TERRESTRIAL ECOLOGY AND DIVERSITY 1

Thursday 9th February | 10:50am - 12:00pm

Room: Main Hall (MB6)

Jess Lawton

La Trobe University

@jesslwtn j.lawton@latrobe.edu.au

Citizen science and community action provide insights on a threatened species: nest box use by the brush-tailed phascogale.

Landscape management and restoration in rural environments is frequently driven by community groups, who often use 'flagship' species to generate broader engagement. Installation of nest boxes for hollow-dependent fauna is a common activity undertaken by such groups. Monitoring the outcomes of such projects offers opportunities for citizen science. We report on a community-led project to install and monitor nest boxes to enhance the conservation of a threatened species, the brush-tailed phascogale Phascogale tapoatafa. A community group installed 450 nest boxes across 150 sites to monitor and provide habitat for the brush-tailed phascogale. Of these, 102 sites were stratified in relation to: 1) geographic sub-region, 2) forest patch size, and 3) topographic position. Nest boxes were inspected five times over eight years. We modelled factors influencing nest box use at the tree-, site-, and landscape-level, and compared nest box data with data from camera traps at 50 sites to assess their value as a monitoring tool. In any given survey, up to 6% of nest boxes had phascogales present and up to 22% had evidence of use by the brush-tailed phascogale. Tree- and site- level factors influenced nest box use by this species; landscape-level factors were not important predictors. Remote cameras were more effective at detecting phascogales than monitoring nest boxes. Nest box monitoring can provide insights into the distribution and habitat requirements of hollow-dependent species and engage the community in citizen science. We discuss how collaboration between scientists and community groups can benefit both parties.

Kevin Newman

PhD Candidate, University of Melbourne

@kdnewman87 kdnewman87@gmail.com

Lure? Nah mate, Din-go

Camera traps are used increasingly for wildlife monitoring and a scent lure is often placed in front of each camera to increase the chance of detection. Statistical methods for analysing camera trap data are typically sensitive to variation in detection among individuals. However, measuring this variation is difficult in wild populations because the identity of individuals is often hard to confirm and the number of undetected individuals within the population is essentially unknowable. This study was on a captive population of dingoes (Canis dingo) to study factors that influence detection by camera traps with or without lured stations. Dingoes, Australia's largest predator, are a threatened species in Victoria. There is limited information available on their population due to their shy and cryptic nature. We aim to inform future research to understand how detection varies by individuals within a species and how this impact estimates of population sizes. Over a 30 day period we tested 18 individual dingoes (in pairs) in a large exercise yard with three treatments; camera only, unbaited station or baited station. The dingoes were a mix of captive and wild-born individuals with an even split of males and females. We found that there was an initial response to the baited lure by all dingoes followed by a sharp decline in detection for most. There is an individual response, particularly for captive-born dingoes, who are more curious about the object.

Ryley Johnston

Honours Graduate, Deakin University

ryleysjohnston@gmail.com

Mapping species' distributions: how useful is citizen science? A case study of the Koala (Phascolarctos cinereus)

Landscape modification and degradation are placing unprecedented pressure on species distributions and ability to persist in their environment. Accurate and regionally relevant information on species' distributions, and the factors driving them, are therefore imperative for effective and targeted conservation efforts. Citizen science programs provide an opportunity to expand the scale of monitoring efforts while reducing the resource limitations associated with traditional systematic survey techniques. In this study I compared the ability of citizen science to produce an accurate model of koala occupancy on the Mornington Peninsula, with a systematic survey approach using passive acoustic monitoring (PAM). Passive acoustic monitoring was undertaken during a single koala breeding season at 100 sites encompassing the different landscape types across the region. I used MaxEnt to model koala presence and to determine the factors influencing distribution from community sighting records. PAM produced a model that had high confidence (95%) in detecting koala presence at a site and low uncertainty across the region. The citizen science model was affected by spatial biases and errors in reporting accuracy, which reduced the predictive ability of the model. In comparing the two models, citizen science over-predicted koala presence across much of the Mornington Peninsula and under-predicted in parks, and areas where koala activity was detected by PAM. My study demonstrates that more guidance is needed to direct search effort of volunteers to maximise the quantity and quality of data. Ultimately, a collaborative approach which employs both techniques would capitalise on the benefits a citizen science monitoring approach provides, whilst maintaining the accuracy and reliability of systematic surveying.

Jessica Chapman

MSc at La Trobe University

jessicacatherine159@gmail.com

The Impact of Insectivorous Birds on Invertebrate Communities and Pasture; an Experiment in Avian Conservation Biocontrol

In the face of the biodiversity crisis, it is crucial to incentivize farmers to make their land more wildlife friendly. As a form of conservation biocontrol, birds may suppress agricultural invertebrate pests reducing damage to pastures and crops, if enough native habitat exists in the landscape to support avian populations. Pasture is of particular interest for habitat conservation given the wide spread of the land use type across the continent. We conducted a paired control/treatment bird exclusion experiment to assess the impact of birds on the invertebrate community and pasture quality. Pairs were established across distance intervals from adjacent remnant habitat and in both the presence and absence of scattered paddock trees. Invertebrate samples, pasture biomass, and measures of pasture vertical growth were taken from each pair. Invertebrate samples were also taken from individual paddock trees at distance intervals. Invertebrate specimens were IDed to a taxonomic level that gave an indication of their functional group (typically to family level). Results suggest that invertebrate abundance is influenced by distance to adjacent remnant, especially in the first 20m, and is generally higher when birds are excluded. Some invertebrates are influenced by the presence of scattered trees, but few are influenced by individual trees. Pasture biomass was higher in control zones when scattered trees were present, suggesting that scattered trees facilitate insectivorous birds to a degree where their suppression of the invertebrate community translates to increased pasture quality.

Eliza Thompson

PhD student, The University of Melbourne

elizat2@student.unimelb.edu.au

Nest boxes for the hollowless: can they work?

Nest boxes are a popular conservation tool across the world. They have been used for bushfire recovery, endangered species conservation as well as within urban areas for human-wildlife connectedness. An area that could benefit from nest boxes are forestry plantations. Here there is a shortage in natural tree hollows due to land clearing and conversion majorly altering the ecosystem. Within such areas there have been various nest box monitoring programs, yet a synthesis on their effectiveness has not been evaluated. Are nest boxes effective measures for conserving and promoting wildlife? Or do they just exacerbate problems and attract unwanted species to the ecosystem? Here we summarise the currently available literature on nest box usage within plantations. We highlight their purpose for installation, their design and the species that are attracted. With this synthesis, we hope that the future of providing artificial breeding habitat for birds is optimised, creating landscapes where wildlife can coexist with forestry.

Clare Bracey

PhD student, Monash University

@BraceyClare clare.bracey1@monash.edu

Effectiveness of privately protected areas for the temperate woodland bird community

Australian woodland birds are a vital component of woodland ecosystems through their functional roles as pollinators, seed dispersers and insect control. Yet temperate woodland birds are declining, with an estimated loss of 70% of their historic habitat. The woodland bird community, which includes 197 species relying on woodlands for survival, is nominated as a threatened ecological community under the Environmental Protection and Biodiversity Conservation Act. Despite decades of research on woodland birds, focussing on their response to threats such as tree clearing and grazing, there is limited research about their response to management actions implemented to alleviate these threats. It is critical to understand the impact of conservation management to woodland birds, to determine the most effective actions and enhance the outcome. One common action for the conservation of threatened species is legally protected areas. However, protection on public land is inadequate to conserve many species and ecosystems. The inclusion of privately protected areas within the protected area network provides one mechanism to address this shortfall. I am exploring the effectiveness of privately protected areas at increasing (or maintaining) woodland bird species richness, abundance and community condition. Using the '2 ha 20-minute' standardized survey method, I have conducted bird surveys on private properties with a protected area (treatment, n=40) and nearby properties without a protected area (control, n=35). This research seeks to provide recommendations that will have direct impact for the woodland bird community and will be relevant to on-ground management and planning decisions for privately protected areas across Australia.

INVERTEBRATE ECOLOGY AND DIVERSITY

Thursday 9th February | 10:50am - 12:00pm

Room: MB10

Monique Burns

Honours student, University of Melbourne

meburns@student.unimelb.edu.au

Comparing wild bee communities at indigenous and exotic urban understorey plantings

Cities often house a diversity of bee species, highlighting their importance for wild native bee conservation. Understorey plants can provide more floral resources to support urban bees and their pollination services. However, the influence of vegetation origin, landscape context and other local characteristics of understorey plantings on bees is unclear. Furthermore, research on the effects of bee species traits in the urban context is lacking. I sampled the bee communities at 17 exotic and 15 indigenous understorey plantings around inner Melbourne. For each site, I recorded mulch cover and measured features of the landscape context in 200 m buffers. I then used Hierarchical Modelling of Species Communities to determine how bee traits may mediate species responses to the investigated variables. Indigenous plantings attracted a greater diversity of bees compared to exotic plantings, with certain plants, such as Wahlenbergia, particularly attractive to a variety of bees. Many native bees responded positively to Myrtaceae tree abundance in the landscape, but none responded to impervious surface. A single bee species responded to mulch cover and its response was negative. Bee traits were not found to influence bee species responses to any of the investigated variables, likely due to the small number of observed bee species that were mostly members of the genus Lasioglossum and exhibited similar responses to environmental variables. My results suggest that growing indigenous understorey plants and increasing native vegetation in the landscape can have a positive influence on urban native bees, thereby contributing to the conservation of bee fauna.

Graham Jury

Consulting Ecologist, TREC Land Services

graham.jury@treclandservices.com

Golden Sun Moth Conservation in Victoria - Challenges and Future Directions

Synemon plana is a Threatened Castniid moth endemic to southeast Australia. The presence of abundant S. plana populations within sheep grazing land has raised questions regarding its response to traditional habitat restoration approaches. In 2022, TREC Land Services and Trust for Nature, completed a knowledge synthesis, intended to highlight knowledge gaps in the ecological management of S. plana and to identify future research directions. Victoria's S. plana populations comprise poorly documented rural populations and fragmented urban populations, with both threatened by development. S. plana has specific biomass requirements that can easily be upset by inappropriate land use practices. Natural S. plana habitat contains native C3 grasses, especially Wallaby Grasses (Rytidosperma spp.). Many such landscapes in Victoria have been modified by stock management, which, under certain conditions, has produced disturbance processes resulting in a dominant native C3 grass structure. S. plana is threatened by the influx of exotic weeds into native grasslands, which alter site structure. Small, isolated urban populations are threatened by genetic factors, including recruitment failure and diminished gene flow. Managing a site S. plana habitat, requires maintaining an appropriately structured grass sward, through intensive biomass reduction approaches. We identify a primary need for: Formal identification keys for S. plana pupae and larvae, providing improved survey efficiency during suboptimal flight seasons. Additional areas include: The response of S. plana to ecological burning and to different grazing intensities; the genetic diversity of S. plana is overdue a reanalysis, due to the abundance of new populations discovered over recent decades.

David De Angelis

Frogs Victoria

d.deangelis@latrobe.edu.au

Myiasis in Australian frogs caused by ectoparasitic fly larvae

Myiasis, or the infestation of living animals by dipteran larvae that feed on living or necrotic tissues, occurs in a range of vertebrates including frogs. Globally, flies in four families (Calliphoridae, Chloropidae, Phoridae, and Sarcophagidae) are known to infest amphibians. Until recently, only 11 fly species in the obligate frog-feeding chloropid genus Batrachomyia (subfamily Oscinellinae) had been thought to cause myiasis in Australian frogs. This talk introduces several instances of external parasitism of frogs by fly larvae in Australia being investigated for the first time. These involve flies in genera other than Batrachomyia infesting frogs in the families Pelodryadidae and Limnodynastidae in Victoria, New South Wales and Queensland. Unlike Batrachomyia larvae which feed subcutaneously, those of the flies being investigated attach themselves externally, including on the trunk and hind limbs of frogs. The rate of parasitism in an area surveyed in central Victoria appears to be low, with a total of 15 larvae found on eight Southern Brown Tree Frogs (Litoria ewingii) among 739 frogs sampled. Although infested frogs appeared to be mostly unaffected, infestation of Victorian Tree Frogs (L. paraewingi) likely resulted in very poor red blood cell counts. Further study is needed to inform the identification and determine the life cycles and ecology of these parasites, as well as the impacts on their hosts. The findings so far indicate the incidence of myiasis and diversity of flies causing the condition in Australian frogs is greater than currently realised.

Duncan Jaroslow

Graduate researcher, La Trobe University

Duncan.Jaroslow@latrobe.edu.au

Terrestrial invertebrate associations with Marchalina hellenica infestations and honeydew availability

Honeydew-producing, herbivorous insects represent a significant proportion of plant pests and can impact local habitats by damaging host plants and excreting carbohydrate-rich honeydew. In 2014, the honeydew-producing scale, giant pine scale (GPS) (Marchalina hellenica, Marchalinidae, Hemiptera), was detected in south-east Melbourne, feeding on Pinus radiata. In its introduced Mediterranean range, GPS is linked to reduced host health, reductions in local invertebrate biodiversity, and provides honeydew to numerous invertebrate species. In this study, pitfall traps were used to assess if ground-dwelling invertebrate communities were altered in association with GPS. Both GPS infestation and a honeydew availability index (HAI) were associated with changes in abundance and decreased diversity of invertebrates at broad taxonomic ranks. Amphipoda, Aranea, Isopoda, and Psocoptera abundances were either reduced in infestations, or negatively correlated with HAI. Although variation in Formicidae communities were better explained by other habitat variables, the abundances of several native ants were related to HAI, such as Rhytidoponera metallica. Further, the relative abundance of some of these ants negatively correlated with one another, suggesting these ants exert interspecific competition for novel honeydew resources and may restructure local ant communities. The consequences of GPS infestation can vary greatly with the ecological importance of each associating taxon. These results illustrate how individual exotic species can alter local invertebrate communities at broad and specific taxonomic levels.

Edward Tsyrlin

Graduate student, University of Melbourne

tsyrline@student.unimelb.edu.au

Molecular methods find the new black or the other 95% of animal diversity

Around 95% of all animals in Australia are invertebrates and insects contribute to 57% of known Australian animal diversity. Apart from focal or economically important species, the state and the effect of climate change and human activities on most invertebrate species remains unknown. This is partly due to difficulties in recognising the known species and taxonomic uncertainty among many taxonomic groups. Combination of traditional and molecular methods presents efficient and cost-effective options for species detection, discovery and taxonomic investigations.

Here we present two case studies: (1) results of surveys of the critically endangered Mt Donna Buang wingless stonefly, (Riekoperla darlingtoni) and a flightless Kallista stonefly (Leptoperla kallistae) using environmental DNA. (2) preliminary results of a taxonomic study of critically endangered Dandenong amphipod (Austrogammarus australis) and endangered Sherbrooke amphipod (Austrogammarus haasei) based on DNA barcoding. The results of the survey of Mt Donna Buang wingless stonefly contributed to the alteration of development of the mountain bike trails through its primary habitat, Cool Temperate Rainforest and provided data for the species listing under the EPBC act.

The unravelling of the amphipod taxonomy allows for further studies of their distribution, natural history and conservation status. The new knowledge on the distribution of flightless stonefly will be used by Melbourne Water and the local council to direct their management actions and to set local environmental standards like stormwater drainage, maximum allowed level of water extraction, and the minimum width of vegetation buffers required along the local waterways.

THREATENED SPECIES AND COMMUNITIES

Thursday 9th February | 10:50am - 12:00pm

Room: MB11

Javiera Olivares-Rojas

PhD Student, Monash University

@javiera_or javiera.olivaresrojas@monash.edu

Species or communities? Identifying cost-effective surrogates for threatened biodiversity management

Given the current biodiversity crisis and a long-term shortfall in conservation funding, surrogate approaches are commonly used when it is impractical or unfeasible to manage all biodiversity of conservation concern. Surrogate species (i.e. umbrella species) have proved to be a cost-effective management approach for threatened species. However, there are no studies evaluating the performance of threatened ecological communities (TECs) as management surrogates, despite the potential broader benefits for biodiversity. We evaluated the use of species, communities or both as management surrogates to maximise conservation outcomes in Australia, under two scenarios. The first scenario aimed to maximise benefit to threatened species, by comparing the cost-effectiveness of a species- or TEC-surrogate approach, accounting for geographic co-occurrence, common threats and management costs. The second scenario aimed to maximise benefit to both species and communities, comparing the performance of a species-only approach versus a combined-approach, which included TECs and species as surrogates. For the first scenario, a community-approach performed poorly due to a lack of geographic overlap with species and high management costs. In comparison, the species-only approach delivered a 700% increase in benefits under the same budget. For the second scenario, prioritising management using a combined-approach delivered the greatest benefit for the same cost compared to the species-only approach. Our findings suggest that prioritising funding across both species and communities is more cost-effective than focusing on either a species-only or community-approach. The best approach, however, would only result in management for 22% of all threatened species and TECs under current spending estimates.

Phoebe Burns

Native Rodent Biologist, Zoos Victoria

@DrPABurns pburns@zoo.org.au

Recovering the Pookila (New Holland Mouse) in Victoria

The endangered Pookila (New Holland Mouse; Pseudomys novaehollandiae) has disappeared from seven of 12 historically occupied parks and reserves in Victoria since 1976. The species has suffered from habitat loss and fragmentation, invasive predators, drought and competition with invasive rodents. Remnant Victorian populations have dangerously low genetic diversity, making them susceptible to ongoing decline, and less resilient to a changing climate. As the factors threatening Pookila worsen, we have developed a multi-faceted and multi-organisation approach to fight extinction and recover this species.

For wild populations, we are working with land managers to mitigate threats on-ground and conducting ongoing monitoring, tracking population trends and responses to management actions. Dramatic declines in recent years have made the addition of ex-situ conservation necessary. In Autumn 2022 we collected a small number of individuals from the wild and established a breeding program at Melbourne Zoo and Moonlit Sanctuary to conserve the species' remaining Victorian genetic diversity. The individuals bred through this program will enable genetic rescue across genetically depauperate populations within the species' Victorian range and others will be reintroduced to parts of the species' historical range where the threats that led to its extirpation can be addressed, including the establishment of a semi-wild insurance population.

Arabella Eyre

Zoos Victoria

aeyre@zoo.org.au

Translocation trial of the Critically Endangered Lowland Leadbeater's possum

Two genetically-distinct management units of Leadbeater's possum (Gymnobelideus leadbeateri) are recognized, a highland population occupying a 70 x 95km region and an outlying lowland population. This lowland population once inhabited swamp forests and paperbark thickets around Western Port bay, but is now restricted to a single reserve with just 24 individuals remaining. The population has continued to decline due to habitat degradation and inbreeding depression. A conservation translocation near Mansfield was undertaken in 2021 in an attempt to increase the number of lowland Leadbeater's possums. Initial success was achieved with territories established and breeding recorded. However, five months post-release an increased predation rate resulted in the termination of the translocation trial. The dynamic nature of predation leaves very small populations at high risk from just a handful of predation events. Thus given the species' vulnerability to predation and very few remaining individuals, establishment of a 'safe haven' site is the most likely pathway to prevent the extinction of this unique genetic unit.

Xenia Münger

PhD student, Monash University

@xeniamuenger xenia.muenger@monash.edu

How effective are models in predicting the genetic outcome of translocations?

Human activity has led to a surge in biodiversity loss. In Australia a third of endemic terrestrial mammals are either listed as threatened (~21%) or have gone extinct (~10%). A large part of this loss is attributed to introduced predators (feral cats, Felis catus; European red fox, Vulpes vulpes). The results: contraction of species ranges, isolation and fragmentation of populations. Such populations are at risk of being drawn into the extinction vortex. Small and isolated populations lose genetic diversity through inbreeding and random genetic drift. In the long term this reduces the evolutionary potential and increases the risk of extinction. Conservation management actions such as translocation, supplementation and reintroduction are counteracting the loss of genetic diversity. However, practitioners face many questions: Which populations are a suitable source? What is a sustainable harvest rate? What sex ratio and what frequency of supplementation maximises the translocation outcome? Many open questions remain. This research is designed to answer some of these questions by building PVAs incorporating genetic data for two threatened marsupials. The aim is to validate the predictions through hindcasting and to forecast population viability to support decision making. With a broad view, there are many unknowns concerning the usefulness and accuracy of such models. For threatened species in particular, any management decision requires careful consideration of all potential outcomes.

Julian Voet

Graduate student, University of Melbourne

@julz_down_under (instagram), @julzdownunder (youtube) jvoet@student.unimelb.edu.au

Persoonia arborea

In the Wet Forests of the Victorian Central Highlands, the two major forms of disturbance are wildfire, and logging for timber production. The main form for logging is “clear-fell, burn and sow” (CBS), which is aimed to imitate the natural disturbance (wildfire) in this ecosystem. However, studies have shown that CBS led to significant floristic differences compared to wildfires, especially for understorey species. One such species is the Tree Geebung (Persoonia arborea), a small tree that is geographically restricted to the Central Highlands. According to the most recent inventories, it is listed as endangered under the Flora and Fauna Guarantee Act 1988 (2022) and critically endangered under the IUCN Red List of Threatened Species. P. arborea appears to respond well to disturbances, being adapted to fire as an obligate seeder and coming up en masse along old logging roads that were subjected to mechanical disturbance from harvesting activities. P. arborea is thought to have long primary juvenile periods and is notorious for being difficult to germinate from seed, like other species in its genus. As a result, it may face serious conservation issues in an ever-changing climate. Untangling the long-term interactions between disturbances and plant demographics will be essential to predict how P. arborea will fare in the face of expected climate adversities. The purpose of this study then, is to identify differences in population dynamics of P. arborea through a broad range of disturbance histories linked to the two major disturbances in the Central Highlands: wildfire and harvesting.

FIRE ECOLOGY

Thursday 9th February | 2:30pm - 4:05pm

Room: Main Hall (MB6)

Benjamin Wagner

Research Fellow - The University of Melbourne

@gliderhabitat benjamin.wagner@unimelb.edu.au

Assessing the quality of post-fire foraging and nesting resources for arboreal gliders in mixed Eucalyptus forests

Understanding the distribution and quality of key foraging and nesting habitats in post-fire landscapes and the associated occurrence and abundance of arboreal gliders is critical for identifying and protecting surviving populations and conserving areas of potential future habitat. Our research combines pre- and post-fire surveys on glider occurrence in mixed species forests of East Gippsland, Victoria, analyses of foliar nitrogen and leaf chemistry of mature and epicormic regrowth, as well as assessments of forest structure and hollow availability. From this data, we develop models of greater glider habitat suitability and abundance/occurrence in post-fire landscapes. The role that foraging and nesting habitat provision within the landscape plays in population survival and recovery of greater gliders has not been quantified and remains a critical knowledge gap. This gap is accentuated by the disjunct spatial arrangement of foraging habitat. Foraging resources in mature forests in the East Gippsland region are more limiting than nesting resources and are influenced by species, soil, topography and climate. The aim of our project is to quantify the post-fire occurrence of foraging and nesting habitat in a matrix of burnt and unburnt forests and to understand how spatial patterns of these resources influence arboreal glider occurrence and abundance across the study region. Hence, our project seeks to determine where in the landscape gliders are utilising post-fire forests for nesting and foraging and what determines their survival in burnt forests. This project will provide critical information for post-fire conservation plans for gliders in Victoria.

Sandra Penman

PhD Candidate, The University of Melbourne

@shpenman spenman1@student.unimelb.edu.au

The impact of repeat high severity fires on microbats

Future fire regimes are characterised by more frequent, high severity fires. Short-interval high severity fires have been identified as a threat across many forest ecosystems as these fires increase plant mortality and inhibit recruitment, transforming forest structure. Changes to forest structure in the temperate forests of SE Australia has implications for the fauna that inhabit these forests. Microbats comprise around a quarter of Victorian native mammals and are susceptible to fire-mediated changes in habitat structure. To understand the impacts of repeat high severity fires we sampled microbats and vegetation structure in a dry sclerophyll forest in West Gippsland that was burnt by wildfire in 2007, then re-burnt in 2013. All sites were sampled at 9 years post-fire. The severity of the past two fires at each site were classified as understorey (U) or canopy (C) fires, giving repeat severity patterns of UU, UC, CU, and CC across the sites. Overall bat activity was highest at sites where the most recent fire was a low severity understorey fire. Vegetation structure also varied between the fire histories, with terrestrial LiDAR allowing for fine scale comparisons. Our findings demonstrate that increased occurrence of high severity fire may modify bat communities across the temperate forests of south-eastern Australia. Understanding these responses will enable us to identify species that are most susceptible to repeat high severity fire and will aid conservation management.

Rachel McIntosh

PhD Student, La Trobe University

r.mcintosh@latrobe.edu.au

How does time-since-fire affect two adjacent vegetation communities along a climate gradient?

Fire and climate are frequently linked with patterns of vegetation structure across the globe. Understanding how these abiotic factors interact can improve ecological outcomes of fire management. Western Victoria is a semi-arid, fire-prone region that lies along a latitudinal climate gradient: mean annual precipitation decreases and temperature increases from south to north. This climate gradient has been linked to fire frequency and the natural patterns of vegetation structure in the region. This study focused on two vegetation communities in conservation reserves along the climate gradient: treeless heathland and treed mallee. We aimed to: 1) identify structural differences between vegetation communities and 2) determine whether the importance of time since fire differed between vegetation communities and along the climate gradient. 50% of structure variables were different between vegetation communities however this did not always translate to different time-since-fire responses. Time-since-fire was significantly associated with more structure variables in the lower rainfall part of the gradient and in the treed mallee vegetation community. Time since last fire is a significant driver of vegetation structure in this system and climate influenced post-fire recovery of some structural elements, likely through water availability. Careful consideration should be given to climate and vegetation communities when planning for fire management.

Ella Plumanns Pouton

PhD Candidate, University of Melbourne

@ellapouton ellap@student.unimelb.edu.au

Fire influence on cone and seed production in serotinous heath species

Fire is a global driver of plant populations and their dynamics. Fire-prone plants have adaptations that help them cope with frequent fire, such as canopy-storage and fire-cued release of seeds (serotiny). However, anthropogenic changes to fire regimes, including fires that are too frequent or infrequent, can threaten species with extinction. Understanding plant extinction risk requires investigating the influence of fire across the plant life cycle. Despite this, the study of seedbanks, including canopy stored seedbanks, are typically neglected in favor of the study of established plants. Our study investigates the distinct and combined impacts of fire interval, time since fire, and height on the diversity of canopy seedbanks in a heathland ecosystem. We aim to understand how fire drives the availability of infructescences (cones) from serotinous species, and the viability of the seeds within those cones. We sampled 57 sites within Gariwerd (Grampians National Park), in south-eastern Australia, across a range of fire ages (0 to 82+ years) and fire frequencies (1-8 fires). Along a 100m transect, we documented all individuals with cones present, and recorded the total number of closed and open cones, and plant height and width. We sampled cones at each site, and tested viability of seeds through a germination chamber experiment. This work will help to identify management strategies that protect biodiversity in heathland ecosystems, through the identification of fire regimes that are favourable to different types of heathland plants.

Tamika Farley-Lehmer

Fire Ecologist at the Conservation Ecology Centre

tamika@conservationecologycentre.org

Striking a balance between Conservation and Bushfire risk in a Flammable System

Fire is a fundamental ecological process within the Australian landscape. Historically, planned-burns have had two distinct and sometimes, mutually exclusive objectives: fuel hazard reduction and supporting ecological processes. We consider that combining these objectives is a desirable outcome. This underpins our research in the highly flammable Carlisle Heath, Otways, Victoria, an ecosystem which is a critical bastion for threatened species.

Two factors fire practitioners can control when planning fire operations are the frequency at which blocks are burnt, and what proportion of the available fuels are targeted. Using a fire regime operations simulation tool (FROST), we developed a series of simulated planned burn scenarios wherein these factors vary. We then used the outputs to examine how coverage of fire will impact the long-nosed potoroo (Potorous tridactylus) population using a population viability analysis. By varying fire frequency and coverage, we aim to identify a regime which reduces wildfire risk without compromising the viability of this population.

Additionally, in collaboration with land-management agencies, six planned-burns have been conducted during the 2021-22 winter burn seasons. These planned-burns, much like the simulations, have experimented with burn coverages. Through monitoring within these burns, we can assess the veracity of some of our model assumptions. Where possible, we compared potoroo density within the real-world burn blocks to the density response predicted by the model. Moreover, using potoroo movement data we can better inform modelled suitable habitat for potoroos. This combination will aid in developing a fire regime that manages both fuel hazard and conservation objectives.

Marissa Blunden

Honours at La Trobe University

marissa.blunden@gmail.com

How do belowground microbial communities & organic carbon respond to altered fire regimes?

Although fire research has surged in the last few decades, the focus has stayed primarily aboveground, a trend seen with much environmental research. However, fire also alters belowground biodiversity causing a cascade of effects on the whole ecosystem largely due to the highly interactive relationship between soil microbiota and aboveground flora. Understanding the effect of fire, particularly of long-term fire regimes rather than singular fire events, on soil microbial communities and their critical role in carbon cycling is necessary to inform management of increasingly fire prone ecosystems. This project builds on an 18+ year burning regime experiment in the Northern Territory where it has been demonstrated that increased fire frequency reduces aboveground woody carbon and canopy cover and annual fires decrease soil CO2 respiration three-fold compared to unburnt plots. By characterising changes to belowground communities and organic carbon we aim to link above- and belowground carbon dynamics. To do this we use amplicon sequencing of bacteria and fungi from the soils of six fire regime treatments (fire applied every 1-5 years, in the early or late dry season, or unburnt), qPCR and soil physiochemical analyses. At the time of writing this abstract I do not yet have results, however I expect to have at least qPCR data, if not the sequencing data, to report on by February, 2023 – stay tuned !

Tallula Harradine-Hodge

Environmental Management Intern at GHD

Tallula.Harradine-Hodge@ghd.com

Connecting Gunaikurnai Cultural Values with Biodiversity and Land Management – Fire and Frog

In 2019-2020, ecosystems in the Gippsland region were devastated by widespread bushfires, negatively impacting Gunaikurnai Country. Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) with Parks Victoria have joint management of 10 parks and reserves in Gippsland. GLaWAC has been working with GHD to monitor the impacts of fires on culturally significant biodiversity. Part of this work involves identifying a discrete area significant to Gunaikurnai and finding an element of the local biodiversity that had cultural significance, as well as wider relevance for ecosystem condition.

Lake Tyers State Park is occasionally managed with planned burns, typically for fuel reduction, but increasingly with a focus on practicing traditional methods. We reviewed online data and consulted with experienced botanists and zoologists, considering what culturally significant flora and fauna was present. We considered which species would have greatest connection to the GLaWAC team working on Country. We linked two vulnerable frog species, the Green and Golden Bell Frog, and the Growling Grass Frog, to the Gunaikurnai story of Tidilick. We collected their sighting records and generated a map of their occurrence in the area. Compiling this data into a mapping software we also included the types of habitats within the area. The purpose of this work was not to retell the story or find the frogs, but to draw attention to the types of habitats the Gunaikurnai rangers could learn about, and seek to plan for when doing burns or responding to wildlife events.

Jaclyn Elise Harris

Monash University, PhD Candidate

@jaclyn__harrisjaclyn.harris1@monash.edu

Trialling Artificial Shelters to Mitigate Post-Fire Predation on Reptiles

Fire is an integral component of Australian ecosystems, and prescribed fire is used widely across the country to manage landscapes. While prescribed burning can reduce bushfire risk, it also significantly changes the habitat, removing vegetation and organic debris. This loss of refuges can be expected to leave species, such as reptiles, more vulnerable to predation. In this research we aim to determine whether artificial refuges can be used to mitigate this post-fire predation pressure. To do this there are two major hypotheses to test: a) artificial shelters will mitigate post-fire predation vulnerability, leading to heightened species richness and abundance captured during pitfall trapping, and b) artificial shelters will not act as an ecological trap. Part B will involve testing the thermal suitability of shelters and monitoring potential predator interest in shelters via camera traps. This research is being conducted in Little Desert National Park, with data from a preliminary trapping season indicating shelters may provide beneficial outcomes to reptiles.

Lily Wheeler

PhD Candidate, University of Melbourne

@LilyJWheeler lwheeler1@student.unimelb.edu.au

Inspecting the impacts of future fire on mammal responses

Fire regimes drive patterns in mammal biodiversity across the globe. The life history traits of many species have evolved under specific fire regimes, and as such they require similar patterns in fire properties such as frequency, intensity, and seasonality to persist. However, climate change is predicted to alter current fire regimes and shifting fire regimes are already known to be a major threat to mammal species. Yet even with this knowledge, our understanding of how future fire conditions are predicted to impact species is limited. It is crucial that we have a clear understanding of how species are affected by future fire to improve both current and future conservation and management actions. To achieve this, we are conducting a systematic literature review using the Web of Science database. Our initial search returned 252 papers and we are currently in the process of screening papers to be included in our analysis. In this study we will highlight the regions that have received the most research, and identify which components of the fire regime and mammal traits are considered by previous studies. We aim to identify the key impacts future fire has been found to have on mammal species and highlight knowledge gaps that should be targeted by future research.

Ange Pestell

PhD Candidate - Deakin University

@pestell37 apestell@deakin.edu.au

The influence of fire and habitat on mammal distribution and activity in Victoria's mallee region

Fire regimes are expected to change substantially under a warming world, and the devastation in many regions and for many taxa as a consequence of the 2019-20 megafires, is a disturbing harbinger of the future. In comparison to plants and vegetation communities, our understanding of the responses of mammals to fire remains relatively poor. In an increasingly flammable world, there are calls for more prescribed (hazard reduction) fires. But what might the consequences of this be for wildlife and how can this best be managed? To answer such questions, we need information that's taxonomically and geographically relevant. Here we report on our study that used two camera traps at 290 sites, spanning more than 895,000 hectares, to survey mammal assemblages in two vegetation types (Heathland – sands and Lowan Mallee) in the semi-arid mallee region of northwest Victoria (Little and Big Deserts). We aimed to investigate whether fire history (time since fire, frequency, and severity), habitat structure, and vegetation composition alter mammal species occurrence and activity in these two vegetation communities, which have a long history of fire (prescribed and bushfire). Here we present the preliminary results of our research and share some recommendations for the future management of these large mallee parks.

FRESHWATER, MARINE, AND COASTAL ECOLOGY

Thursday 9th February | 2:30pm - 4:05pm

Room: MB10

Jodie Valpied

Research Academic, The University of Melbourne / President, Bacchus Marsh Platypus Alliance

jvalpied@gmail.com

Monitoring when the platypus river turns orange: Impacts of construction-related sedimentation on platypus food and habitat in Bacchus Marsh (MAISOP Project Phase One)

The Werribee River through Bacchus Marsh supports a population of platypus (Ornithorhynchus anatinus), a threatened species in Victoria. Fine sediment runoff from broadacre urban development has been entering this section of the Werribee River, to the extent that the river sometimes turns orange. Fine sediment can negatively impact aquatic macroinvertebrates, on which platypus feed, and contribute to habitat degradation.

The MAISOP Project (Monitoring and Addressing Impacts of Sedimentation On Platypus habitat) aims to investigate and address relationships between construction-related sediment input and platypus habitat parameters, including macroinvertebrate availability, in the Werribee River, Bacchus Marsh.

The project is led by Bacchus Marsh Platypus Alliance, in collaboration with Bio2Lab and Melbourne Water.

Real-time turbidity sensors were installed in the Werribee River, upstream, midway, and downstream of Bacchus Marsh's broadacre urban development area. The sensors transmit data via cloud technology. Citizen scientists trained in the Agreed Level Taxonomy method collected macroinvertebrate and habitat data at each site. Data was analysed using multivariate analysis techniques.

This paper presents findings from the project's first phase. Median turbidity levels were more than five times higher downstream than upstream of the housing development area. Upstream turbidity levels were consistently low (75th percentile = 8 NTU), whereas downstream turbidity levels were consistently high, reaching 200 to 405 NTU on 17% of the days measured (75th percentile = 53 NTU). Macroinvertebrate counts were significantly poorer downstream compared to upstream of the housing development area. Implications for platypus and the project's next steps will be outlined.

Elodie Camprasse

Deakin University, casual research fellow

@ECamprasse elodie.camprasse@deakin.edu.au

Solving mysteries behind one of the world's most iconic marine invertebrate aggregations

Every winter, in the heart of Port Phillip Bay and parts of the Great Southern Reef, a truly amazing natural phenomenon unravels: the gathering of thousands and thousands of great spider crabs. Those crabs come to the shallows together to seek safety in numbers and they are on a mission. In order to grow, they need to shed their hard shells and expand their soft flesh before hardening a new, bigger and shinier shell. Dodging hungry predators on the hunt for a soft crab at that time of year is tricky business – the best place to be is in the middle of a pile, protected by other crabs! The spider crabs and their aggregations have been captivating people locally and internationally – Sir David Attenborough himself featured this natural wonder which happens nowhere else in the world in BBC Blue Planet II. Would you believe that despite all this attention, we know very little about spider crab biology and ecology? Dr Elodie Camprasse and her team at Deakin University are here to change that and are using a mix of traditional and citizen science to study spider crab aggregations and their ecological role. Come hear about the research program and the data collected during the first spider crab season to be studied in-depth.

Peter Puskic

Institute for Marine and Antarctic Studies

@PeterPuskic peter.puskic@utas.edu.au

Implications of plastic ingestion on the growth and fledging success of seabirds

The plastic pollution crisis poses economic and societal challenges which greatly impacts human populations with reduced capacity to manage plastic debris. Global efforts to reduce marine plastics will require sound scientific evidence to guide policy decisions. Because of this, the conversations regarding plastic pollution often focuses on the impacts of ingestion on wildlife. However, our understanding of plastics physiological impacts on wildlife is limited, often relying on opportunistic sampling of compromised individuals. Here we partnered with Aboriginal Muttonbirders (yula mulaka), wildlife rescue clinics, and parks managers (Phillip Island Nature Parks), to collect young yula/Short-tailed and Flesh-footed Shearwaters across a spectrum of health. We explored blood chemistry, trace element analysis, and broadscale growth metrics as a proxy for seabird health in relation to ingested plastic loads. We found beached birds to be smaller (by wing length and body mass) compared to rescued fledglings, however, no significant links between bird size, trace element burden or blood chemistry, could be detected to plastic ingestion in either species. Beached birds had more plastics than rescued birds, suggesting plastics may reflect parental provisioning. We document histopathological harm and changes in gut microbiota which may be associated with high plastic loads. When comparing the literature on plastic ingestion of birds at this age, our findings are in line with majority of seabirds globally. These results suggest that birds at this level of exposure may not be physically impacted by the ingestion of plastics, though extreme levels of plastics may impact on seabird growth.

April Timmis

PhD candidate Deakin university

atimmis@deakin.edu.au

Fear, Flight, and Fitness: The adaptive significance of escape responses.

Predator prey interactions from the preys' perspective involve 3 key steps: detection, assessment/monitoring, and responding to a potential threat. Hence, early detection is vital for staying alive/ maintaining fitness, even when resting. Birds rest in a variety of positions, typically to suit the weather conditions, but do certain resting postures affect escape response i.e. is there a trade-off between thermoregulation and vigilance? I investigated 8 shorebird species and used flight initiation distance (FID) as a metric of escape response. FID is the distance at which the bird commenced fleeing from the investigator. I found that FID was not significantly influenced by resting posture hence, carrying on from the pilot study, I set up a new project investigating FID from an evolutionary perspective. Previous work on FIDs assumes differences in escape response have an adaptive evolutionary basis, this project will test this assumption by examining FID heritability and how FID is linked to survival and individual fitness in environments associated with differing levels of human impact. The study species for this project is the Hooded Plover Thinornis rubricollis. They are a threatened shorebird species, highly unsuccessful breeders, have been extensively banded and monitored and their habitat overlaps with various human recreational usage. This research will highlight how different human and predation pressures influence escape behaviour, and how it influences hooded plover survival. This can be used to inform management practices within hooded plover habitat, particularly to ensure appropriate and meaningful implementation of buffer zones for planned development and ongoing threats.

Scott Alexander McKendrick

PhD Candidate, University of Melbourne

scott.mckendrick@unimelb.edu.au

Instream vegetation recruitment in relation to flow regime and potential implications for restoration

Instream vegetation is a critical component of the stream ecosystem providing multiple ecosystem benefits. Flow regime is a key controller of instream vegetation communities but is often altered through regulation or excess runoff. Low flows are likely to be important for instream plant recruitment from the propagule bank.

We investigated the effects of eight flow regimes comprising two flood durations and three low flow durations, or permanently moist or flooded conditions, on early instream plant community development from the propagule bank, and emergence of sown seed of six instream species.

Permanent flooding resulted in poorer recruitment outcomes and different vegetation communities than the other seven treatments with similar patterns found across plant functional groups. When assessing instream species only, the greatest recruitment responses tended to be with longer flood durations (seven days) and intermediate low flow durations (14 days).

Low flow periods are critical for recruitment from the propagule bank, however, once emerged, instream species may be able to withstand a wide range of flow conditions. Provision of greater geomorphic complexity that creates shallow zones for colonisation and pioneer plant community assembly may lead to ecosystem benefits, if refuge from high velocity flow is provided.

Piyumi Chathurika Wijepala

PhD candidate, University of Melbourne

pwijepala@student.unimelb.edu.au

Effect of inundation timing and duration on the growth and reproduction of native riparian and terrestrial plants

River regulation and subsequent changes to flow regimes have dramatically impacted riverine ecosystems. In a regulated river, riparian plants may experience partial or full submergence at a time of year that would naturally have low flows. While the effects of environmental flows have been widely investigated, there remains key knowledge gaps on how timing and duration of flow events influence each of the life-history stages in plant recruitment, particularly flowering and seed production and how this might vary between different species and lifeforms. Thus, we conducted a nursery-based experiment to determine the growth and reproductive responses of riparian and terrestrial plant species commonly occurring in riparian zones to different durations of inundation in spring and summer. Three levels of inundation duration were applied (2 weeks, 4 weeks and no inundation) in both early spring and summer on four riparian and terrestrial plant species. Weekly observations were made on plant growth, flowering and seed production. Longer inundation decreased plant growth and had greater but variable impacts on reproduction. Spring inundation mimicking natural flow conditions supports riparian plant communities by reducing terrestrial plant survival, growth and reproduction. Whereas summer inundation can have severe impacts on riparian species as it inundates plants during typical growth and flowering periods thus reducing their growth and reproductive output with potential detrimental impacts to riparian plant communities.

Pranali Deore

Research Fellow, The University of Melbourne

pranali.deore@unimelb.edu.au

Intraspecific variation in photosynthetic performance of the cnidarian photosymbiont, Breviolum minutum, under short-term cumulative heat stress

Microalgae in the family Symbiodiniaceae form mutualistic symbioses with numerous host invertebrate animals (e.g., Cnidaria, Mollusca, Porifera) and protists (e.g., Foraminifera and Ciliates). Symbiodiniaceae provide photosynthetically fixed carbon in exchange for CO2 and nutrients such as ammonia-nitrogen from the host. This symbiotic association is perturbed under elevated temperature. The abundance and diversity of Symbiodiniaceae genera (e.g., Breviolum, Cladocopium, Durusdinium) in part determines the resilience of the host to ocean warming caused by climate change. Intraspecific variation between two B. minutum strains (ITS2 types B1o-B1i-B1g and B1a-B1b-B1g) is hypothesised to be linked with heat stress tolerance in the sea anemone, Exaiptasia diaphana. We evaluated the thermal melting point of these B. minutum strains subjected to increases in temperature every 25 min from 26oC to 40 °C. In both strains, we observed a decrease in the maximum photosynthetic yield of photosystem II as temperature increased. However, each strain was different in their thermal melting points (35.3oC and 34oC, respectively) and showed contrasting levels of stress-induced non-photochemical quenching which is an indication of differences in activation of underlying photo-protective mechanisms. Overall, the different photosynthetic responses suggest that intraspecies variation may be linked to different heat stress adaptation mechanisms which may underpin resilience to temperature increases of these B. minutum strains.

Mishal Gudka

PhD Candidate, Deakin University

mgudka@deakin.edu.au

Evaluating the design of resilience potential assessments of coral reefs to improve resilience predictions

As threats mount, we will most likely fail to protect coral reefs without drastic and dynamic local action. Resilience-based management approaches offer a potential solution but have been held back due to challenges measuring resilience. Globally, resilience potential assessments have emerged as the most popular method for operationalising coral reef resilience. This approach is based on combining indicators of bio-physical features and processes that influence a reef's ability to survive disturbances. These decision-support tools predict how reefs may respond to a specific disturbance and provide reef managers with information to prioritise areas and actions for protection. Despite their wide adoption, only approximately half the assessments have contributed directly to management, suggesting considerable scope to advance current approaches. This study reviews over 70 resilience potential assessments conducted between 2008-2022, to provide the first global synthesis of how indicators are selected, designed and analysed. Assessments are evaluated against a priori criteria based on recommended guidelines and principles for indicator selection and design. Preliminary findings suggest that assessors must be explicit with their decisions at various steps such as providing criteria or justification for indicator selection and weights applied during index construction. The references used to translate variables into meaningful indicators of resilience require more thoughtful consideration and guidance, and there is an urgent need for validation of resilience predictions using empirical data on responses to disturbances like bleaching. Implementation of the robust approaches presented will strengthen the analytical aspects of assessments thereby improving the reliability of resilience information provided to decision-makers.

Kristova Yubilius Indrataruna

Master student at University of Melbourne

@KrisTovaSci kindrataruna@student.unimelb.edu.au

Exploring the value of Cyanobacteria as probiotics for coral reef conservation

Coral reefs are the most biodiverse ecosystems on the planet. However, corals are under threat from climate change, which triggers coral bleaching – the loss of the coral's symbiotic partners, algae of the family Symbiodiniaceae. In this relationship, Symbiodiniaceae supply the coral host with most of its organic carbon demand. Therefore, bleached corals will starve. Some coral colonies may recover if environmental conditions are suitable for Symbiodiniaceae recolonisation. However, prolonged bleaching reduces the likelihood of survival. Current marine heatwaves are more frequent and intense than ever, thereby making natural coral recovery difficult. Microbiome manipulation, such as probiotics, has been proposed to help corals recover from bleaching and develop higher heat tolerance. Corals associate with many microorganisms, including bacteria. Among them, Cyanobacteria are photosynthetic bacteria that reside in the coral tissue and skeleton. Changes in coral-associated bacterial communities may affect coral phenotype, including coral health, bleaching tolerance, and recovery. Here, we explore the potential for Cyanobacteria to be used as probiotics to increase coral climate resilience. Their photosynthetic ability might help corals survive through bleaching periods by temporarily supplying the coral host with organic carbon until conditions are suitable for Symbiodiniaceae recolonisation. As a first step, we pure-cultured Cyanobacteria from healthy corals. Gene sequence analysis of the 16S rRNA gene was used to identify the isolated colonies and confirm they are Cyanobacteria Whole-genome sequencing will be employed in the future to assess their functional potential and determine their suitability as bacterial probiotics. This research will provide additional tools for coral reef conservation.

Danielle Wallace

PhD candidate at the University of Melbourne

@that_frog_gorldanielle.wallace@student.unimelb.edu.au

Breed, or die another day? The effect of chytrid fungus infection on the breeding colours of the Alpine Tree frog

After the onset of disease, animals are faced with a trade-off: invest their energy in mounting an immune response, or commit to a last-ditch breeding event before succumbing to infection? Surprisingly, there is growing evidence that some species are investing solely in reproduction when disease emerges. This phenomenon is known as terminal investment. Frogs are currently threatened by the worst wildlife pandemic ever known – the amphibian chytrid fungus. However, some species have been able to persist with infection increasing their reproductive output through a terminal investment strategy. We investigated how breeding colouration in the critically endangered Alpine Tree frog was influenced by chytrid fungus infection. We found that both in the field and in the lab, infected frogs were significantly more colourful than healthy individuals. This has implications for mate choice, as infected frogs that are more colourful could also be more attractive to females. Our findings could also indicate that Alpine Tree frogs may not gain immunity to chytrid fungus over time, if highly infected, colourful frogs are being selected for. Disease can have significant impacts on populations directly by causing mortality, but also indirectly by changing mating patterns and recruitment potential. It is therefore vital that we understand how frogs are responding to disease, and how their reproduction and breeding display is manipulated by infection, to ensure that we implement appropriate conservation management techniques.

Aurore Counilh

PhD student, Deakin University

@aurore_counilh s222116568@deakin.edu.au

Environmental effects on the foraging behaviour of breeding Australasian gannets

In breeding seabirds, foraging success impacts reproductive success. However, foraging success is affected by individual variations in foraging behaviours and by environmental factors. South-eastern Australia has been subject to accelerated warming of sea surface temperatures, with shifts in species distributions already being observed. As such, understanding the effect of environmental conditions on foraging behaviour of marine predators is key to understanding how climate change might affect their populations in this region.

In the present study, the effect of local and broadscale environmental factors on the fine-scale habitat use of Australasian gannets (Morus serrator) during the breeding period were investigated. At-sea movement data were collected between 2011/12 – 2021/22 at two breeding colonies in northern Bass Strait (Point Danger and Pope's Eye) with contrasting oceanic conditions. Hidden Markov Models were used to assess the transition probabilities between states (foraging, commuting, resting) in relation to local variables. Subsequently, GLMs were used to investigate the relationship between the proportion of the trip spent foraging and 1) average local variables encountered during each trip, and 2) broadscale indices (Southern Ocean Index, Indian Ocean Dipole, Southern Annular Mode).

Due to both local and broadscale environmental conditions in south-eastern Australia having been shown to affect foraging behaviour in marine species, and differences in foraging behaviour having been observed between the two colonies, similar results are expected.

ADVANCES IN METHODS

Thursday 9th February | 2:30pm - 4:05pm

Room: MB11

Shandiya Balasubramaniam

Data Analyst, Atlas of Living Australia

@ShandiyaB shandiya.balasubramaniam@csiro.au

Tools for continental-scale biodiversity data assessment using the Atlas of Living Australia

The Atlas of Living Australia (ALA) is Australia's national biodiversity database, storing over 100 million observations of plants, animals, and fungi sourced from over 800 data providers. The ALA Science and Decision Support Team has a broad remit to improve the usability of the ALA for researchers nationwide. In this talk we outline: 1) the nature of the data stored by the ALA and its utility for a range of questions in ecology and conservation; 2) efficient methods to query the ALA through the browser, or from commonly-used programming languages such as R and Python, and; 3) how users can apply the resulting data to common problems via our technical posts at labs.ala.org.au. In combination, these tools provide access to a wealth of data in record time, allowing novel insights in a range of fields.

Diana Robledo-Ruiz

Research Fellow, Monash University

@drobledoruiz diana.robledoruiz1@monash.edu

Easy-to-use R functions to identify sex-linked loci and conduct sex-assignments for conservation genomics

Navigating conservation genomic analyses can be challenging because of many potential errors. Failure to remove sex-linked loci can bias measures of genetic diversity, population structure and the results of parentage analyses. In this study, we present four R functions designed to (1) identify and remove sex-linked loci in ZW and XY sex determination systems, (2) infer the genetic sex of individuals, (3) remove loci with abnormally high heterozygosity, and (4) produce input files for parentage analysis software. We used these functions on genomic data of two species and, in order to assess the impact of properly removing sex-linked loci, we compared the biological inferences drawn from genetic data before and after using our functions. We found that standard filters, such as low read depth and call rate, are inefficient at removing sex-linked loci, failing to remove up to 28.7%. This failure to comprehensively remove sex-linked loci lead to (i) an overestimation of up to 9% of population FIS, and up to 8% of the number of private alleles (ii) equivocally inferring significant differences in heterozygosity between sexes, (iii) masking of genetic population structure, and (iv) inferring ~11% fewer parent-offspring relationships in parentage analyses. We discuss how these biases can affect ecological and evolutionary inferences and thus have a negative impact on conservation management decisions. For reduced-representation datasets with at least 15 known-sex individuals of each sex, our functions offer convenient, easy-to-use resources to avoid this, and to sex the remaining individuals.

Nadine Gaskell, Heather Stewart & Marty Lockett

NG: Biodiversity Coordinator, Knox City Council; HS: Biodiversity Planner, Cardinia City Council, ML: Ecologist, Urban Light Lab, The University of Melbourne

martylockett@gmail.com; nadine.gaskell@knox.vic.gov.au; hstewart1966@icloud.com

Making outdoor lighting more wildlife-sensitive; effective collaboration between local government and researchers

Artificial light at night (ALAN) is a major disruptor of wildlife behaviour and physiology, but most outdoor lighting is designed with little consideration of its ecological impacts. Over the last 18 months, local governments in Melbourne have been collaborating with each other and ecological researchers to get ALAN on the agenda; identify barriers to 'wildlife-sensitive' lighting; create tools to help council officers incorporate better lighting into projects; and share these outcomes across the state and around Australia. We will discuss the development of this collaboration; the wildlife sensitive tools and strategies that have emerged from it; and how these outcomes are being adopted and implemented to provide a better night-time environment for suburban wildlife.

Zoe Metherell

PhD Researcher, University of Melbourne and Ecological Designer at ZM Environments

zme@student.unimelb.edu.au

The Streetscape Ecological Design Toolkit - codesigned with City of Melbourne

Addressing the biodiversity crises through regenerative or ecological design approaches is, increasingly, a goal for cities and other land-managing organisations. Contributing to this movement, Melbourne developed their first strategy for ‘Nature in the City’. The goals of this strategy include enhancing biodiversity and creating places where people can connect to nature. Each time a street or other council-managed site is redesigned, there is an opportunity to do this in a way that supports ecological renewal. However, there are challenges related to accessing, interpreting, and applying scientific and practice-based knowledge in this process. To address these challenges, we codesigned the Streetscape Ecological Design Toolkit with landscape architects and urban ecologists from the City of Melbourne.

As we will show, this is a completely novel set of ecological design tools for scientists and designers. It includes a collection of 82 ecological design 'patterns'. Each one communicates the science and interprets this into a design concept that can be applied to the design of a Melbourne street. All the knowledge is synthesised in an interactive drawing of an ecologically designed street. The toolkit can be modified as knowledge grows, and adapted to suit other types of sites, to work in different ecosystems, or for other organisations.

Other than bringing ecological knowledge into design, applications for this toolkit include interdisciplinary knowledge-sharing and collaboration between urban ecologists and landscape architects, and socialising a vision for biodiversity in the city.

Nick Bradsworth

Helmeted Honeyeater Field Officer, Zoos Victoria

@bradsey nbradsworth@zoo.org.au

18-months on: establishing a new wild population of critically endangered Helmeted Honeyeaters

Range-restricted species are among those at greatest risk of extinction due to climate change. The critically endangered Helmeted Honeyeater provides a good illustration of this, where the last wild population is confined to a single locality at Yellingbo, 50 km south-east of Melbourne. The establishment of new populations to provide risk-spreading is an urgent priority for the Recovery Team, however options are limited owing to the widespread destruction of the taxon's preferred habitat. Following an assessment of potential translocation sites throughout the species' historic range, during 2021 and 2022, a total of 48 Helmeted Honeyeaters were released to a new location in the Yarra Ranges National Park, 30 km from the last wild population at Yellingbo. In 2021, 32 birds were released, comprising 14 captive-bred, and 18 wild-sourced birds. Post-release monitoring revealed that the captive-bred birds displayed far greater post-release site fidelity. The 2022 release cohort, 16 individuals, were all captive-bred. Nesting at the translocation site was limited during spring 2021 owing to the age of the birds released. However, six nesting attempts were documented, with only one attempt successful in producing a fledgling owing to high rates of nest predation. Thus far in 2022, three nesting attempts have been successful and four have failed, with predation by tiger snakes emerging as a potential issue for this population. Adjusted focus camera traps installed at supplementary feeding stations have provided a very effective, novel method to monitor the translocated population.

Arman Pili

PhD Candidate, Monash University

@arman_pili armannorciopili@gmail.com

The escalating global problem of human-mediated accidental transport of alien species

Global biotic homogenisation will continue escalating given inadequate biosecurity worldwide. Developing stringent biosecurity is hindered by a lack of essential information on the global flows of alien species, especially those that are accidentally transported and neglected by biosecurity due to inapparent economic significance. We analysed a database of alien amphibians and reptiles ("herpetofauna") accidentally transported to New Zealand — the largest and most comprehensive database of its kind. We provide evidence and new perspectives on the temporal, geographical, taxonomic, and transport sub-pathway dimensions of the global flows of alien species. We decomposed the systematic processes and estimated the economic drivers of the alien herpetofauna transport frequency using locally-weighted smoothing and best subset modelling. We explored geographical patterns regarding source regions and ports of entry, and temporal trends in species diversity. We constructed a species×transport sub-pathway network to analyse the diversity of sub-pathways used by alien herpetofauna, and of alien herpetofauna using each sub-pathway. Transport frequency of alien herpetofauna fluctuated over time, coinciding with changes in biosecurity and economic expansion and recessions. Alien herpetofauna originated worldwide and arrived at ports of entry across New Zealand. 243 species of alien herpetofauna, 45 of which are new records since Chapple et al. (2016), were accidentally transported to New Zealand, primarily as stowaways. Our study illuminates that transport frequency, spatial extent of source regions and destinations, species diversity, and accidental transport sub-pathways of neglected alien species are hugely underestimated and dynamic. These crucial oversights in the global flows of alien species significantly impede biosecurity worldwide.

Casey Visintin

Research Fellow, RMIT University

casey.visintin@rmit.edu.au

How diverse is the vegetation in my landscape design?

Structural diversity in vegetation is important to support biodiversity; however, urban environments are often planned and designed by built environment professionals with very little consideration of this feature. There are many political, administrative and technical factors impeding biodiversity-sensitive design practice, one of which is design professionals lacking tools to adequately measure and assess basic landscape characteristics such as structural diversity in vegetation.

We have developed a simple, yet expandable, method to assist design professionals assess and visualise structural diversity in vegetation during the design process. We demonstrate our methods using a small speculative residential project, however, we expect equal applicability at larger scales such as an urban precinct.

Michael Traurig

PhD candidate, Deakin university

mtraurig@deakin.edu.au

An exploration of the relationship bewteen ecosystem condition and human well-being through a systematic review

Healthy and functioning ecosystems are essential for human well-being. Understanding the roles, they play in providing benefits to people, and how consequences of changes in ecosystem condition affects their capacity to do so is critical to maintaining and sustainably improving human well-being. For the past two decades, studies have explored the relationships between species richness and benefits to human well-being, relationships and trade-offs between services, and shared drivers of change amongst multiple services. However, a review examining the relationship between ecosystem condition and natures benefit to human wellbeing at a biome level has yet to be conducted.

Here I explore and synergize the evidence currently available to conceptualize the broad patterns that link ecosystem condition to the benefits they provide to human well-being. Using an ecosystem typology these relationships will be analysed at a biome, and where possible at an ecological functional group level, to develop a framework mapping the direction of these relationships (positive, negative, neutral and complex) and comparing how consistent these relationships are between biomes. This research aims to broadly address: (1) what is the relationship between ecosystem condition and the benefits provided by each biome, (2) Which biomes are most studied, and where the gaps lie in understanding these relationships, and (3) Which benefits to human well-being are broadly at risk from degradation of ecosystems.

URBAN ECOLOGY

Friday 10th February | 10:30am - 12:00pm

Room: Main Hall (MB6)

Holly Kirk

Research Fellow, RMIT University

@HollyKirk holly.kirk@rmit.edu.au

Timing is everything - how to include tree flowering phenology in urban design

The intersection of ecological theory with urban design has great potential for the delivery of biodiversity conservation benefits during urban development. Achieving healthy urban ecosystems that support diverse flora and fauna means designing landscapes that provide for multiple ecological processes and account for the complexity of resource provision for multiple species.

Flowering phenology has considerable impact on the persistence of pollinating species within a landscape but is not yet considered in the design of urban green spaces and streetscapes. We demonstrate how flowering phenology can be used to assess the resource provision potential in a typical residential streetscape design.

We take an existing streetscape design from a residential greenfield development site master plan as a case study to demonstrate how flowering phenology can be visualised and quantified spatially. This allows identification of 'hunger gaps' in the existing landscape architecture and assessment of design improvements targeted at the year-round provision of flowering resources. Inclusion of this approach during the design phase of urban development could ensure pollinating birds and insects are better supported within the novel urban ecosystem, maximising both the biodiversity and human welfare outcomes of urban design.

Fiona Hoegh-Guldberg

PhD Student - RMIT ICON Science

@FionaHG2 s3931551@student.rmit.edu.au

Bridging the gap: A framework to combine Biodiversity and Water Sensitive Urban Design (BSUD & WSUD) in urban development.

The increasing application of nature-based solutions to address conflicts between development, biodiversity and human wellbeing reflects limitations in the status-quo of current development norms, globally. These limitations are especially relevant in the face of increasing climate change pressures on ecosystems and communities. Water and biodiversity are critical components within nature-based solutions. However, the interdisciplinary exchange of knowledge and holistic planning between Water Sensitive Urban Design (WSUD), biodiversity and climate objectives is currently limited. We propose a framework to integrate the principles of WSUD with Biodiversity Sensitive Urban Design (BSUD) based on literature analysis and workshop outputs from a panel of experts in water, biodiversity, architecture, and urban planning fields. This framework includes principles to account for synergies in development between ecological and hydrological factors of: connectivity, resources, threats and human/nature interactions. The framework is applied to a theoretical case study to showcase: 1) ways to test synergies; and 2) methods to measure and monitor outcomes to achieve both biodiversity and water management objectives. The results of the case study illustrate the importance of incorporating historical biodiversity and hydrological dynamics within predevelopment and early-stage planning at the macro-scale. The visual communication and monitoring of synergistic or antagonistic outcomes is fundamental to the uptake and accessibility of this development tool.

Tyler King

PhD Candidate - Deakin University

@tylerking321 kingty@deakin.edu.au

Exploring local community networks in biodiversity management.

Local residents and community groups play an important role in creating and managing habitat for urban biodiversity. Whether planting native vegetation in backyards or converting median strips into wildflower meadows, these small-scale projects have huge benefits for biodiversity – especially insects, birds and reptiles.

While historically overlooked within environmental management and urban greening projects, these initiatives have gained increased recognition and support from local councils – notably through programs such as Gardens for Wildlife. Although this conversion of lawns into native gardens is a win for local biodiversity, these spaces can also be a source of local politics and tension as plants are poisoned or stolen by anonymous neighbours.

For my presentation I will draw from my PhD research with wildlife gardeners and community groups involved in biodiversity management, exploring the establishment and management of these spaces, in addition to the politics of urban greening initiatives.

Madeleine Callas

Environmental Scientist, AECOM

mcallas26@hotmail.com

Microbat activity and species richness in Melbourne's urban green spaces

Australian cities are becoming increasingly urbanised, posing new challenges for wildlife in these areas. Recent research suggests that urban parks, though highly modified, may be important refuges allowing certain species to persist. Microbats are known to inhabit urban landscapes, but previous research has often focused on their use of remnant habitat patches, and their use of highly modified open spaces is not widely understood. We acoustically surveyed for microbats at 35 sites across greater Melbourne, to determine whether they are utilising open green spaces such as parks and ovals, and identify any influential landscape factors. Across 557 detector nights, we recorded ten of the sixteen native species known to occur in Melbourne. We modelled the activity of individual species, total microbat activity, and species richness, against landscape and site factors. Activity and species richness were lower in areas with more roads, and greater in areas with more nearby trees and watercourses. Our results confirm that microbats are utilising Melbourne's open green spaces, and support the importance of these areas, especially when trees and/or watercourses are nearby. We recommend improving connectivity between open urban parks, conserving nearby riparian corridors, and situating new parks and sporting facilities in less urbanised, well-vegetated areas.

Alicia Dimovski

PhD Candidate, La Trobe University

@AliciaDimovski a.dimovski@latrobe.edu.au

Does bat friendly lighting have a physiological cost?

Artificial light at night (ALAN) is one of the most common and fastest growing forms of urban pollution and has been identified as a key threat to biodiversity. ALAN fundamentally changes the night-time environment by masking natural light cues and desynchronising the body's internal clock. Nocturnal fauna species, such as bats, are adapted to low light conditions and are therefore among the most vulnerable to the impacts of artificial light at night. The behaviour and activity of insectivorous bats is disrupted by short-wavelength artificial light at night, but not long-wavelength light. However, the physiological consequences of this lighting have not been explored. We investigated the effect of LEDs with different spectra on urinary melatonin in an insectivorous bat. We collected voluntarily voided urine samples from Gould's wattled bats (Chalinolobus gouldii) and measured melatonin-sulfate under ambient night-time conditions (baseline) and under red, amber, filtered warm white and cool white LEDs. We did not detect an effect of short-term exposure to LEDs at night on melatonin-sulfate concentrations in the Gould's wattled bat. Findings from this study will improve our understanding of physiological impacts of artificial light at night on wildlife and support the development of "wildlife-friendly" lighting in urban areas.

Samuel Holleran

PhD Candidate, University of Melbourne

@sam_holler samholleran@gmail.com

Greening the Cemetery: Care, Memorialisation, and Green Infrastructure

Growing cities, changing traditions, and an evolving ecological consciousness have shifted the way we view urban cemeteries. This presentation examines community participation in the reimagining of cemeteries in densifying cities as sites for gardening and green infrastructure.

As one of the longest-term land uses (administratively defined as 'perpetual'), cemeteries often appear to be static—yet they are always shifting. Often, this means taking on park and civic functions, while gradually transitioning away from active burial and towards the status of 'heritage site'. While some cities have protectively sealed off these sites, others have linked them to cycling and parkland networks, applying a 'preservation through use' model of stewardship. Case studies from three cemeteries in middle-ring Melbourne suburbs illuminate the transition to 'legacy' status, highlighting opportunities to reconnect these spaces to their surrounding neighbourhoods, establishing them as sites of ecological and historical encounter and modelling how other cemeteries can thoughtfully take on more park-like functions without loosing their emotional resonance.

This presentation builds on two years of ethnographic work with gardeners and cemetery managers to examine tensions between land yield (for burials) and the rewilding advocated for by eco-minded community groups. It also uses archival research to trace back socially-rooted ideas of greenspace networks and their utility for, and challenge to, urban growth.

Sandra McCullough

Biodiversity Manager, Earthwatch Australia

@Earthwatch_Aus smccullough@earthwatch.org.au

Tiny Forests: Growing Resilient Cities

Sustained urban land clearing in Australia has caused habitat fragmentation, species extinction and overall biodiversity loss. Nevertheless, research shows that our cities still hold substantially more threatened species per unit area than our rural areas. Unfortunately, the broader Australian community lack understanding of the true value of biodiversity, and how individuals can play a role in improving and protecting biodiversity. Tiny Forests are Earthwatch Australia's nature-based solution. These are dense and fast-growing native bushland, which function as important wildlife refuges for urban biodiversity; as well as providing cooling benefits, carbon capture, storm water mitigation, and an inspiring outdoor living classroom as a place to learn and connect with nature. Tiny Forests are approximately 200m2, and follow an established planting method developed in the 1970's by Dr Akira Miyawaki (the Miyawaki method). This requires the use of indigenous species only, very high species diversity, and very dense planting. Soil preparation includes excavation and addition of soil amendments determined through soil testing. The method is shown to result in accelerated growth, of about 10 times faster than traditional forests. As the forest establishes, biodiversity levels increase, and maintenance requirements decrease. Through structured and facilitated citizen science days, data will be collected to help understand the benefits of the planting methodology on biodiversity, soil, growth rate, temperature; and ultimately the success of the Miyawaki method in the Australian context. This paper will discuss the Tiny Forest approach and provide early-stage results of activities here in Australia and how they compare to findings elsewhere.

Hugh Stanford

PhD Candidate - RMIT

s3766622@student.rmit.edu.au

Mapping informal green space to better study human-nature interactions in the urban environment

People living in urban environments are increasingly detached from the natural world, interacting with nature in less frequent and meaningful ways. This has potentially negative implications for pro-environmental sentiment through a phenomenon termed the “extinction of experience”. Designing cities in a way that supports biodiversity and encourages human-nature interactions in an unstructured and open-ended way can combat the extinction of experience. Informal Green Spaces (IGS) may provide an opportunity to facilitate human-nature interactions in cities. IGS are urban green spaces that exist despite the formal forces shaping the urban environment, and include overlooked land uses such as vacant lots, brownfield sites and railway easements. Despite their potential social and ecological benefits, research in IGS is still an emerging field. Recent work has called for methods to spatially map these sites so that we may better understand them, the role they play in enabling human-nature interactions in the urban environment, and how governance and policy could be used to maximise the values provided by these spaces. The contribution of IGS to urban nature conservation is particularly poorly understood, in part because these spaces can be hard to identify. I outline a novel method to spatially map potential IGS, quantifying the occurrence and understand their arrangement in the urban environment. The method uses a framework of social-ecological characteristics and secondary, open government data to identify areas where IGS are likely to occur. The method is applied to a case study within Greater Melbourne to test its accuracy, validity, and potential for use in urban planning. The mapping method has many potential applications for future research on IGS. These include providing a better understanding of the role of IGS in facilitating human-nature interactions and how these spaces may best be governed and managed (or not managed) to further combat the extinction of experience in the urban environment.

Madeline Taylor

Masters student, University of Melbourne

madelinet@student.unimelb.edu.au

Urban BioBlitzes in Greater Melbourne: Evaluating contribution to local biodiversity knowledge

A BioBlitz is a brief event (usually 24 hrs) where participants are encouraged to capture as many sightings as possible of biodiversity. Traditionally scientists and naturalists were recruited to participate to provide a snapshot in time of species diversity within a particular area. Today however, BioBlitzes have developed into citizen science events due to their ability to engage the public and provide opportunities for education and connecting individuals with nature. This is especially powerful in urban environments where urban-dweller’s connection with nature is often low. Additionally, BioBlitzes can produce large quantities of biodiversity occurrence data. City Nature Challenge, a global citizen science BioBlitz between cities worldwide, generated 1.7 million biodiversity records during the 2022 event. These benefits have led to citizen science BioBlitzes growing in popularity worldwide, especially within urban environments. Within the literature, there is ample evidence on how BioBlitzes provide social benefits, however little is known about their contribution to local biodiversity knowledge. My research project aims to resolve this knowledge gap by analysing biodiversity records generated through BioBlitzes held within LGAs of Greater Melbourne. The project will analyse data across multiple BioBlitz events and different green spaces. It will compare biodiversity records generated during BioBlitzes against records found within the Atlas of Living Australia, to identify the event’s contribution to knowledge of current biodiversity (biodiversity detected within the last 30 years), new species to an area and rediscovery of historical species (not detected within the last 30 years, but previously present within an area).

ENVIRONMENTAL POLICY AND SCIENCE COMMUNICATION

Friday 10th February | 10:30am - 12:00pm

Room: MB10

Sarah Garnick

Senior Policy Officer- Department of Energy, Environment and Climate Actions

sarah.garnick@delwp.vic.gov.au

Applying new science to old policy problems: Optimising timber harvesting buffer widths for threatened aquatic taxa

Forestry operations have the potential to impact on aquatic fauna by increasing sediment input into streams beyond natural levels. To mitigate these impacts, riparian buffer strips (where harvesting is excluded) are maintained between coupes and waterways. The under prescription of buffer widths can lead to negative ecological impacts, while over prescription can lead to negative financial impacts to the industry as these buffers contain merchantable timber.

Current buffer widths under the Code of Practice for Timber Production in Victoria vary by species, and their appropriateness is untested. To address this gap, the Department of Environment, Land, Water and Planning (DELWP) commissioned research to answer: How far does surface runoff, that carries sediment, travel through vegetation in different environmental situations before it is absorbed in the ground.

Due to the complex and contested nature of the knowledge gap, a multidisciplinary, multi-institutional governance structure was established. Members contributed research, policy and industry expertise. The project Steering Committee included DELWP, the Arthur Rylah Institute (ARI), the Department of Jobs, Precincts and Regions (DJRP) and VicForests. To provide necessary technical expertise to the Steering Committee and develop the study design, a technical committee was also formed including ARI, DELWP, the University of Melbourne, VicForests, Alluvium, and Jacobs.

The project evaluated the consistency of current buffer width with evidence from field-based measurements, then used hydrological modelling to develop a risk-based tool for assigning buffer widths. This tool allowed policy decisions about ecological and economic trade-offs to be transparently articulated in developing new buffer width prescriptions.

Katie Jackson & Luis Kennett

Urban Forest Programs Officer, Department of Energy, Environment and Climate Actions

katie.jackson@delwp.vic.gov.au

More Trees for a Cooler, Greener West Program

The western region currently has the lowest tree canopy cover in Melbourne, at a staggering 5.5%. Urban development that results in the loss of trees and vegetation causes average temperatures in these areas to increase. This is known as the urban heat effect, which impacts the health of both people and animals. To help address this, our team at the Department of Environment, Land, Water and Planning is delivering the More Trees for a Cooler, Greener West Program. This program aims to plant trees 500,000 trees across Melbourne's west to help address problems of the urban heat effect as part of Cooling and Greening Melbourne. This presentation will highlight some of the exciting tree planting projects that have been funded under the program thus far, showcasing the efforts of the collaborative partnerships with DELWP, local land managers, schools, and community groups, planting 120,000 trees to date!

Nicholas Carter

PhD Candidate - Deakin University

@NickCarter_182 nbca@deakin.edu.au

How well does legislation protect a threatened apex predator?

Environmental legislation is an important component of conservation and combating habitat loss, but often has its limits in its capacity of protecting ecological values if not supported or informed by research data. In response to relevant legislative requirements, ecological impact assessments are undertaken to determine what level of impact a development or habitat modification project may have on local biodiversity. However, undertaking impact assessments of highly mobile and elusive animals, like that of apex predators, can be quite difficult, particularly as they can use suitable habitat wherever available throughout our dynamic landscapes of multiple land tenures, where the same environmental policies may not apply. The Powerful Owl (Ninox strenua), is a threatened apex predator which utilises landscapes comprising many land-use types and due to their life traits, are a difficult species to manage for conservation and adequately understand or calculate impacts to individuals and habitats they utilise. We spatially investigated GPS tracking data against various state environmental policy and industry impact assessment tools to test the utility and validity these legislative aspects have for protecting Powerful Owls and their habitats. We found that state legislation has very limited capacity in protecting Powerful Owl habitat and that owls are likely being dismissed from impact assessments. As a result, it is considered these protection deficiencies may be contributing further to the species decline and highlights the critical need for policy to incorporate research data for effective conservation and management.

Lily van Eeden

Postdoctoral Research Fellow, Arthur Rylah Institute for Environmental Research

@lilyvaneeden lily.vaneeden@delwp.vic.gov.au

Nature for all: Understanding who benefits from spending time and nature and how to improve inequality of access

Spending time in nature is good for our mental and physical wellbeing. During COVID, many people sought out nature to ease the stresses of isolation, but others did not have the same ease of access. Indeed, urban green space has been linked with gentrification in many cities resulting in social justice issues, typically among poorer and diverse communities. Using the results of a survey of Victorian residents (N = 1500), we sought to understand differences in who was able to receive wellbeing benefits through nature engagement during COVID. We explored relationships between spending time in nature, changes in time spent in nature during COVID (e.g., development of new nature-based hobbies or discovery of new nature areas), subjective wellbeing, perceptions of one's local nature places (e.g., perceived safety in urban parks), demographics, and spatial variables. We identified positive relationships between subjective wellbeing and (1) spending time in nature and (2) new nature behaviours since COVID. Older people and women were more likely to feel unsafe in their local nature places, and this fear was associated with lower subjective wellbeing. Linguistically diverse respondents were more likely to have developed new nature-related hobbies since COVID. Spatial analysis is still underway. The analysis of spatial and demographic variables as predictors of wellbeing and spending time in nature can inform policy and urban planning to improve equality of nature access for Victorians and support new nature-related behaviours among diverse communities.

Tarryn Coward

Policy Officer, Department of Energy, Environment and Climate Actions

tarryn.coward@delwp.vic.gov.au

Learnings from developing the Marine and Coastal Strategy 2022

The health of the marine and coastal environment is threatened by many drivers of change, including climate change, population growth and ageing infrastructure. The Marine and Coastal Strategy 2022 is a five-year action plan that was released by the Department of Environment, Land, Water and Planning as part of a suite of reforms to improve how issues and impacts in the marine and coastal environment are managed in Victoria.

Development of the Strategy included an extensive engagement process to align the Strategy with the priorities of government, Traditional Owners, land managers, peak bodies and coastal communities. The process used a range of approaches including stakeholder workshops, online public consultation and one on one discussions with action leads. These approaches, along with research recommendations and Victoria's policy context informed the Strategy's six actions: 1. Traditional Owners determine how their rights and obligations are embedded into planning and management of the marine and coastal environment; 2. Improve the condition and ecological connectivity of habitats and respect and care for our marine and coastal areas; 3. Adapt to climate change; 4. Support sustainable use and development of the marine and coastal environment; 5. Implement the Marine Spatial Planning Framework; 6. Identify resource needs for sustainable marine and coastal environment.

The Strategy is now in its first year of implementation. This presentation will focus on key learnings and reflections from the development and consultation process.

Emily Gregg

RA, ICON, RMIT University

@SciEms egregg593@gmail.com

A reflection on ethical considerations for conservation messaging

Conservation science is inherently a normative, value-driven field of research and practice. In recent times there is increasing interest in conservation scientists engaging in more strategic messaging approaches to affect targeted behaviour change or influence values and attitudes towards conservation. These approaches introduce new ethical dilemmas that conservation professionals may not have considered or are ill-equipped to deal with.

In this talk I discuss and reflect on ethical considerations for conservation messaging including those that apply across all stages of conservation messaging (be reflexive, engage responsibly, and consider power), as well as those that apply when defining the problem (ensure fairness in audience targeting), designing the solution (use equitable messages and calls to action and use truthful messaging and authentic messengers), and considering outcomes (consider intended and unintended consequences). I also consider these in the context of a controversial, 'wicked' conservation issue: the management of overabundant kangaroo populations. My hope is that taking the time to reflect in this way paves the way for more effective and ethical strategies for conservation messaging, leading to more open, trusting, and sustainable relationships with our audiences.

Julian Petris

Policy Officer, Department of Energy, Environment and Climate Actions

julian.petris@delwp.vic.gov.au

What do we mean by 'protecting' wildlife

In 2020, a review of the Wildlife Act 1975 was announced. The Act is responsible for protecting wildlife, and regulating its use. One of the first question to resolve, is what the purpose of the act should be. Initial feedback of the review criticised allowing wildlife to be used while also protecting wildlife. The nature of this conflict changes based on how we define 'protecting wildlife'. Are we protecting ecosystems or animals?

When protecting ecosystems, individual animals have limited weight. The Act must regulate use to ensure sustainability, but otherwise there is no conflict with this definition of protection, and use provisions.

When protecting individual animals, then conflict becomes much more difficult to resolve. Are we concerned with animal welfare, or animals' lives? The globally recognised gold standard for animal welfare is the 'Five Domains'. These domains include good environment, nutrition and health, but life is not listed. Over-valuing animal lives removes euthanasia as a tool for reducing suffering. Nor is animal welfare simple from an ecosystem framework. Animals injure each other without regard for welfare as part of their nature. A functioning ecosystem is innately inhumane. There is limited evidence human intervention rescuing individual animals from human or natural processes provides a benefit to populations or ecosystems.

For animals under human control, welfare has been prioritised over life. For wildlife, we must decide where our responsibility ends, and how we prioritise ecosystems in relation to life.

Cristina Margherita Napoleone

Director (TERRAIN Projects)

cristina@terrain.earth

Biodiversity Assembly by TERRAIN

Australia's biodiversity is in crisis with over 1,700 species of flora and fauna and whole ecological communities known to be threatened and at risk of extinction as listed under the EPBC Act (1999). Ongoing threats to species loss include: degradation and fragmentation of habitat, invasive species, altered fire regimes, unsustainable land use and mismanagement of natural resources, changes to aquatic environments and water flows.

Responding to this crisis requires integrative geography as a socio-ecological solution, coupling educational and social programming alongside ecological revegetation. Such an approach is critical for meaningful and long lasting engagement with the land that is being tended to.

The Biodiversity Assembly by TERRAIN will engage the community across two key activities: (1) Coordinated environmental volunteering planting days for young people [18-35] on designated ecological restoration sites in Victoria using the Miyawaki planting method; and (2) A complementary educational initiative delivered through public workshops and a hiking club across Victoria's bioregions, each thematically joined by a guest expert in the field of biodiversity and qualified guide.

This pilot TERRAIN Project (in-development) is intended to commence in 2023, supported by Parks Victoria's Volunteering Innovation Fund for Biodiversity, in partnership with the City of Greater Dandenong, Bunurong Land Council, DELWP Port Phillip, Australian Ecosystems, Brettacorp Inc, Regenerating Farms, and Gearon Civil.

The project addresses Victoria's historical land clearing by restoring biodiversity for resilient landscapes; and leaves participants with a heightened connection and appreciation of the importance of biodiverse ecosystems for a healthy planet within a local context.

TERRESTRIAL ECOLOGY AND DIVERSITY 2

Friday 10th February | 10:30am - 12:00pm

Room: MB11

Emily Scicluna

PhD candidate, La Trobe University

@SciclunaEmily 17442819@students.latrobe.edu.au

Fat-tailed dunnarts of the Victorian grasslands: vulnerable to extinction

Fat-tailed dunnarts occur across Australia and are found in a variety of habitats. The fat-tailed dunnarts of Victoria however, are geographically isolated and are genetically distinct from the rest of Australia. In Victoria, this species occurs in grasslands, grassy woodlands and shrublands. Grasslands once covered 30% of the state, but there is now <1% of the original habitat remaining. As 55% of Victoria is freehold agricultural land, most of this species' populations persists on privately owned farmland. Fat-tailed dunnarts can survive in degraded landscapes, but they rely on basalt rocks or soil cracks for shelter which are not maintained in cropped landscapes. Between 1985 and 2019, there have been increases of 21 to 488% in the number of hectares under dryland cropping across Victoria (dependent on Catchment Management Authority region), as farmers are forced to accommodate changing climate. This threatens what little remains of appropriate habitat for fat-tailed dunnarts and has likely contributed to population declines and local extirpation. Due to ongoing population declines the fat-tailed dunnart has recently gained Scientific Advisory Committee support for the nomination as Vulnerable in Victoria under the Flora and Fauna Guarantee Act, fulfilling two IUCN criteria. We hope this will promote conservation of the last remaining small mammal of our grasslands.

Kristy Williams

Deakin University

kwilliams@zoo.org.au

An island wide perspective: The threatened long-nosed potoroo coexisting alongside the feral cat on French Island, Victoria

Introduced predators have heavily impacted two thirds of Australian mammal species, particularly critical-weight-range mammals (35 g to 5.5 kg). Understanding the environmental context and behavioural mechanisms, including spatial and temporal activity and habitat use, which allow native species to coexist in the presence of invasive predators is critically important for biodiversity conservation. We investigated how the threatened long-nosed potoroo (Potorous tridactylus) is coexisting with feral cats (Felis catus) on fox-free French Island, Victoria. Still images from 60 Reconyx cameras deployed every ~2km² across the island between 2018 and 2020, and habitat analyses at each camera location, were used to determine site occupancy, colonisation, extinction probability and temporal activity patterns of potoroos and cats. We found that potoroo site colonisation probability was positively associated with the proportion of Eucalyptus cover, but also with cat activity. The extinction probability of potoroos at each site differed between sampling periods and was influenced by higher shrub cover and a greater proportion of Eucalyptus present. Cat site occupancy was not significantly influenced by any environmental predictors. There was a significant difference between peak activity times of feral cats and potoroos, with potoroos peaking in activity around two hours after that of cats. Potoroos may be relying on habitat cover and reducing shared temporal activity with cats to reduce their predation risk and coexist with feral cats on French Island.

Kathryn Knights

PhD candidate, University of Melbourne

kaknights@student.unimelb.edu.au

Optimised distance sampling offers advantages in cost-efficiency over common plot-based methods for density estimation of high-density species

It is often taken for granted that high density and sessile species, such as many plants, are unlikely to escape detection during surveys to estimate their density and abundance. As a result, imperfect detection may not be accounted for in such surveys. However, research has shown that detectability is likely to be <1, even for highly detectable sessile species. Ignoring imperfect detection may lead to erroneous conclusions in comparative studies; an apparent difference in abundance may only reflect a difference in detectability between habitats, before and after interventions, or over time. There are many potential methods that could be applied to estimate detectability, such as double observer methods, time to detection methods and distance sampling, but their relative cost-efficiencies for surveying high density species are not well understood. Using field studies of two high density plant species and simulation, we explore the balance between the costs of sampling and the bias and precision of the estimate of density for several survey methods. We compare the common approach – uncorrected counts of individuals in plots – with less commonly applied methods including double observer plot counts and variations of distance sampling. Our results indicate that distance sampling can offer advantages over uncorrected plot counts for the same survey effort, such as lower bias, and optimized distance sampling – a novel method – delivered comparable precision and lower bias for our case study species. We propose that optimized distance sampling is a cost-efficient method for surveying high density species.

Rae Read

Masters of Environment and Sustainability, Monash University

raeread@gmail.com

Are 'other effective area-based conservation measures' (OECMs) supporting local and Indigenous communities managing forests: An analysis of the potential of other conservation frameworks to supplement the OECM guidelines

Forests continue to decline across the world and less than half of all forests remain intact. Many of our intact forests are outside of Protected Areas (PAs) and overlap with lands managed by local and Indigenous communities. Other effective area-based conservation measures (OECMs) have been suggested as an alternative conservation designation to PAs which could support local and Indigenous communities in a forest context. However, OECMs are poorly defined and understood, and the lack of literature on formally recognised OECMs presents a challenge to the adoption of OECMs more broadly. Many studies are still defining methods with which to identify potential OECMs and tend to leverage other existing conservation frameworks to supplement the OECM guidelines. This study analysed globally relevant conservation frameworks identified in the literature to determine which frameworks could support the implementation of OECMs in forests managed by local and Indigenous communities. The analyses considered a framework's applicability to: (1) the core OECM criteria as defined by the IUCN, (2) local and Indigenous communities, and (3) forests. The frameworks were then analysed against the five dimensions required to implement OECMs in practice, namely, identifying, registering, governance and management, monitoring, and funding of OECMs. The key findings of this study identified, conceptually, which frameworks were better suited than others in supporting different elements of OECMs, and the minimum frameworks required to supplement the implementation of forested OECMs managed by local and Indigenous communities.

Te Ao Marama Eketone

Honours Student, Deakin University

@tameketone teaomarama77@gmail.com

Long-nosed potoroo and eastern barred bandicoot activity and habitat use in relation to feral cat reduction on French Island, Victoria

Invasive predators, including feral cats, are key drivers of global biodiversity decline and extinction. Predators can alter the use of space and temporal activity patterns of their prey, including habitat selection, through fear-mediated changes to behaviour. Predator free wildlife havens are therefore essential for the conservation of many threatened species. However, few studies have experimentally elucidated how prey behaviour may change as predator numbers and risk of predation are reduced. My study aimed to investigate changes in the foraging behaviour and activity of eastern barred bandicoots and long-nosed potoroos following the reduction of feral cat abundance, and whether any responses were influenced by closed vs. open habitats. To do this, I used giving up density stations in front of motion triggered cameras across Bluegums on French Island, Victoria. My results indicated that after feral cat reduction, closed habitats were used more frequently by both species, foraging behaviour increased, potoroo and bandicoot activity increased over time, and the use of more open habitats increased. My study suggests bandicoots and potoroos appear to recognise feral cats as a threat and may be modifying their behaviour to mitigate predation risk. More broadly, this suggests these native species may be able to occupy and use more open habitat more frequently in the absence of feral cats. My study therefore indicates that the cat eradication program is likely benefiting native prey, and such information can be used to help inform conservation programs and actions involving similar species and ecological contexts.

Sally Burgemeestre

PhD Candidate, Deakin University

sburgemeestre@deakin.edu.au

Do fire and feral horse impacts interact to alter the movement ecology of the Broad-toothed Rat Mastacomys fuscus

The Australian Alps have experienced multiple large fires over recent decades and feral horse populations are increasing, particularly in Kosciuszko National Park where feral horses are protected and hunting limited. The Broad-toothed Rat (BTR) is a threatened species which relies on tall, dense vegetation commonly found in association with riparian areas or alpine bogs. However, this habitat is disproportionately used by feral and strongly susceptible to their impacts. In alpine and subalpine regions, fires can result in highly fragmented landscapes which can further compound the impacts of feral horses and compromise the dispersal of small mammals, including the BTR. However, it remains unknown how feral horse impacts interact with fire to affect wildlife. This study attempts to understand the habitat use patterns of BTR within burnt and unburnt areas of a feral horse dominated system, and to determine if fire and grazing by feral horses affect BTR movement, habitat use and selection and home range size across post-fire landscapes. The study proposes to use trapping and tracking methodologies to gain insight into how Broad-toothed Rats use the post fire landscape. Outcomes will provide insights into the effects of fire and feral horses on BTR and will contribute to the conservation efforts of the threatened species.

Aviya Naccarella

PhD Student, Deakin University

@AviyaNaccarella s222570272@deakin.edu.au

Fungi the missing puzzle piece – what role might fungus-feeding mammals play in ecosystem function?

Digging mammals have the capacity to alter ecosystem processes and functions. By digging they improve soil health, provide habitat for other species, and spread seed and fungal spores. Fungi help plants access nutrients and water. However, our knowledge of how these mammals influence plants through spreading fungal spores, directly through feeding or indirectly through digging, is limited. Digging mammals were once common across Australia, however, with the introduction of feral cats and red foxes many have greatly reduced in geographical range, population size or been driven to extinction. Disentangling interactions between mammals, fungi and plants is key to understanding what processes have been lost. This project will investigate this tripartite relationship through four lenses: function, revegetation, translocations, and novel landscapes. The overall research aim is to understand what role these digging mammals can play in restoration projects through their contribution to maintaining and restoring ecosystem function and health.

James Templeton

Project Officer & Research Assistant - Conservation Ecology Centre

james.templeton@conservationecologycentre.org

The contemporary and pre-colonial distribution, community ecology and soil condition of murnong (Microseris sp.) across Eastern Maar country

The effect of colonisation on Indigenous peoples' food practices was catastrophic and its effects still reverberate today. Murnong (Microseris sp.) is often referred to as 'yam daisy' and was one of the most important staple foods for Aboriginal people in south-eastern Australia prior to the British invasion. Today, this plant of profound cultural and economic importance is only found in remnant stands of vegetation and in extremely small patches in south eastern Australia. The Eastern Maar Aboriginal Corporation, representing the Gadubanud, Gulidjan, Kirrae Whurrung, Peak Whurrung and Gunditjmara tribes of south-west Victoria, grew great swathes of murnong crops as a staple food on the productive volcanic plains that dominate this region. This project investigates the contemporary and pre-colonial distribution, community ecology and soil condition of murnong across Eastern Maar country. Contemporary distribution and flora community structure has been determined by cross-organisational information sharing and widespread flora surveys. Historical distribution and flora community structure is being determined through palaeoecological analysis of sediment cores extracted from a series of targeted waterbodies. The soil environment, known to be critical for root crop health, will be analysed using soil from contemporary populations and soil biota in the palaeoecological samples. This information will provide insight into understanding where murnong grew under traditional Aboriginal management and what environmental factors are essential for it to persist.

POSTER SESSION

Thursday 9th February | 6:00pm - 8:00pm

Julianna Santos

PhD Candidate - University of Melbourne

@jsantosecology jlsantos@student.unimelb.edu.au

Does pyrodiversity influence genetic diversity?

Inappropriate fire regimes are among the main threats to biodiversity worldwide. Understanding relationships between fire and extinction risk is crucial for effective conservation management. While knowledge of animal ecology in fire-prone ecosystems is increasing, little is known about how 'pyrodiversity' – variation in fire regimes – influences genetic diversity within and between animal populations. Fire shapes the availability and connectivity of habitats used by small mammals and reptiles, and therefore variation in fire regimes is likely to influence genetic diversity of a range of species. However, the nature of this influence (e.g. relationships between variation in fire regimes and mechanisms underpinning variation in genetic diversity) are little understood. This project aims to understand how pyrodiversity shapes the abundance and genetic diversity of small mammal and reptile populations. We collected data on small mammal and reptile abundance, and tissue samples for genetics in a range of 'fire mosaics' in the Murray Mallee region of south-eastern Australia – selected to represent variation in the amount, configuration and diversity of post-fire age classes. Previous studies in the Murray Mallee region show that many species of mammals and reptiles are associated with antecedent fire. But, to the best of my knowledge, no studies have explored how genetic diversity is associated with pyrodiversity in this region. Improving understanding of relationships between pyrodiversity and genetic diversity will help identify the characteristics of habitats and fire mosaics associated with larger and healthier small mammal and reptile populations which are better able to adapt to environmental change.

Sarah McColl-Gausden

Future fire risk analyst, The University of Melbourne

@sarahmccg mccoll.s@unimelb.edu.au

FROST aka Fire Regimes and Operations Simulation Tool aka a way to explore current and future fire regimes with applications for ecology, fire management and risk planning

Fire regimes are changing across the globe in response to complex interactions between climate, fuel, and fire across space and time. These changes have implications for a range of fields, including fire management, ecology, and biodiversity.

Here we present a simulation tool, Fire Regimes and Operations Simulation Tool, otherwise known as FROST. FROST uses a framework of "modules" to combine fire behaviour simulations with Bayesian network (BN) models to capture and account for uncertainty in the modelled systems. The central framework is made up of a weather module, ignition module, and fuel module, all of which inform a fire event simulator. This tool can be used to quantify risk to a range of values, including people, property and ecological values posed by both wildfires and planned fires.

FROST allows for comparisons between multiple fuel management strategies, multiple future climate projections, and can be run in almost every Australian landscape. Outputs from FROST can help identify where in the landscape wildfire risk is likely to be the highest for the value/s of interest. This simulation framework is currently being used by a wide range of researchers and practitioners to prioritise resource allocation and explore a range of ecological questions. Current applications include: predictions of future fire regimes, spatially explicit population viability analysis, the cost effectiveness of fuel management solutions and a range of field based fire ecology studies. This poster will showcase the modelling framework itself as well as current and potential applications in the fields of fire ecology and biodiversity.

Jessica Keem

PhD Candidate, University of Melbourne

@JessicaKeem jkeem@student.unimelb.edu.au

Fire, fauna, and the future: identifying and protecting biodiversity hotspots from extreme disturbance events

Refuges are vital for the survival and persistence of fauna in the wake of disturbance events. While certain environments support a disproportionately high level of biodiversity, they are often isolated due to landscape fragmentation. As such, these biodiversity strongholds, or 'hotspots', are at risk from extreme disturbance events (e.g., fire) resulting in largescale biodiversity loss. While Australia is no stranger to bushfires, climate change is accelerating catastrophic fire events; fire refuges are therefore a critical first line of defence in safeguarding biodiversity. Through this study we aim to identify, protect, and enhance fire refuges across landscape-scale biodiversity 'hotspots', of Victoria, Australia. To achieve this objective, we will conduct four interconnected research chapters: 1) a global systematic literature review to identify locations of fire refuges and which associated attributes enhance species recovery from fire; 2) creation and on-ground validation of a model identifying areas of high biodiversity value interlaid with refuge location and fire risk for Victoria; 3) connectivity metrics derived from genetic analysis for species across a gradient of biodiversity, refuge and fire risk in a model-defined landscape; and 4) models simulating the capacity for prescribed fire to protect or enhance fire refuges in this landscape. This research will provide a rare example of systematically synthesised fire refuge data. More broadly, our research outcomes will provide management bodies with a framework to identify and protect areas of high biodiversity value from catastrophic fire events.

Emma Church

PhD, University of Queensland

e.church@uq.net.au

How do marine citizen science experiences to promote stewardship actions?

Australian's love coastal areas. More than 85% of our population live within 50 Km of the coast. But the health of Australia's coastal and marine environments are declining due to pressures such as climate change, pollution, habitat destruction and invasive species. Increasing individual participation in stewardship actions will be one part of effective management strategies. Marine citizen science experiences have potential to increase individual uptake of stewardship behaviours. However, little is understood about the relationship between different elements that make-up such experiences and the varying effects on willingness to do different stewardship behaviours. In this study we surveyed individuals (n=130) choosing to attend one of 24 marine citizen science events. Using quantitative methods, we differentiate the social and nature aspects of the marine citizen science experiences and examine how these experiences shaped individual willingness to adopt different types of stewardship behaviours. We provide practical advice for those wishing to create experiences to engage future stewards.

Danielle Wallace

PhD candidate at the University of Melbourne

@that_frog_gorldanielle.wallace@student.unimelb.edu.au

Lovesick frogs - how is amphibian breeding display changing with infection?

The devastating fungal pathogen, Batrachochytrium dendrobatidis (Bd), has caused widespread amphibian declines and extirpations. Although the disease mechanism has been well examined, the effect of infection on reproduction has received little attention. Here, we investigated how chytrid fungus affects male mating display in the critically endangered Alpine Tree frog, Litoria verreauxii alpina. We collected call recordings of wild frogs in the field and used a spectrophotometer to analyse male breeding colouration in the field and in the lab, while swabbing all individuals for infection. We found that the colouration was affected by chytrid fungus infection with almost all colour chromas increasing with Bd infection status and load. These are the first results to show that chytrid fungus infection influences male breeding colouration. Calling performance was not affected by infection status, but was closely linked to temperature variations within different amphibian microhabitats. The results that we present here are important but often overlooked aspects of disease ecology. Sublethal effects of disease can impact breeding behaviour and display. Therefore, such changes in reproduction and breeding success are crucial to investigate as they might have dramatic consequences on population trajectories and substantially influence population decline or recovery potential.

Kylie McGenniskin

Honours Candidate, La Trobe University

sanguinedragonflye@hotmail.com

Phylogenetic and environmental determinants of oothecal structure in Australian mantises

Morphological traits can be used to determine phylogeny and environmental adaptations. The mantis egg case (ootheca) is designed to protect the eggs from climatic conditions and predators.

Mantises can be useful indicators of ecosystem health, but can be hard to detect; however, their oothecae are more apparent and long-lasting. Being able to definitively identify mantis oothecae may be advantageous for invertebrate surveys. Previous studies have indicated that oothecae are phylogenetically distinct and stress that it is important that they are included in the taxonomic descriptions of Mantodea. No previous work has been done on the oothecae of Australian Mantodea and the information included in species descriptions is sparse at best.

We are exploring the morphology of Australian Mantodean oothecae using micro CT for internal measurements, analysis of porosity and volume. Comparing this and external measurements to climate related parameters (rainfall & temperature) to determine if there is significant variation in oothecae produced in different environments.

Our hypothesis is that mantis ootheca morphology will be driven primarily by phylogeny but with some variation due to environment.

Allison Menzies

Honours, La Trobe University

@AllisonJMenzies 1510973@students.latrobe.edu.au

Investigating a pollinator community in a grassland using metabarcoding

Using metabarcoding, sweep netting, vane traps and observation to describe and understand an invertebrate visitor/pollinator network at Illabarook Flora Grassland Reserve in the Victorian Volcanic Plains. This project will compare the results of metabarcoding of the flowers 5 target plant species with traditional survey methods, as well as creating a picture of the pollinator network within the grassland.

Arman Pili

PhD Candidate, Monash University

@arman_pili armannorciopili@gmail.com

Using individual-based models to show how indiscriminate disregard of spatial landscape and dynamic environment results in spurious predictions of species establishment success

Understanding the factors, processes, and mechanisms that allow species to establish has been a holy grail of theoretical and applied eco-evolutionary research (island biogeography, invasion science, reintroduction biology). A pivotal yet neglected mechanism is how establishment success is mediated by founding individuals' interactions and responses to changing environmental conditions and the diversity and distribution of habitats within the landscape. We demonstrated the promise of individual-based models — by simulating 18000 incursion scenarios using virToad (developed by Pili et al. (2022)) — for understanding how temporally dynamic environmental conditions, spatially heterogenous landscapes, founding population size, and introduction frequency interplay in mediating species establishment success in a globally notorious alien invader, the cane toad (Rhinella marina). Overall, static and running-window binomial generalised linear models revealed that establishment success significantly and substantially fluctuates with changing environmental conditions and varies in different landscapes. The dynamic effect of the temporal environment can be explained by introduction timing not coinciding with the cane toads' key life-history events (phenology), particularly the breeding season. Whereas the effect of the spatial landscape can be explained by mate limitation (allee effect), where adult cane toads have difficulty locating each other across a landscape. Propagule size swamped the effects of the temporal environment and spatial landscape when ≥ 18 individuals were introduced (≥90% probability of establishment). But in real-world incursion scenarios where at most three cane toads are accidentally introduced in a year, disregarding the effects of temporal and spatial changes in the environment leads to spurious predictions of establishment success.

Emily McColl-Gausden

Research Fellow, The University of Melbourne

@EcoEmcg emily.mccoll@unimelb.edu.au

Designing a Victoria Biodiversity Index

Monitoring species populations over time is crucial for understanding the impacts of catastrophic events, when to trigger management actions, and measuring management effectiveness. Measuring changes in biodiversity over time is generally achieved using species-based indicators. Species data can come in many different forms. From long term monitoring data at a single site to incidental observations where the sampling effort, detection error, and species bias can differ greatly. Using these variable data to monitor trends in biodiversity is therefore challenging. The Threatened Species Index (TSX) is an excellent example where monitoring data for 100s of species across Australia has been pooled to enable the development of meaningful trends for birds, mammals, and plants. While some Victorian data is incorporated into the TSX, for many species, the type of data available e.g., occurrence data, was not appropriate for the TSX analysis. In collaboration with the Department of Environment, Land, Water and Planning (DELWP), this project builds on the TSX to develop a Victorian Biodiversity Index (VBX) using additional analyses to incorporate the so far underutilized abundance of occurrence data. Developments in occupancy modelling have enabled occurrence data to be incorporated into biodiversity indexes. We are using Bayesian hierarchical occupancy-detection models to estimate the proportion of sites predicted to be occupied by a species, which can then be incorporated into a living planet index analysis, producing meaningful trends for Victorian biodiversity. Using this data would achieve greater taxonomic coverage in biodiversity indices and improve our understanding of biodiversity change.

James Kelleher

PhD Candidate, University of Melbourne

kelleherj@student.unimelb.edu.au

Dynamic occupancy models for the applied ecologist

When making conservation and management decisions, practitioners often need to understand drivers of species occurrence at the landscape scale. Dynamic occupancy models (DOMs) are a valuable tool for modelling colonisation and extinction while accounting for imperfect detection, i.e., failure to detect a species when it is present. DOMs have been applied to a diverse range of studies in Australia and around the globe. We conducted a review of papers using DOMs to characterise the historical and current state of their use, including why users turn to this model class and what decisions they make during the modelling process. Findings from this review indicate that DOM's potential for generating spatial and temporal predictions may be underexploited and few authors have applied them for this purpose. We also examined how models were fit, including how covariates were selected for inclusion. The extent and method of model selection varied substantially, and consensus on the most reliable methods was limited. Building on this finding, we explored how model selection approaches can influence model outputs and predictions using a long-term data set of Swiss breeding bird records. Preliminary results indicate that approach used for model selection can yield divergent estimates of key parameters, potentially resulting in different conclusions regarding where to conserve or which factors are most important in driving species range dynamics. Further emphasis on how model selection can impact outputs is essential to ensure that practitioners can generate robust predictions; in this presentation I outline my current and upcoming research on this subject.

Megan Hirst

Post Doctoral Fellow- Royal Botanic Gardens Victoria

@meghirst megan.hirst@rbg.vic.gov.au

Exploring the germination niche breadth of key Victorian alpine species to inform rehabilitation programs

The Australian Alps are critically vulnerable to climate change, with alpine plant communities already showing signs of stress. With a reduction of protective snow cover, this poses further risks to snow dependent and endangered species, notably above the tree line. With less snow, the alpine environment will change dramatically, and effect ecosystem function, nutrient cycling, and soil stability due to the significant role of alpine plants. Mountain Champions: Building resilient alpine environments with less snow is a collaborative Australian Research Council (ARC) project involving research and industry to bridge the gap between ecological theory and practical rehabilitation. A combination of field, laboratory and experimental glasshouse studies will inform and build knowledge into rehabilitation and restoration efforts by quantifying the interactions between snowpack and summer soil water availability, plant tolerances to extreme conditions and alpine plant adaptative and regeneration capacity. This project arm focuses on the Victorian Alps, testing plant responses at a seed level, specifically the germination/dormancy response across a temperature range using a suite of alpine endemics to view the 'optimal germination window'. All species responses are examined, with the understanding timing and germination success is predicted to alter as average global temperatures rise. In the summer-autumn of 2022, we made 164 seed collections from 34 taxa (graminoids, forbs, shrubs) from elevational transects around the Bogong High Plains. Additional mountain transects (i.e., Mt Hotham) will be explored in early 2023. We are testing the germination responses from target species using a thermo-gradient plate and series of incubators in our experimental design, with representation across populations where applicable. Germination metrics will be informative on early life strategy of these alpine plants.

Berenice Della Port

PhD student La Trobe University

@BereniceDpg b.dellaporta@latrobe.edu.au

Defining and assessing soil health from a microbiological point of view across agroecosystems

Many key ecosystem functions, such as C sequestration and nutrient cycling, are governed by soil microbial communities. However, quantifying soil condition, particularly from the perspective of soil microbial communities, remains a challenge. Improvements in soil microbial community health are often assumed to follow specific management practices, but quantitative and qualitative indicators of soil health are still widely disputed. The physical and chemical properties of a productive soil are reasonably well accepted, including high soil organic matter, stable structure, good texture, and optimum soil pH. However, while soil physical and chemical properties provide a snapshot of soil condition, they do not provide an understanding of how management strategies affect soils in the short term or allow projection of soil health into the long term. The state of microbial communities could provide these predictions provided an ecological framework for soil community trait-productivity relationships (the major knowledge gap) can be identified. The ability to assign the incredible diversity of microorganisms to predictive frameworks based on their discrete life-history traits will strengthen our understanding of ecosystem responsiveness and recovery from environmental disturbances and management practices. My project will address this knowledge gap systematically by linking microbial bio-indicators with known soil physio-chemical properties. We are measuring and linking soil physical, chemical, and microbial indicators of soil productivity across 15 Victorian farms to validate pre-existing hypotheses with respect to management practices at local and landscape scales, and in doing so, to propose enriched metrics of soil health with a specific focus on soil C cycling.

Ryan Fisher

Research Assistant, Masters of Environment Student (University of Melbourne

fisher.r@unimelb.edu.au

Assessing Morphological Leaf Traits, and Hydraulic Vulnerability in *Eucalyptus* species across a climatic gradient in Victoria, Australia.

We investigated key drought-related traits in leaves, Specific Leaf Area (SLA), Huber Value (HV), and leaf vulnerability curves in three Eucalyptus species from contrasting climatic environments within the field. We then compared those traits to previously obtained data of the same species, grown within an arboretum. Trait expression is driven by genetics, responses to environmental conditions (phenotypic plasticity) or both. Analysing field data, we observed that all measured traits differed among species. This was based on a significant difference between E.polybractea (dry) and E.delegatensis (wet) whereas no difference was found between E.delegatensis and E.obliqua (mesic). We found statistically significant differences between field and arboretum trait expressions for all three species for SLA ($p < 0.05$). No significant difference between field and arboretum traits expression was observed for P50 (the 50% loss of conductance – obtained from the leaf vulnerability curves) in E.obliqua and HV in E.delegatensis, suggesting that phenotypic plasticity was not influencing P50 in E.obliqua and HV in E.delegatensis. Trait differences due to different species' genetics were evaluated by comparing the trait expressions of all species measured previously in the. We found no trait differences among all three species, grown in the arboretum, for SLA and HV. There were significant differences observed in P50, with E.obliqua expressing the highest P50 (most vulnerable to embolism) and E.polybractea being the most resistant to embolism. Suggesting that SLA and HV are mainly determined by phenotypic plasticity, and p50 is determined through both genetics and phenotypic plasticity, this is not uniform across the eucalypt genus.

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