AFSS member update from Victoria June 2024
Compiled by Vic Rep, Teresa McIntosh, with help from Barbara Downes

Museum Victoria

Dr Richard Marchant, Senior Curator, Entomology, Museums Victoria

Developing new techniques to identify caddisflies (Julian Finn & Richard Marchant)

Over the past eight years Julian Finn and Richard Marchant, both curators at Museum Victoria, Melbourne, have been photographing, collecting and identifying adult caddisflies in the Otway Ranges. To date we have photographed and collected almost 3500 individuals, representing 19 families, 43 genera and 75 species. All specimens have been formally identified, using published keys and Museums Victoria’s extensive reference collection, and lodged in the State Collection.

We have found that we can distinguish almost all species based entirely on live colouration and external body form. Traditionally this approach has not been used. Instead, examination of caddis genitalia, wing venation and feeding appendages by microscope is used to discern species of adults. In the field we use UV lights to attract caddis. Initially we placed UV lights underneath bridges because their concrete surfaces offer an excellent background colour. To catch specimens where there are no bridges we have built what we call a ‘dalek’ (apologies to Dr Who!) – a step ladder covered in marine plywood painted pale grey (concrete colour). UV lights are suspended from the top of this structure and the caddis alight on the sloping surfaces.

Figure 1 Left: UV lights set up under a bridge; Right: The dalek on the Wye River in the Otway Ranges
One of our aims is to produce a photographic key to adult caddisflies. Using live characteristics to recognise caddisfly species has many potential advantages. By identifying adult caddis in the field, spatial and temporal changes in diversity may be quickly recognised and threatened species can be monitored without needing to collect specimens. Using characters visible to all allows every citizen scientist, land manager and caddis-loving trout fisherman to get involved monitoring their local waterway.

**RMIT University**

**Dr Sarah Treby, Research Fellow RMIT**

**Research on mussel populations in the Dandenong Ranges**

We’ve been closely studying two mussel species in the Dandenong Ranges: *Hyridella drapeta* (common) and *Hydriddella narracanensis* (rare). After an 8-year interval, we’re re-surveying 30 sites to assess changes in their populations. Our process involves surveying a 50 m stretch of creek, meticulously counting all mussels, and then returning them to their natural habitat.
Additionally, we’re investigating habitat characteristics, including sediment size and water quality parameters (EC, pH, DO, turbidity, and temperature). Our goal is to uncover any potential relationships between these environmental factors and the presence/abundance of these species.

This research builds upon my previous honours project at La Trobe University, where we delved into population genetics, life cycles, and shell morphology of these fascinating creatures. By understanding the limitations faced by rare freshwater mussel species like *H. narracanensis*, we hope contribute to their conservation and address the factors contributing to their decline.
Quantitative Aquatic Ecosystem Laboratory

Deakin University, School of Life and Environmental Sciences

Professor Rebecca Lester, Dr Jan Barton, Dr Ty Mathews, Dr Galen Holt, Dr Georgia Dwyer

The Quantitative Aquatic Ecosystem Laboratory continues to investigate a range of projects aimed at better understanding our aquatic ecosystems, how they may change under future climates and how we may be able to manage them more effectively, including from a holistic perspective including human uses.

We wrapped up another successful field season in Marysville counting caddisfly egg masses. We are currently developing a non-stationary approach to assessing what future population numbers may arise, focusing on recruitment success and the ability of females to utilise new oviposition habitats.

We have continued to develop tools to assess responses to future climates and water management in the Murray-Darling Basin. This includes the development of a management-oriented toolkit to assess ecological and economic outcomes under a range of scenarios, including assessing how effective proposed adaptation options may be. We are also investigating the current condition of ecological assets under the Sustainable Rivers Audit and comparing the outcomes across different model types - those based solely on inundation of identified habitats compared with process-based models.

Figure 5 Left: David Dodemaide and George Cunningham counting hydrobiosid egg masses in the Acheron River. Middle: Rebecca Lester with Pat Pickett on board a Southwest University chartered research vessel on the Pengxi River, a tributary of the Yangtze River, China. Right: The Turnip Creek catchment where a recently started catchment rehydration experiment hopes to change farm management to alter flows in Turnip Creek, Victoria.

We also continue to participate in the Victoria Drought Resilience Adoption and Innovation Hub as the knowledge brokers for the program and have commenced a project investigating the ability of diverse pasture plantings to reduce the summer feed gap. Other research includes assessing the impacts of willow removals from riparian zones, the use of satellite data to identify perennial crop types, the impact of algal blooms on food webs in the Three Gorges Reservoir and any impacts of electromagnetic radiation on platypus behaviour. We acknowledge the important contributions of many research and stakeholder partnerships in enabling these projects to occur.
Deakin University, Faculty of Engineering

Shashini Fernando, PhD student

Quantifying the capability of constructed wetlands to manage and naturally treat stormwater runoff

Constructed wetlands, as a form of water sensitive urban design (WSUD) assets have been commonly implemented to regulate stormwater quantity overflows and quality issues. They are also known as the ‘kidneys of the ecosystem’, due to their ability to naturally filter contaminants. They are low-cost, engineered waterbodies that naturally treat contaminants in the water and improve the water quality, they also have a low-energy requirement.

As a PhD student in the faculty of engineering at Deakin University, my research is based on quantifying the capability of these constructed wetlands to manage and naturally treat stormwater runoff containing heavy metals before safely returning it into the environment. Part of my research also is to understand the impact of restoration of constructed wetlands on the water quality. Recently, my team and I had the honour to present some of our work to The Hon. Gayle Tierney MP, Minister for Skills and TAFE, Minister for Regional Development regarding our progress on this work at Deakin University.

Some of our upcoming research is to understand whether constructed wetlands have the ability to treat stormwater runoff containing heavy metals, whether it acts as a sink or sometimes a source for these toxic contaminants. To also further understand the availability and mobility of these heavy metals within the constructed wetland systems and its implications on the greater environment. We look forward to sharing more updates in this space, stay tuned for more updates on our research into environmentally friendly approaches for water quality improvement and stormwater mitigation using constructed wetlands.

Federation University

Professor Peter Gell

Peter reports that he has “retired” but has an Emeritus role at Federation University and continues paleoecological research as a consultant, trading professionally as Diatoma. In October 2023 Peter and Federation University launched a new Elsevier volume Ramsar Wetlands: Values, Assessment, Management, co-edited with Nick Davidson and Max Finlayson. The photo shows Peter handing a copy to the Secretary General of the Ramsar Convention Dr. Musonda Mumba during the Society for Ecological Restoration conference in Darwin in September 2023. Peter continues his Adjunct role at Diponegoro University in Java as part of the Cluster for Paleolimnology and is working on reconstructing wetland histories at Milawa, Lower Barwon, Seaford Swamp.
Freshwater Ecology Lab

University of Melbourne, School of Geography, Earth & Atmospheric Sciences

Dispersal and recruitment of species across landscapes: a new synthesis (ARC Discovery project)

Drs Jill Lancaster, Barbara Downes, Deb Finn (Missouri State University) and Ros St Clair (Museum Victoria)

Begun in mid-2021, this research project aims to test hypotheses about the ability of adult aquatic insects to disperse across landscapes and how this may shape stream communities, using caddisflies. Additionally, five species will be analysed genetically to determine whether common expectations about dispersal ability are reflected in actual dispersal when measured using genetic variation.

Can caddisflies fly over catchment boundaries?

In the first field season, we tested whether caddisflies are able to fly to catchment boundaries and potentially cross over them to connect rivers on either side. To do this, we located catchment boundaries that were shared by two rivers that either each emptied into the ocean in different places or emptied into a regulated major river but at distant points. We called these boundary pairs, and we had five such boundary pairs.

Light traps were placed on either side of each of the shared boundaries within the forest along a line roughly parallel to the ridge, and were multiple kilometres away from water. Light traps were also placed immediately beside each stream at two locations along each creek. We also set up SLAM intercept traps of two sizes at all sites, but they caught surprisingly few aquatic insects.

About half of ~ 130 species of caddisflies (> 44,000 specimens from 18 families) were caught on at least one boundary, which demonstrates that many caddisflies are able to fly upstream beyond where there is any surface water and reach catchment boundaries. Rivers within boundary pairs were faunistically more similar to each other than either river was to other rivers in its own catchment. That pattern is otherwise very difficult to explain without invoking successful dispersal.
These data are turning models about stream populations upside down. A commonly held view is that the fauna residing in headwater streams are isolated at the top of dendritic networks (the Isolated Headwaters model). This research suggests that, far from being isolated, headwater streams may act as conduits for insect dispersal – not only for headwater species per se but also species that live much further downstream. You can read about it here if interested (open access): Lancaster, Downes, Finn & St Clair (2024).

An unexpected and most welcome side benefit of this research is that we discovered five new species and a new genus of caddisflies – all collected at locations < 100 km from Melbourne! This is surprising given this area is one of the most intensively collected places in the country, and it illustrates that the taxonomy of caddisflies (and no doubt other insect groups) is far from complete. Specimens have been handed over to Ros St Clair, David Cartright and Alice Wells (who are continuing to push caddisfly taxonomy forward), and this research has benefited greatly from their input and help.

It’s a reminder: identification keys should be viewed as “works in progress”. New species may pop up anywhere. So, if something doesn’t fit the key, keep in mind that you may have a species as yet unknown to the taxonomists – and it would be helpful to seek advice and to retain such specimens in case they do turn out to be a new species.

How good are dispersal proxies at predicting which species are the best dispersers?

In a related study, we used the above samples of caddisfly species to test the veracity of commonly used dispersal proxies. Dispersal proxies include characteristics like wing size, with larger wings thought to confer superior dispersal ability. Other proxies use “expert opinion” on whether species are “good” or “poor” dispersers. Dispersal proxies are widely used to test hypotheses about the role of dispersal in shaping metacommunities and are central to the dispersal–range size relationship proposed by biogeographers.

However, the great majority of proxies have never been subject to an empirical test to see if they correctly predict which species have superior dispersal ability.

We removed and dry-mounted one pair of wings from each of multiple individuals for each of 59 species (12 families of caddisflies), some of which were boundary species (i.e. had dispersed) while the rest were never found on a boundary. We tested whether aspects such as wing size and shape or expert opinion about dispersal ability correctly predicted which species were found on boundaries.
Not one of the dispersal proxies predicted which species were good dispersers. Boundary species included both the largest caddisfly in the data set (*Triplectides similis* [Leptoceridae] – wing span 15.1 mm) and one of the smallest (*Hellythria simplex* [Hydroptilidae] – 3.4 mm). All families except two contained both boundary and non-boundary species – putting to the sword the presumption that entire families share the same dispersal ability. Even genera contained both boundary and non-boundary species. Additionally, “expert opinion” about caddisfly dispersal abilities resulted in outcomes that were actually worse than assigning dispersal ability scores at random and, at best, were no better than random.

Our data thus show that dispersal proxies are unreliable, which means that tests of hypotheses that rely on them are unfortunately also unreliable. This work has just been published in the Proceedings of the Royal Society, and you can read it here if interested (open access): Lancaster, Downes & Kayll (2024)

**Helping out endangered Macquarie Perch**

In past research, we have shown that pairs of garden stakes can be used to boost invertebrate density and diversity in streams degraded by the effects of land clearance. Garden stakes can also boost numbers of small-bodied fishes.

![Figure 11 Examples of wings, showing fore (top) and hind (bottom) wings in uncoupled position. Left: *Austrheithrus glymma* (Philorheithridae) a boundary species with relatively large, rounded wings; Right: *Maydenoptila cuneola* (Hydroptilidae), a small, boundary species with long narrow wings. *M. cuneola* was among the smallest of the caddisflies but their wings make them look like miniature jet fighters. Indeed, hydroptilids were the single most abundant group on catchment boundaries – in complete defiance of their alleged poor dispersal ability due to small size.](image)

![Figure 12 Left: Effects of adding stakes to sites in Hughes Ck on detritus densities, and species richness and total densities of invertebrates Right: Effects of stakes on numbers of juvenile River Blackfish in Hughes Ck; a small effect was also seen on Macquarie Perch (Lancaster & Downes (2017); Cornell et al. (2022)).](image)
The stakes work by accumulating packs of detritus, which then provide large increases in living space, predator- and flow refuges and food.

Recently, Goulburn Broken Catchment Management Agency deployed this technique in Hughes Creek with the long term goal of boosting population numbers of endangered Macquarie Perch. We were on hand to provide advice about how the stakes work and how to deploy them (densities, locations). A large array of staff from GBCMA, Hughes Creek Landcare, Native Fish Australia and Taungurung Land and Waters Council were on hand to participate and help drive in pairs of wooden stakes.

Two sites were “staked” and GBCMA will also add nearby collections of logs to supplement the addition of resources of living space. Regular monitoring of fish numbers in Hughes Ck will examine whether numbers are boosted around sites with stakes. It is hoped that such sites will increase the survival of Macquarie Perch, thus hopefully boosting their overall population numbers in Hughes Ck. GBCMA press release is here.

**Ecohydraulics Laboratory**

**University of Melbourne, Department of Infrastructure Engineering**

**Prof Angus Webb and Dr Wim Bovill**

It has been a very busy time for AFSS members of the Ecohydraulics lab. Currently, Wim Bovill and Angus Webb are hard at work on the Flow-MER2.0 Monitoring and Research plan for the Goulburn River and Northern Victorian Tributaries areas, with other AFSS members of the consortium including Wayne Koster (Arthur Rylah Institute), Claudette Kellar (RMIT) and Mike Grace (Monash University). This project will see activities extend over a wider geographic footprint compared to the previous Flow-MER and Long-Term Intervention Monitoring projects and opens opportunities for far greater indigenous leadership and engagement in monitoring and research.

From the post-graduate students supervised by Angus, Meghan Mussehl submitted her final thesis back in December 2023 and received the all-important pass letter shortly thereafter. Dr Mussehl has since been working on a OneBasin CRC project and is now enjoying some well-deserved time off in the Australian outback before deciding what’s next.

Amali Dahanayke (co-supervised by Joe Greet and Justin Brookes) is in the final stages of thesis madness for her MDBA-funded project looking at vegetation and shoreline erosion in Lake Victoria, NSW. She is aiming to submit in April/May and may have already done so by the time you read this. After that will be a trip back to Sri Lanka for the first time since she arrived in Melbourne just weeks before the first pandemic lockdown in 2020.
Xiaoyan Dai continues her good work looking at monitoring designs for environmental management projects. Diana recently had the singular honour of being selected as the sole representative of the University of Melbourne at the Stockholm International Youth Science Seminar, where she attended the Nobel Prize awarding ceremony, rubbed shoulders with Nobel Laureates, and is no doubt eyeing off one of these awards for herself in future.

Yiwen Xu continues to chase *Daphnia* around artificial stream networks in the laboratory. Some interesting results are emerging that largely support the findings of previous theoretical research on the effects of network structure on population outcomes, but statistical power to detect significant effects remains an issue in these labour-intensive experimental systems.
Waterway Ecosystem Research Group

University of Melbourne, School of Agriculture, Food and Ecosystem Sciences

Detecting Southern and Brown Toadlets using eDNA

Elizabeth Hamshaw (UoM Honours student), Dr Ryan Burrows (UoM / Melbourne Water), Dr William Steele (Melbourne Water), Dr Rhys Coleman (Melbourne Water)

A new multi-institutional research project, led by Elizabeth Hamshaw, is underway to optimise the detection of the Southern Toadlet (*Pseudophryne semimarmorata*) and the Brown Toadlet (*Pseudophryne bibronii*) using environmental DNA from water samples collected during the Autumn breeding season. The project will also aim to better characterise their unique habitat requirements. Both species are listed as endangered in Victoria and have recently experienced a drastic decline in the Melbourne region due to a variety of pressures. They inhabit damp areas of forests, woodlands, heaths, and grasslands in south-east Australia but not necessarily near permanent water. Elizabeth and the team will filter water for eDNA at the same times and locations that traditional call surveys are undertaken by Ecology Australia and community groups. Pools, wetted depressions, and creeks that are nearby known nests and burrows (from call surveys) will be targeted. Sampling began in early April and will continue until mid-May. A greater understanding of their habitat requirements will guide interventions aiming to ensure water availability during the breeding season. If DNA screening successfully detects toadlets, the method can be rolled out more broadly during the breeding season to improve our understanding of their distribution. For further information, contact Elizabeth (ehamshaw@student.unimelb.edu.au) or Ryan (ryan.burrows@unimelb.edu.au).

Birrarung billabong monitoring for changes in dissolved oxygen and ecosystem metabolism

Dr Joe Greet (UoM), Dr Ryan Burrows (UoM / Melbourne Water), Wurundjeri Woi-wurrung Narrap Ranges

Since October 2023, we have been recording dissolved oxygen and weather conditions at three billabongs along the Birrarung-(Yarra River). The project will provide a better understanding of how water quality responds to wetting and drying cycles to inform environmental water management. This work is part of a
larger ARC-funded project in partnership with local Traditional Owners (Wurundjeri Woi-wurrung) to determine ecological responses to flooding and fire (cultural burning) and develop TO-led management plans for these ecologically and culturally significant sites. For further information, don’t hesitate to get in touch – greetj@unimelb.edu.au.

Figure 17 Left: Joe proudly showcasing one of the custom buoys housing a weather station and dissolved oxygen logger Right: one of the buoys in Banyule Billabong.

Deer love waterside views! Mapping deer density and impact to better protect riparian areas

Dr Ami Bennett (UoM), Dr Melissa Fedrigo (UoM), Dr Joe Greet (UoM)

After ~5 years collating and collecting deer scat count data from >1,900 locations and surveys of damage to >20,000 individual trees and shrubs, we have produced predictive maps of deer density and impacts for the Greater Melbourne area.

Figure 18 Spatial predictions of deer density modelled using quantile regression forests.
Within the region, deer are likely to be most abundant near waterbodies due to the availability of high-quality forage and water, and prefer lowland locations that have access to both open and forested habitats. This research is aimed at helping water and land managers identify and assess risks posed by deer and prioritise assets for protection and locations for control. For further information, please see our recent paper and don’t hesitate to get in touch – greetj@unimelb.edu.au

And that’s (almost) a wrap for the Dry Rivers Research Coordination Network

Dr Ryan Burrows (UoM / Melbourne Water)

Since 2018, over 30 academics and practitioners from many countries have been collaborating on research to enhance our understanding and the protection of non-perennial rivers. Beside the many online meetings, we have met in person for workshops in Utah, New Mexico, Montana, and Georgia. It has been an enormously productive RCN with over 20 publications and several major grants. While the RCN officially ends 2024, the collaborations will continue!

Figure 19 Left: The attendees of the last Dry Rivers RCN meeting in Georgia; Right: Ryan Burrows, Mathias Messenger, Jake Hosen and team on a Flint River float trip.

Improving our understanding of the distribution, drivers, and functions of streams plants

Scott McKendrick (UoM), Yung En Chee (UoM), Sacha Jellinek (UoM / Melbourne Water), Joe Greet (UoM)

This past summer we started a project to better understand the distribution of aquatic and marginal plants along stream channels (instream vegetation). Very little is known about Australian instream plants despite their role in many stream processes. We surveyed 82 sites across the Greater Melbourne region, identifying plants, their cover, as well as a range of geomorphic attributes. While we are yet to analyse the data, it is clear that streams across different land uses, geomorphology types and riparian conditions support instream plants. The plants, however, were frequently patchy making this data both fun and challenging to work with! This data provides an important baseline for further investigation.
This work hopes to build on recent PhD research by Scott McKendrick, which shows how catchment hydrology may limit the benefits of improving geomorphic complexity to promote instream vegetation and highlights the important biogeomorphic role (propagule and sediment trapping) of instream plants, and how instream plants in urban streams are less likely to provide this function (soon to be available online). Keep an eye out for Riverine aquatic plants trap propagules and fine sediment: implications for ecosystem engineering and management under contrasting land uses.

**Figure 20** Left: Emergent and aquatic vegetation on the Werribee River (western Melbourne) with complex, boulder dominated geomorphology; Middle: Scott McKendrick lost in Phragmites; Right: aquatic and emergent vegetation in Cannibal Creek (eastern Melbourne), which is sand-dominated with lots of large wood.

**Figure 21** Conceptual model of biogeomorphic succession redrawn and adapted from Gurnell et al. (2012) to include submerged aquatic species. Section A (grey box; A1–A2) is an added initial step to the conceptual model and shows submerged aquatic species first colonising the stream channel, (B) fine sediment and propagules are then trapped and retained facilitating marginal emergent species colonisation as sediment aggrades and water becomes shallower, (C) an underwater shelf forms, (D) and then a bench as sediment aggrades above the low flow level and wetland plants start colonising, (E) and finally sediment aggrades to form an extension of the bank which is colonised by riparian species.