology of urban environments and ways in which we can create better cities for people and nature. This includes work to highlight the importance of cities as places for biodiversity and to better understand the different challenges faced by our urban wildlife including frogs, birds and insects. Lastly, my research focuses on practical solutions to help conserve biodiversity and connect people with nature in their neighbourhood.

**Science communication**

I’m a keen science communicator and enjoy sharing stories of nature in the city, including via my blog at kirstenparris.com and through stand-up science comedy.

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A motorbike frog from Fremantle, WA, living the suburban lifestyle.

A small frog from Frog Fest 2019, a family-friendly festival celebrating Melbourne’s biodiversity.
Wildfires are a key ecological process that have shaped global biodiversity for millennia. Despite the evolution of plants and animals with fire, fire regimes are changing and happening in a rapidly changing world. There is an urgent need to understand how fire can be managed to help conserve biodiversity.

My research focuses on understanding how fires (both wildfires and planned fires) affect the distribution and abundance of animals. In particular, I’m interested in how properties of fire regimes such as size, intensity and frequency vary in different ecosystems and what the implications of this are for biodiversity. I study the effects of fire regimes on important ecological processes such as animal movement, habitat use and species interactions. Additionally, I am interested in determining how fire interacts with other threats such as land-use change, invasive predators and climate change.

I work with a range of animal groups, including birds, mammals and reptiles and conduct primarily field-based research across a range of ecosystems in south-eastern Australia, including heathlands, woodlands and tall forests.
My research aims to develop solutions to the suite of environmental problems created by urbanisation. Green infrastructure can mitigate the negative impacts of development on our waterways, as well as improve the quality of life for people. My aim is to help build the evidence base required to make the major policy changes necessary to achieve sustainable development.

Cities generate substantial volumes of polluted runoff, which is carried by highly efficient drainage networks to our creeks and rivers. As a result, we not only waste precious water resources but also degrade waterway ecosystems. I study engineered vegetated systems which are designed to reduce the volume of polluted stormwater in urban waterways. My background is in plant ecophysiology, studying nutrient uptake mechanisms and drought tolerance in vegetation far from the city at restored mine-sites and eucalypt plantations.

Urban environments provide a fantastic opportunity for plant ecophysiologists to contribute to mitigating impact of cities on the environment, as well as making them better places to live. I work mainly on improving the design and function of green roofs, street tree systems, constructed wetlands and biofiltration systems.
There are roughly 300,000 plant species. We know a lot about some, but not others. Effective conservation and management require good ecological knowledge. I aim to speed the development of that knowledge through measurable plant traits and quantitative models.

I am a quantitative ecologist who integrates fundamental and applied research, working mainly with plants. A clear challenge in plant ecology is how to generalise understanding: how to move beyond treating every study and every species as a special case.

Research in my group mainly falls in two fields:

1. The analysis of plant functional traits and types and their generality
2. Predicting, planning and measuring the outcomes of vegetation conservation, management and landscape restoration.

Most of the work includes developing and applying conceptual and quantitative ecological models appropriate to the problem at hand.

The use of functional traits provides a means to transfer knowledge from well-studied species to less well-studied species. That can be about where plant species occur or how they grow or respond to fire.

On the topic of vegetation management, our work on Eucalypt woodlands spans conducting experiments on tree regeneration, providing models of vegetation change and the provision of animal habitat, and we monitor the outcomes of management for plant and animal communities.
I aim to improve the health of our rivers and streams by working with partners to change land and water management practice.

Protecting and restoring stream ecosystems

The way people use land, particularly how they drain it, degrades rivers and streams, resulting in the loss of the rivers’ remarkable biodiversity and the ecosystem services they provide, such as the provision of fresh water. Our research aims to identify and prioritise alternative approaches to urban (and rural) land and water management to protect and restore streams and maximise their biodiversity.
I am to provide an empirical basis for better understanding relationships between forest management and fuel hazard. I also investigate indigenous cultural burning practices in relation to forest carbon balance, greenhouse gas emissions, forest resilience and fuel hazard.

I am a forest ecologist with expertise in soil science and forest ecosystem ecology. My interests include the ecology of Australian forests and nutrient cycling in forest soils. My research focuses on the biogeochemistry of forest ecosystems, the productivity of forests, carbon and nutrient cycling in forests, greenhouse gas fluxes from forests and bushfire fuels science. Current projects include recovery of bushfire fuels after wildfire, recovery of tropical forests following fire and management of tropical plantations for sustained productivity.
My mission is understanding people and how they connect with nature — social science to help protect, restore and manage ecosystems.

My research extends knowledge of human-environment relationships and applies this to issues of environmental management. My work is grounded in environmental psychology, but I often work in teams of academics from other disciplines to address challenges associated with ecosystems in urban and wider landscapes.

**Human-nature connections**

My research explores human relationships with natural environments, ecosystems, plants and animals, and with ‘nature’ more broadly. Much of this work is concerned with nature in cities: plants, urban greening, and ecosystems that support urban populations. My interest is in understanding the psychological dimensions of these connections. One aspect of this work examines how environments influence psychological function and experience, such as changes in mood, attention and creativity. A second aspect is concerned with factors that underpin environmentally significant behaviour, such as social values, understanding, and emotional affiliation with the natural world.

**Social expectations and environmental policy and practice**

Much of my work has been with forest and fire management agencies, helping them to understand psychological factors than are relevant to their decision making. For example, I have worked with colleagues to better understand why people support or oppose different ways of managing forests or using land. Increasingly, this work has focused on understanding how knowledge from social research can be integrated into environmental planning and management.
I work predominantly in urban areas because although they are the cause of many of the world’s environmental problems cities also offer humanity great hope for a sustainable future. I seek to understand urban biodiversity patterns and ecosystem processes and then develop applied solutions to reduce the negative impacts of urbanisation such as biodiversity loss, excess urban heat, stormwater runoff and CO₂ emissions. I am passionate about demonstrating how native plants can be used more widely in cities to provide ecosystem services such as cooling and stormwater adsorption, biodiversity habitat and greater connection to country for all Australians.

Urban Ecology

I am interested in how urbanisation affects the assembly of plant and animal communities, their distribution and what characteristics or traits of species mediate this. My research in this area has included sampling local and regional vegetation and insect communities, quantification of plant traits, and international collaborations which have developed influential syntheses and conceptual frameworks.

Green Roofs

Over the past 12 years, I have led green roof research in Australia, working with other Green Infrastructure Research Group members to create a collaborative, cross-disciplinary network of researchers, government agencies and industry partners. We conduct high-quality research encompassing green roof substrate design, plant palette selection and testing, and quantifying green roof stormwater, energy and social benefits. This work has provided the evidence base for state and local government policy and planning schemes and was integrated into the award-winning Growing Green Guide. More recently, we have been researching how to increase the uptake of green roofs in Australian cities.

Native grassland and grassy woodland ecology conservation, restoration and management

Southeastern Australia’s native grasslands and grassy woodland are critically endangered ecosystems threatened by urbanisation and land-use intensification. My research has sought to better understand their ecology and develop effective management and restoration techniques. It builds on work done in my PhD and decades of research at the University’s Burnley Campus and includes herbivory, seed ecology, nutrient manipulation and direct seeding techniques for restoration. I have also edited a book on the ecology, restoration and management of native grasslands and developed an app to increase awareness and help species identification.
I am motivated by the conservation of species because I have been so lucky to experience the awe and wonder of nature and wildlife. I want future generations to have that opportunity. When we allow extinctions, we steal something precious from future generations.

Australia’s biodiversity is unique and rich. Australia is one of the world’s ‘megadiverse’ nations, with more species than any other developed nation and the highest levels of endemism (uniqueness). 87% of our mammals, 93% of our reptiles and 94% of our frogs are found nowhere else on the planet. Yet Australia is at the forefront of extinctions driven by dramatic land use change (habitat clearing and degradation) and the proliferation of invasive species following European invasion. We have the highest rate of biodiversity loss of any developed nation and the second highest rate of loss on the planet. We are responsible for 35% of all mammal extinctions globally since 1700. On average, our threatened bird populations have declined in abundance by 50% since 1985.

I will engage in any research anywhere on the planet that can help stem the tide of extinctions, but I do most of my work in Australia. I currently lead work in several key areas of conservation research: on-ground trials of conservation actions, design of monitoring to understand the state and trends of species and the effectiveness of conservation actions and policy, the costs of conservation, prioritisation of conservation investment and ongoing conservation policy failure.