The 69th New Zealand Entomological Society Conference

Dunedin 7-9 April 2021

The Cromwell Chafer Beetle (*Prodontria lewisii*, Family Scarabaeidae) is a flightless beetle found in only one spot: The Cromwell Chafer Beetle Reserve in Central Otago, NZ.

Kia ora!

We welcome you to the 69th annual conference of the New Zealand Entomological Society, at the Otago Museum in the takiwā of Ngāi Tahu. We have a full and exciting programme planned including symposium dedicated to a discussion regarding insect conservation. There is plenty of time allocated for breaks, lunches and evening activities. Please engage to the fullest and make the most of what is always an inclusive, stimulating and collegial conference that is particularly student-friendly. We look forward to meeting each of you!

On behalf of the Society Executive and organisers,

Ngā mihi

Jenny Jandt, Sheri Johnson, Barbara Barratt, Emma Curtin, Cilla Wehi, Anne Wignall, Tara Murray, and Aaron Harmer

Information for Delegates

The conference and most events will be at the Otago Museum [419 Great King Street – see map at end of Programme for additional details].

Oral presentations

Please load your talks onto the presentation laptop as early as possible, prior to the beginning of the sessions. Presentation slots are 10 minutes (full talks) or 3 minutes (speed talks) plus question time. Please rehearse your presentation to ensure it stays within the allocated time.

Posters

Please place your posters on the poster boards provided in the Hutton Theatre during registration (Wednesday morning).

Thank you!

Special thanks to those that assisted in planning

Otago Museum Staff: Vanessa Graham, Emma Burns, Cody Phillips, Kane Fleury, On Lee Lau
Catering: Otago Museum and University of Otago Staff Club
Programme Cover Art: Jessica Chen
Programme Committee: Jessica Chen, Melita Busch, James Crofts-Bennett, Steve Kerr, Emma Curtin
Museum Tour Coordinator: Mateus Detoni
Wooing Tree Winery: Discount on Beetlejuice wine (Chafer Beetle)

Plenary Speakers

Emma Curtin is a PhD candidate at the University of Otago, working on ecological and agricultural effects of dung beetles. She received her MSc from Massey University, where she researched the Cromwell Chafer beetle. Emma is currently the president of the Otago Entomology Society.

Wednesday, 11:15: The extraordinary story of an unassuming beetle: The past, present and future of the Cromwell Chafer Beetle

Jonathan Barnsley provides analyses of various issues for the Chief Departmental Science Adviser at the Ministry for Primary Industries (previously for the Prime Ministers Chief Science Adviser). Recently, he was the lead-author of a literature scan/expert interview paper on what is known about insect population trends in Aotearoa New Zealand (currently in the submission process).

Wednesday, 15:30: The environment and (terrestrial) insects

Jacqui Todd is a research scientist at Plant & Food Research, Auckland. Her research has three intertwined themes: functional invertebrate ecology in orchards; risk assessment of arthropod biological control agents; bioconversion of waste streams by insects and other invertebrates. She also occasionally investigates edible insects.

Thursday, 8:45: Can we increase the numbers of native and beneficial invertebrates in our orchards?

Rod Morris has been telling stories about our natural history for more than four decades now. He's been a zookeeper, a teacher, an author, and a wildlife ranger. For half of that period he was a natural-history filmmaker - producing and directing documentaries about some of our best-loved birds - kiwi, kākāpō, kōkako, kea, kakī (black stilt), and kakaruia (black robin). These days, nature photography and public speaking occupy more of his time, and his focus is on the 'lesser known creatures' - especially among the reptiles and invertebrates. He is concerned as well, about threatened environments like the montane coal measures on the West Coast and the Canterbury plain's braided river systems.

Public Talk, Thursday, 5:30pm: How the 'moss leopard' got its name – invertebrate 'discovery' stories

Janice Lord is an Associate Professor of Botany at the University of Otago. Her interests include the evolution, ecology and conservation of New Zealand's unique plants, and how they interact with pollinators, seed dispersers and microbial mutualisms.

Friday, 8:45: Saturation or stimulation? The effect of mast flowering on pollinators

The 69th Entomological Society of New Zealand Conference
The Otago Museum, Dunedin
Schedule of Events 6 April – 9 April 2021.

Tuesday 6th April

10:00	Museum Tour	** Reserved in advanced. Confirmation provided via e-mail.*
14:00	Museum Tour	** Reserved in advanced. Confirmation provided via e-mail.*

Wednesday 7th April

Unless otherwise stated, activities will take place in the Otago Museum, Hutton Theatre.

09:00	Registration Opens	
	Early morning tea: Coffee and Snacks Available (Come by for some chats!)	
	Posters can be hung on poster boards	
10:00	Museum Tour	** Reserved in advanced. Confirmation provided via e-mail.*

Welcome Mihi

11:00	Kaumātua Hata Temo (University of Otago)	

Plenary

11:15	Emma Curtin	The extraordinary story of an unassuming beetle: The past, present and future of the Cromwell chafer beetle

Lunch

12:00	Lunch	*Hutton Theatre, Catered by Otago Museum*

Conservation Symposium: Part 1

13:00	Tara Murray	Introduction to Conservation Symposium
13:10	Eric Edwards	Te Papa Atawhai – DOC invertebrate conservation desire
13:25	Tara Murray	The Department of Conservation's research priorities for managing threatened species
13:40	James Tweed	Determining the full range of threatened biodiversity that requires management: Data deficient invertebrates of Southland & Rakiura
13:55	Chris Green	Actions towards the recovery of Mahoenui Giant Wētā
14:10	Aaron Bertoia	Developing monitoring methods to understand alpine invertebrate responses to introduced mammalian predators
14:25	Morgane Merien	'*Do insects have friends?*' and other such questions: Insect conservation and community engagement
14:40	Discussion	

Afternoon Tea

15:00	Tea	*Hutton Theatre, Catered by Otago Museum*

Plenary

15:30	Jonathan Barnsley	The environment and (terrestrial) insects

Conservation Symposium: Part 2

16:15	Thomas Hewitt	The impact of mammalian insectivores *Rattus rattus* (rat), *Mus musculus* (mouse) & *Erinaceus europeus* (hedgehog) on the size and abundance of mainland Coleoptera and Orthoptera
16:27	Yasmin Singh	Effects of predator exposure on wētā behaviour and habitat use
16:39	Meg Kelly	Examining behavioural differences between predator aware and predator naïve *Hemideina crassidens*
16:51	Warren Chinn	Tracking the snowline: Responses to climate change by New Zealand alpine invertebrates
17:03	Phil Lester	The population dynamics, prey, and potential distribution of the European paper wasp (*Polistes dominula*) in New Zealand
17:15	Break	

Poster Session & Reception

17:30	Poster Session	** The Otago Museum Atrium*
	Reception drinks and nibbles provided	
18:30	Museum Tour	** Reserved in advanced. Confirmation provided via e-mail.*

Thursday 8th April

Unless otherwise stated, activities will take place in the Otago Museum, Hutton Theatre.

08:30 Coffee (Come by for some chats!)

Plenary

08:45	Jacqui Todd	Can we increase the numbers of native and beneficial invertebrates in our orchards?

Morning Session 1

09:30	Max Buxton	Nocturnal pollinators are important for crop plants: a global review
09:42	Julia Bohorquez	Does scale insect infestation affect the attractiveness of Mānuka to honey bees?
09:54	Julia Kasper	Flower use by four species of bumble bees (Hymenoptera: Apidae) in the South Island of New Zealand, derived from pollen samples obtained from museum specimens

Morning Tea

10:00	Tea	*Hutton Theatre, Catered by Otago Museum*

Morning Session 2

10:30	Zoe Smeele	Using a gene silencing approach, with carbon quantum dot nanoparticles, to treat viral infections in honey bees
10:42	Josh Gilligan	Steps towards implementing a Gene Drive for invasive wasp species
10:54	Gemma McLaughlin	Molecular methods to manage wasps in New Zealand
11:06	Melita Busch	Who defends the colony? Looking at the defence response of *Vespula* wasps

11:12	Mateus Detoni	Evolutionary and ecological pressures shaping social wasps collective defences
11:24	Heshani Edirisinghe	Variation in responses to simulated predator attacks in ladybirds (Coleoptera: Coccinellidae)
11:36	Francis Burdon	Novel biomarkers reveal landscape influences on linkages between aquatic and terrestrial food webs
11:48	Andrea Clavijo McCormick	Complex ecological impacts of the giant willow aphid invasion in New Zealand

Lunch

12:00	Lunch	*Hutton Theatre, Catered by Otago Museum*
12:30	Curator's Meeting	

Afternoon Session 1

13:30	Neil Birrell	Metabolomic fingerprinting of an edible insect species, *Prionoplus reticularis*, using Gas Chromatography Mass Spectrometry
13:42	Luna Thomas	Is there male dimorphism in the iconic Helm's stag beetle?
13:54	Christina Painting	Exaggerated sexually selected weapons maintained with disproportionately low metabolic costs in a weevil with extreme size variation
14:06	Nathan Burke	Male coercion and female injury in the sexually cannibalistic Springbok mantis
14:18	Aaron Harmer	Biomechanics of sexually selected weapons in New Zealand harvestman
14:30	Mary Morgan-Richards	Lack of assortative mating in a modified landscape leads to a hybrid swarm
14:42	Cilla Wehi	Eco-evolutionary dynamics between sexually selected weaponry and foraging in tree wētā (Orthoptera)

Afternoon Tea

14:45	Tea	*Hutton Theatre, Catered by Otago Museum*
15:00	Tribute to John Nunn	

Afternoon Session 2

15:30	Eloise Lancaster	Who is laying eggs? Reproductive skew in native NZ ants
15:40	Simon Connolly	Monogyny and introgression in New Zealand fishing spiders (*Dolomedes*)
15:52	Claudio Cubillos	Evolution of the thermal plasticity in different traits across New Zealand stick insects (Phasmatodea)
16:04	Anoek Grosmann	The impact of temperature acclimation on metabolic rate of New Zealand stick insects
16:10	Nicola Sullivan	Vibrational communication in passionvine hopper (*Scolypopa australis*) – potential for residue-free pest management
16:22	Cassandra Mark-Chan	Lichen moths do not benefit from lichen masquerade in the absence of a matching background
16:34	Anthony Stumbo	Importing foreign butterflies into New Zealand: Ethics, biosecurity, and sustainability
16:46	Break	

Public Talk

17:30	Rod Morris	How the 'moss leopard' got its name – invertebrate 'discovery' stories

Banquet

19:00	Banquet	**The University of Otago Staff Club, 90 Union Place West* All registered attendees are invited for food and drinks. We will walk over after the talk, or you can join us at your convenience.

Friday 9th April

All events will take place in The Otago Museum, Hutton Theatre.

08:30 Coffee (Come by for some chats!)

Plenary

08:45	Janice Lord	Saturation or stimulation? The effect of mast flowering on pollinators

Morning Session 1

09:30	Julie Kasper	Mosquitoes in New Zealand – The endemics and the intruders. Monitoring tools and citizen science to compare invasive with endemic mosquito species over time – outcompeting, pathways and health issues
09:42	Mariana Musicante	Exclusion of exotic mosquitoes in New Zealand

Morning Tea

10:00	Tea	*Hutton Theatre, Catered by Otago Museum*

Morning Session 2

10:30	Kiran Horrocks	Can sterile parasitoids be employed for eradication by mitigating potential risk of non-target impacts?
10:42	Thomas Saunders	Exploring host-specificity through chemical ecology to gain insights into the ecological host ranges of three *Trissolcus* (Hymenoptera: Scelionidae) parasitoids in New Zealand
10:54	Sarah Inwood	2 species in 1 sample: RNAseq of a parasitoid within its host
11:06	Michelle Guerrero	Diversity of entomopathogenic fungi in New Zealand and their potential for pest management
11:18	Mike Cripps	Impact of the gall fly, *Urophora stylata*, on seed production of *Cirsium vulgare* in New Zealand
11:30	Leslie Mann	*Paropsine* defoliation within Eucalyptus species
11:42	Roanne Sutherland	Granulate ambrosia beetle: a new threat to broadleaf trees in New Zealand

Lunch

12:00	Lunch	*Hutton Theatre, Catered by Otago Museum*
12:30	Entomological Society of New Zealand AGM	

Afternoon Session 1

13:30	John Early	Mason wasps (*Pison* spp.; Hymenoptera: Crabronidae) in New Zealand
13:42	Danilo Hegg	High alpine sorcerers: the cave wētā genus *Pharmacus* Pictet & de Saussure, 1893

13:54	Phil Sirvid	The Opiliones of New Zealand: Revisionary synthesis and application of species delimitation for testing biogeographic hypotheses – post-ICA 2019 update
14:06	Cor Vink	The rise and fall of two orbweb spiders
14:18	Shaun Thompson	A preliminary phylogeny of *Porrhothele* (Porrhothelidae) based on mitochondrial DNA

Afternoon Tea

14:30	Tea	*Hutton Theatre, Catered by Otago Museum*

Afternoon Session 2

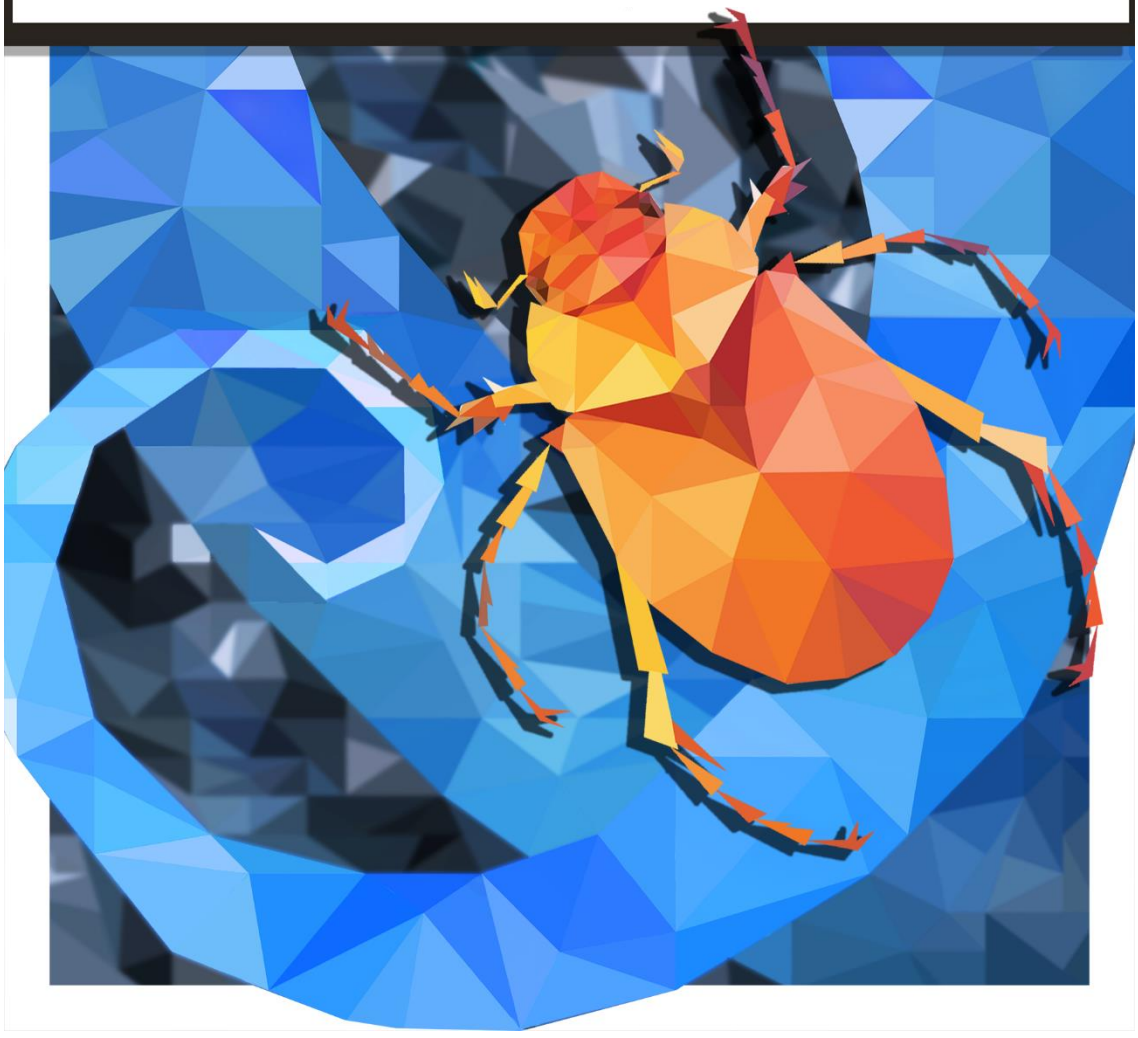
15:00	Rich Leschen	Male antennae of beetles
15:12	Graham McCulloch	Genomics reveals widespread ecological speciation in flightless insects
15:24	Johnathon Ridden	Georeferencing your collection: I'm sure it was somewhere in that valley
15:30	Rebecca Le Grice	Geography and local environment as important drivers of coastal Diptera community variation throughout Aotearoa|New Zealand
15:42	Leilani Walker	Scavenger hunt; Reconnecting historical terrestrial invertebrate collections from Rangitāhua (Kermadec Islands)
15:54	Ruby Moore	Freshwater Invertebrate Monitoring and Citizen Science with Ngati Kuri Schools in the Far North

Awards and Conclusions

16:06	Awards
16:30	Conference Closes

Plenaries

(in order of schedule)



11:15 – Wednesday, April 7th

Emma Curtin

The extraordinary story of an unassuming beetle: the past, present and future of the Cromwell chafer beetle

Curtin, E.R.[1], Barratt, B.I.P[2]. & McKinlay, B.[3]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
email: emma.curtin@postgrad.otago.ac.nz
[2] *AgResearch Invermay, Biocontrol, Biosecurity and Bioprocessing, Mosgiel, New Zealand*
[3] *Department of Conservation, Dunedin, New Zealand*

The Cromwell chafer beetle, *Prodontria lewisii*, is a critically endangered species, with the entire population restricted to an 81ha reserve in Central Otago, New Zealand. The Cromwell chafer is the only insect in the southern hemisphere with its own reserve, making both it and its habitat unique. Here we will describe the history of Reserve and the Cromwell chafer itself, from the discovery of the beetle in 1903, through to the creation of the Reserve in 1983 and onwards to the research taking place in the present day. The Department of Conservation manage the reserve and we describe how research informs current and future management. The results of ongoing monitoring efforts have shown that despite multiple threats in the form of dam building, introduced predators and habitat destruction, the population has remained relatively stable since 2001. However, the threats facing the beetle are changing over time and new threats are emerging. Redback spiders were first observed on the Reserve in 2008 and a single spider is capable of killing over 40 beetles. Spider surveys have shown that manually filling in rabbit burrows deprives redbacks of their favoured web-building habitat and leads to a reduction in chafer beetle deaths. As well as providing habitat for invertebrate pests, mammals – including humans – pose threats in themselves. We examine these pressures in turn and detail the studies undertaken to date to understand each of them. We also explore the possibility of translocating the Cromwell chafer beetle to alternative habitat outside the Reserve. A study aiming to identify key plant and soil types for optimum larval and adult survival using both field and laboratory raising experiments has shown that the Cromwell chafer is highly habitat-specific, requiring particular soil and plant combinations in order to thrive. We aim to provide a holistic picture of this special species – its unusual past, threats to its present, and hopes for its future.

"The next generation of *Prodontria lewisii* in the making". Photo taken on the Cromwell Chafer Beetle Nature Reserve by ER Curtin.

15:30 – Wednesday, April 7th

Jonathan Barnsley

The environment and (terrestrial) insects

Barnsley, J.E.[1], Roche, J.R.[2], Gerrard, J.A.[1], Hughey, K.F.D.[3]

[1] Office of the Prime Minister's Chief Science Advisor, University of Auckland, Auckland, New Zealand
[2] Ministry for Primary Industries, Wellington, New Zealand
[3] Department of Conservation, Wellington, New Zealand
https://www.linkedin.com/in/jonathanbarnsley/

Insect population health has received significant media attention as part of a larger biodiversity crisis. In particular, a recent global assessment of biodiversity estimated that 10% of all insect species are threatened with extinction; however, it is not yet certain if reported declines in insect biodiversity are, truly, global. Three key questions need to be addressed in Aotearoa New Zealand: (1) what is the state and trend of insect populations; (2) if there are declining trends, what are their drivers; and (3) given the drivers, what can be done to rectify and reverse declines. Like other aspects of environmental monitoring, there are distinct gaps in our understanding of the condition of invertebrate communities. This inhibits the answering of these questions. Our scoping review explored what is known about the potential occurrence of mainly endemic terrestrial insect decline in Aotearoa New Zealand. The review was undertaken to inform strategic policy advice. Thus, the aim of the study was to identify key themes of concern for insect population health, to capture expert perspectives on how to better understand this issue, and to recognise what key barriers to work exist for answering the three research questions. A mixed methods approach was used, beginning with a literature review to establish a prevailing international narrative for insect populations and to explore its relevance in Aotearoa-New Zealand, through the analysis of threat classifications, key informant interviews, an expert panel, and targeted engagement and input from Māori. Overall, we found that there are existing databases and field studies which could be utilised for well-designed meta-analysis or resampling works to provide short-term insights. In the medium- to long-term, more detailed contemporary research is required to fully document New Zealand's invertebrate fauna and to monitor key elements. This work needs to be considered also within the context of a Te Ao Māori frame, including a commitment to co-design and co-implementation.

Image taken near Arthur's Point, Queenstown in Jan 2017

Summary work stream can be found on the PMCSA website: https://www.pmcsa.ac.nz/2019/11/12/is-aotearoa-losing-its-insects-we-dont-have-the-data-to-say/

08:45 – Thursday, April 8th

Jacqui Todd

Can we increase the numbers of native and beneficial invertebrates in our orchards?

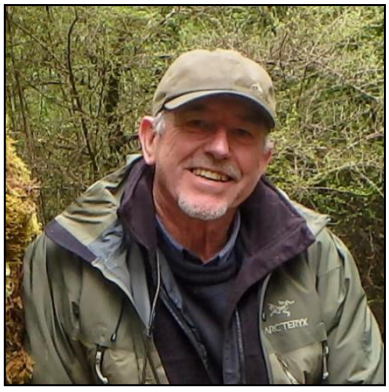
Todd, J.[1]

[1] *Plant and Food Research, Auckland, New Zealand*
https://www.researchgate.net/profile/Jacqui_Todd

Over the past decade we have conducted a number of studies to try to provide an answer to this question. We started with surveys of the invertebrates found in kiwifruit and apple orchards and tried to determine the proportion that were native or beneficial exotic species. Through collaboration with a number of wonderful growers we were able to investigate the management practices that were having an effect on the populations of invertebrates in the orchards. We've also made some progress towards identifying the species contributing to the suppression of pest insect populations and decomposition processes on the orchards, and we've started research to understand the resource needs of native pollinators. With the increasing interest in planting native trees and shrubs on "unproductive" areas of land, there is hope that orchards can become areas of ecological, as well as productive, value.

Image: Orchard landscape in the Bay of Plenty

17:30 – Thursday, April 8th



Rod Morris

How the 'Moss leopard' got its name - invertebrate 'discovery' stories

Morris, R.[1]

[1] *Dunedin, New Zealand*

Film: https://www.nzonscreen.com/profile/rod-morris
Photography: https://www.rodmorris.co.nz/

Rod's talk at the conference is colourfully illustrated but a little eccentric. This power-point presentation documents his family's various interactions with rare and unusual invertebrates - phasmids, wētā, flies, leaf-veined slugs, ticks, lice, giant land snails and planarians - encountered while travelling both here, and overseas. On the journey he poses a seemingly unrelated but important question: what child could possibly exist, growing up in our society without a name?

Interview with RadioNZ on the Denniston Plateau
https://www.rnz.co.nz/national/programmes/ourchangingworld/audio/2500717/rod-morris-on-the-denniston-plateau

Mercury Islands tusked weta *Motuweta isolata*. Photo by R. Morris.

08:45 – Friday, April 9th

Janice Lord

Saturation or stimulation? The effect of mast flowering on pollinators

Lord, J.[1]

[1] Department of Botany, University of Otago, Dunedin, New Zealand
email: janice.lord@otago.ac.nz

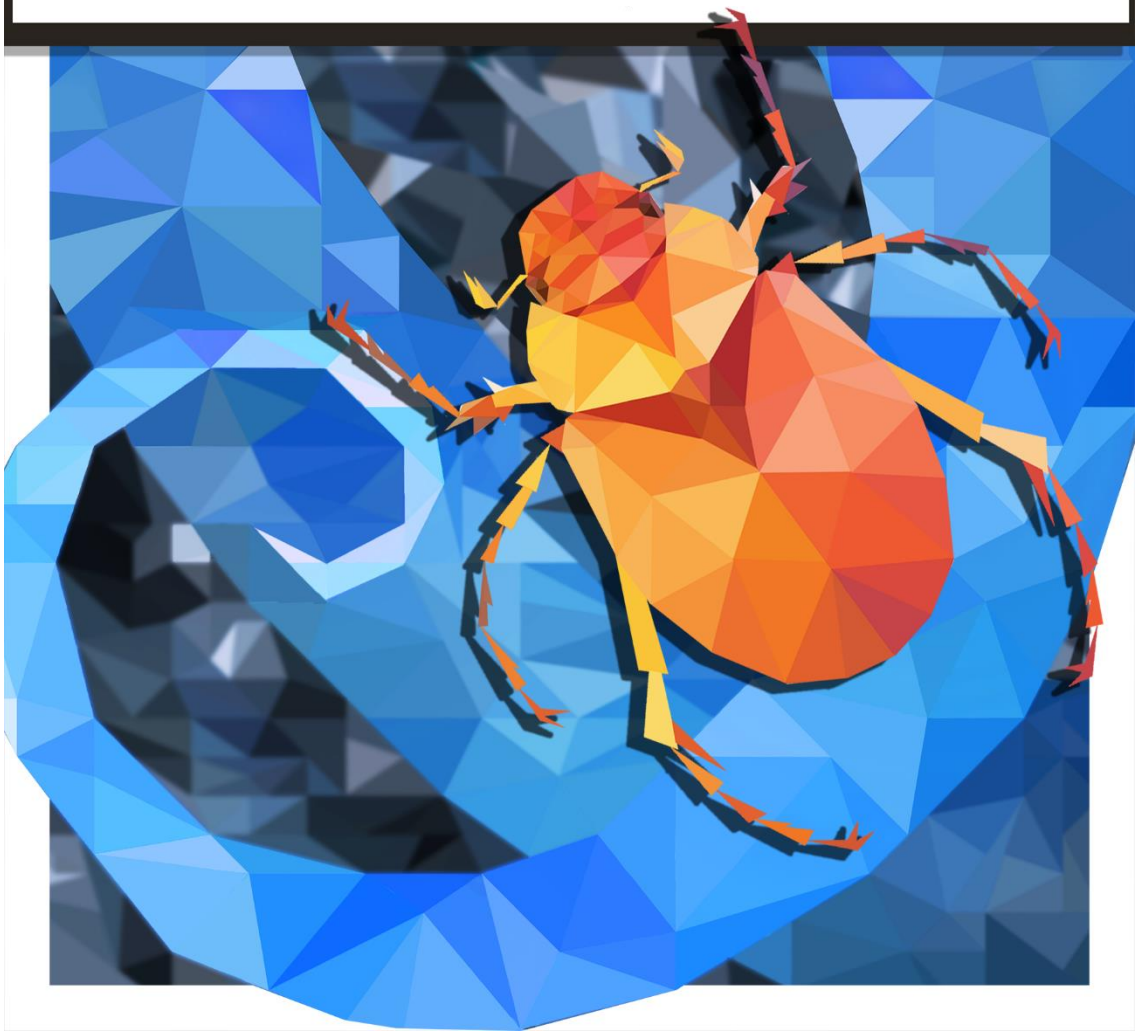
Masting is a pattern of reproduction in plants in which years of very high seed production are separated by several years with little or no seed production. Satiation of seed predators, typically invertebrates, during mast years, is thought to be a major advantage of masting behaviour. Little is known, however, of the consequences of masting for insects that utilise floral resources, as the plants that have been most researched in New Zealand and worldwide are wind-pollinated. In New Zealand alpine ecosystems, *Aciphylla* species (taramea, speargrasses), some *Celmisia* species (mountain daisies) and *Dolichoglottis* species (alpine groundsels) show mast-flowering behaviour and are insect-pollinated. This talk presents multi-year data from summer surveys of visitors to flowers on the Remarkables Range, Otago. Several of those surveys occurred in years where *Aciphylla* and *Dolichoglottis* species were flowering heavily. As expected, these masting species attracted large numbers of flower-visiting insects. However, the numbers of insects visiting flowers of all species was also significantly higher. Hoverflies and native bees in particular showed significant increases in local abundance in heavy masting years. These results suggest firstly that insect-pollinated masting plants could be critical drivers of community-wide pollinator services, and furthermore, that the ability to detect trends in New Zealand insect numbers could be strongly affected by the frequency of masting in the native flora.

Syrphid fly accessing *Aciphylla aurea* flowers, Rastus Burn Recreation Reserve, Remarkables Range.

Submitted Talk Abstracts

(in order of schedule)

Wednesday 7th April



13:10 – Wednesday, April 7th

Te Papa Atawhai – DOC invertebrate conservation desire

Edwards, E.[1], Scrimgeour, J.[2], Green, C.[3], Chinn, W.[4], McKinlay, B.[5], Beard, C.[6], O'Donnell, C.F.J.[4], Drinan, T.[4], Rolfe, J.[1], Moore, S.[7], Litchwark, S.[8]

[1] *Department of Conservation, Whanganui-a-Tara, New Zealand*
[2] *Department of Conservation, Turangi, New Zealand*
[3] *Department of Conservation, Tāmaki Makaurau, New Zealand*
[4] *Department of Conservation, Ōtautahi, New Zealand*
[5] *Department of Conservation, Ōtepoti, New Zealand*
[6] *Department of Conservation, Kirikiriroa, New Zealand*
[7] *Department of Conservation, Whakatū, New Zealand*
[8] *Department of Conservation, Wairau, New Zealand*

Invertebrate biodiversity is apparently declining alarmingly across the full range of species. The ability of conservation practitioners to document mostly irreversible losses is limited and our response needs direction. In an attempt to reach out both within and beyond our organisation, Te Papa Atawhai's invertebrate experts developed a set of six focus topics, with three addressed here:

Knowledge issues

- There is scale and complexity to what we don't know, but tactical approaches can have considerable positive impact
- Sponsoring taxonomic research has more impact than managers anticipate but it's hard to start
- Capturing more spatial data across more taxa improves valuing of sites you manage or assess
- Wānanga among experts to capture key knowledge priorities for valued ecosystems harbouring valued invertebrate fauna

Elevating profile

- Acknowledging that our communication needs to extend beyond our peers, and we must work closer with communication experts
- It's not just about species – we need to tell powerful ecosystem-level stories too

Working with others

- Recognising almost all invertebrate expertise sits outside DOC
- Establish an internal technical specialist group as a node with iwi, DOC Operations Group and Aotearoa entomological community
- Provide a prospectus of opportunity for invertebrate conservation science

13:25 – Wednesday, April 7th

The Department of Conservation's research priorities for managing threatened species

Murray, T.J. [1], Borkin, K.M. [2], O'Donnell, C.F.J. [3]

[1] *Department of Conservation, Terrestrial Science Unit, Ōtepoti, New Zealand*
[2] *Department of Conservation, Terrestrial Science Unit, Taupō, New Zealand*
[3] *Department of Conservation, Terrestrial Science Unit, Ōtautahi, New Zealand*
Presenter email: tmurray@doc.govt.nz

Te Mana o te Taiao | the Aotearoa New Zealand Biodiversity Strategy calls for all threatened species to be managed by 2030, yet there are currently no management prescriptions (i.e., action plans detailing how DOC operations staff will manage species on the ground) for most species listed as Threatened, At Risk, Data Poor and Data Deficient under the New Zealand Threat Classification System (NZTCS). To achieve these ambitious goals, considerable research is required to develop and test the methods needed to protect and enhance indigenous species. Given the size and importance of this task, prioritisation and transparency is required to ensure the right research is being undertaken to benefit the most species with the available resources.

In 2019, a process for identifying and prioritising the research needs for all species that need work was commenced. An initial subset of 1,311 species (those classified as Threatened or At Risk-declining under the NZTCS) were selected for this comprehensive Research Gap Analysis (RGA). Of these, 1,198 could feasibly be assessed, including 313 terrestrial invertebrates (including insects, spiders and snails). The small number of invertebrates assessed so far reflects the fact that most are either listed as Data Deficient (>1,471) or are yet to undergo a threat classification assessment.

In this presentation we outline how species' research needs were assessed, important research needs that were identified for invertebrates, and next steps in this process. We will discuss future opportunities for collaboration and cross-organisation alignment of research priorities to improve the conservation outcomes for invertebrates across Aotearoa | New Zealand.

13:40 – Wednesday, April 7th

Determining the full range of threatened biodiversity that requires management: Data deficient invertebrates of Southland & Rakiura

Tweed, J.M.H.[1], Wakelin, M.[2], McKinlay, B.[3], Murray, T.J.[3]

[1] *Ahika Consulting Ltd, Dunedin, New Zealand*
[2] *Ryder Environmental Ltd, Dunedin, New Zealand*
[3] *Department of Conservation, Terrestrial Science Unit, Ōtepoti, New Zealand*
Presenter email: jamestweed@ahika.co.nz

A key part of DOC's goal to halt biodiversity decline is to identify the full range of species that require conservation management. Currently, there are ~4,987 species classified as Data Deficient (DD) under the New Zealand Threat Classification System (NZTCS), meaning there is insufficient information to determine if they are threatened and in need of protection, or not. Over 1000 of these are terrestrial insects or spiders that have been found on only a few historical occasions that may not have been followed up in recent times. Some are likely to be threatened, while others could be locally common. Targeted surveys have the potential to provide estimates of distribution and abundance to see a threat classification changed from DD to Not Threatened, Threatened or At Risk, and decisions could then be made on how to protect those species that really need it. Here we report on surveys undertaken in 2020/21 targeting 161 DD insects and spiders previously recorded from mainland Southland and Rakirua. We focused on areas that have previously been difficult to access, and areas considered most likely to represent the distribution of multiple target species. A variety of sampling methods were used to maximise the likelihood of detecting as many species as possible. Although samples are still being processed, a range of the target spider and insect species were detected. Where possible, ecological information was gathered on these species. In this talk, we discuss the approach taken, the work still to be done, and our learnings from this project. We will also highlight some case study species that were detected and look at how the data gathered using this approach can help us to better assign a species to the appropriate threat category.

Figure 1: A female *Nomaua arborea*, possibly the first specimen ever found.

13:55 – Wednesday, April 7th

Actions towards the recovery of Mahoenui Giant Wētā

Haigh, A.[1], Bridgman, L.[2], Easton, L.[3], Emmitt, T.[2], Green, C.[4], Scrimgeour, J.[5], Watts, C.[6]

[1] *Department of Conservation, Taupo*
[2] *Department of Conservation, Hamilton*
[3] *Department of Conservation, Te Kuiti*
[4] *Department of Conservation, Auckland*
[5] *Department of Conservation, Turangi*
[6] *Manaaki Whenua/Landcare Research, Hamilton*

The only known natural population of the Mahoenui Giant Wētā (*Deinacrida mahoenui*) exists in an isolated reserve in the southern King Country where it is considered taonga. The species has survived by adapting to live in thick, closely cropped spiky gorse even in the presence of introduced mammalian predators. Population monitoring from 2005 – 2012 showed the wētā to be increasing but from then until 2020 wētā abundance has declined dramatically. Changes in the structure of the gorse habitat and subsequent increased susceptibility to mammal predators are likely contributors to the decline. Translocated populations from the Reserve have established at two other sites and are establishing at a third where mammals are in low densities or absent. However, each of these carries a level of uncertainty in population persistence. A DOC advisory group was set up and prepared an assessment of potential population recovery options. Predator control has been boosted in the Reserve, along with more intensive monitoring. A new wētā monitoring technique will be trialled and a predator-proof fence is under consideration. Preparations are well advanced for a captive breeding programme to provide wētā for further translocated populations in mammal-free habitats. Engagement with local iwi and enabling their role as kaitiaki is critical to recovering Mahoenui giant wētā.

14:10 – Wednesday, April 7th

Developing monitoring methods to understand alpine invertebrate responses to introduced mammalian predators

Bertoia, A.[1], Monks, J.M.[2], Murray, T.J.[2], Robertson, B.C.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
[2] *Department of Conservation, Terrestrial Science Unit, Ōtepoti|Dunedin, New Zealand*
Presenter email: beraa464@student.otago.ac.nz

Invertebrates fulfil many important roles in ecosystems; they are pollinators, seed dispersers, predators, detritivores and food sources for other organisms. Globally, invertebrate populations face many pressures, including climate change and loss of habitat, which have led to local population declines and even extinctions. Despite their importance, knowledge of how to monitor and manage invertebrates for conservation purposes is limited. This is especially concerning in New Zealand where species face the additional threat of introduced mammalian predators. Introduced pests have decimated native species across the country, including those that reside in the alpine zone, a rugged area that lies above the treeline. At lower elevations, introduced predators are known to prey on large-bodied invertebrates, but we have a poor understanding of how they influence alpine species. The research presented here aims to better understand the relationship between large-bodied alpine invertebrates and mammalian predators in the South Island, New Zealand. We will outline research to develop and test monitoring methods that are effective and practical to collect invertebrate population data in the alpine zone. Using these methods, we will examine the relationship between invertebrate activity, time of year, and various environmental conditions (weather, temperature, etc.) to understand the relative importance of environmental conditions on alpine invertebrate detectability. Going forward, we will monitor invertebrate communities in predator-controlled and predator-dense sites across the South Island to determine how predator activity influences the activity of large-bodied invertebrates. This research will generate refined invertebrate monitoring methods, provide suggestions for future monitoring programmes, and begin to explore the relationship between introduced mammalian predators and large-bodied alpine invertebrates.

14:25 – Wednesday, April 7th

'*Do insects have friends?*' and how to answer other such questions: Insect conservation and community engagement

Merien, M.[1], Murray, T.J. [2]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
[2] *Department of Conservation, Biodiversity |Terrestrial Science Unit (Southern Team), Dunedin, New Zealand*
Presenter email: morganemerien@gmail.com

An important re-occurring question for invertebrate conservation is "how do we engage the public with our cause?". To put it simply, we must first engage with them about insects in general. In this talk, we will use case studies to discuss some of the ways this is currently happening, who is involved, and who they are engaging with. We will outline concepts that work, and what does not work. Finally, we will also explore some new methods that both individual members, and the Society as a whole, can engage with the public in this quest for greater awareness of invertebrates, their values, and their conservation needs.

16:15 – Wednesday, April 7th

The impact of mammalian insectivores *Rattus rattus* (rat), *Mus musculus* (mouse) & *Erinaceus europeus* (hedgehog) on the size and abundance of mainland Coleoptera and Orthoptera

Hewitt, T.W.[1]

[1] *Victoria University of Wellington, Wellington, New Zealand*

The impact of introduced mammalian predators on indigenous vertebrates is well documented, however the general responses of indigenous invertebrate communities is less so. Beginning in 2012 pitfall traps and artificial wētā motels were established across 7 study sites in the Aorangi and Remutaka ranges east of Wellington. LMER and GLMM models were used to examine whether mammal tracking rate had any impact on the size or catch/occupancy of invertebrates.

Increased rat and mouse tracking were predicted to reduce Coleoptera catch whilst increased hedgehog tracking was correlated with increases in Coleoptera catch. Pitfall trapped wētā (*Hemiandrus spp*) showed strong negative responses to increased rat tracking, neutral responses to mice and positive responses to hedgehogs. Tree wētā (*Hemideina crassidens*) occupancy rates showed a decline in response to increased mouse abundance whilst the mean size of tree wētā showed an increase in response to rats and mice. These results demonstrate the complexity of understanding mammal invertebrate interactions which cannot be expected to be the same everywhere and the importance of long-term temporal studies of invertebrate populations.

16:27 – Wednesday, April 7th

Effects of predator exposure on wētā behaviour and habitat use

Singh, Y.J.[1]

[1] *School of Natural and Computational Sciences, Massey University, Auckland, New Zealand*
Presenter email: yasminsingh9@gmail.com

Many species of New Zealand wētā are currently 'at risk', with several relying on breeding programmes and predator-free islands for their survival. Continued conservation management of wētā species is needed to prevent extinction. However, many gaps remain in our understanding of their basic natural history, including population demographics, habitat use and behaviour. My Masters research is investigating wētā behaviour and habitat-use in response to predator exposure. I am focusing on two North Island species from different groups: the Auckland tree wētā (*Hemideina thoracica*) and a giant wētā, the wētāpunga (*Deinacrida heteracantha*). I am monitoring wētāpunga on Otata Island in the Hauraki Gulf to understand the demographic response of this population to the reintroduction of a native predator, the Duvaucel's gecko. The second part of my research is focused on responses to mammalian predators in Auckland tree wētā by comparing behaviour and habitat-use across pest- free and pest-infested sites. Outcomes of my research on Auckland tree wētā will be transferable to species of higher conservation priority. I will present preliminary data on aggressive interactions between male tree wētā and outline my plans for my thesis.

16:39 – Wednesday, April 7th

Examining behavioural differences in predator aware and predator naïve *Hemideina crassidens*

Kelly, M.[1], Wehi, P.[2], Johnson, S.L.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
[2] *Centre for Sustainability, University of Otago, Dunedin, New Zealand*
Presenter email: kelme074@student.otago.ac.nz

New Zealand's endemic fauna face significant threats of population decline due to predation from introduced predators. This is partially due to the lack of shared evolutionary history with terrestrial mammalian predators, preventing endemic fauna from developing appropriate antipredator behaviours to cope with mammalian predators over evolutionary time. Population declines have been observed in New Zealand wētā, primarily due to predation from introduced rats. While general antipredator behaviours in this group are documented, behavioural differences between groups with differing mammalian predator exposure have not been examined in detail. This study examines differences in activity, refuge seeking, and aggression between wētā living in a predator-free habitat and those living in urban, non-controlled areas. A 'predator-free' group of *H. crassidens* was assessed within Zealandia, a predator-free sanctuary in Wellington. A second, 'non-controlled' group were gathered from urban sites in the Wellington area and were assessed in the field. Repeated measures of behaviour were video recorded and analysed using EthoVisionXT behavioural quantification software. Behavioural differences between predator aware and predator naïve wētā may indicate that particular groups of wētā are at risk if they experience a sudden change in predation pressure (i.e., translocation of captive reared individuals, or populations that experience lapses in predator control).

16:51 – Wednesday, April 7th

Tracking the snowline: Responses to climate change by New Zealand alpine invertebrates

Chinn, W.[1]

[1] *Department of Conservation, New Zealand*

Alpine invertebrate communities may already be experiencing the effects of climate warming in the Southern Alps of New Zealand. The current ecological paradigm for climate change in alpine ecosystems holds that communities may shift upslope with climate warming, in lockstep with an optimal thermal regime. This idea is reviewed and tested using a combination of field observations and a simple model. Invertebrate populations were modelled against a local isotherm proxy; the End Of Summer Snowline (EOSS), a parameter that captures all elements of the preceding year's climate. The trial appears to be the first attempt to couple the alpine cryosphere with the biosphere. The forty-year EOSS data set, for fifty index glaciers, showed that the snow line has risen an average 3.7 m^{-a}. This is equivalent to raising alpine isotherms by almost 150 m and presents alpine biotic populations with four possible scenarios: upslope tracking, stasis, horizontal dispersal, or local adaptation. We also characterize the alpine invertebrate biota (AIB) and present two case studies showing that high-elevation taxa have tracked the snow line within a narrow range, while lower elevation populations can apparently shift upward within a considerably great range.

17:03 – Wednesday, April 7th

The population dynamics, prey, and potential distribution of the European paper wasp (*Polistes dominula*) in New Zealand

Lester, P.J. [1], Howse, M.W.F.[1], McGruddy, R.A. [1], Toft, R.J. [2], Haywood, J.[3]

[1] *School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand*
[2] *Entecol Ltd., Nelson, New Zealand*
[3] *School of Mathematics and Statistics, Victoria University of Wellington, Wellington, New Zealand*
Presenter email: phil.lester@vuw.ac.nz

Populations of the European paper wasp (*Polistes dominula* Christ) were first realised in New Zealand in 2016, although this species may have arrived as early as 2011. Over the last two summers we have been monitoring populations in Nelson.

The abundance and colony survival of *P. dominula* was greatest in suburban areas, where nests were predominantly built within or on anthropogenic structures. Colony survival of *P. dominula* was comparatively higher than for *Polistes chinensis* Pérez. Neither *Polistes* species were found to nest within forest sites, with translocated colonies of *P. dominula* unsuccessful within forest habitats.

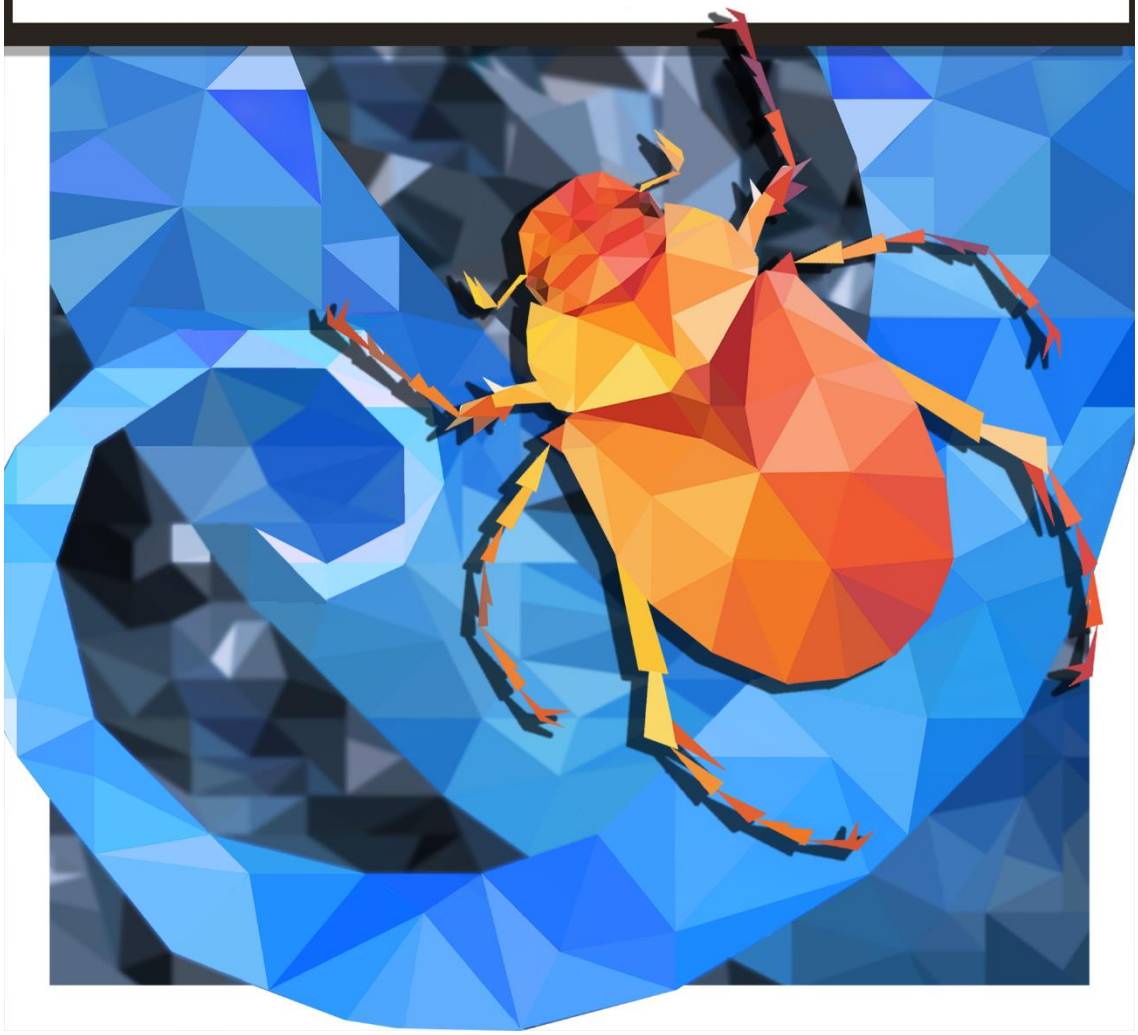
The wasp diet was analysed using DNA barcoding of larval gut. Lepidoptera were highly represented, while flies and true bugs were also abundant. Concordantly, there have been substantial declines in the abundance of several local butterfly species in Nelson following the introduction of this wasp. Field experiments found *P. dominula* to be a major cause of monarch caterpillar mortality.

Bioclimatic modelling methods were used to predict areas of suitable habitat. Much of the North Island and eastern parts of the South Island were predicted to be suitable habitat for this wasp. These results suggest that *P. dominula* could potentially establish across more of the country.

Submitted Talk Abstracts

(in order of schedule)

Thursday 8th April



09:30 – Thursday, April 8th

Nocturnal pollinators are important for crop plants: a global review

Buxton, M.N.[1], Lord, J.M.[2], Gaskett, A.[3], Pattemore, D.E.[1]

[1] *The New Zealand Institute for Plant & Food Research Ltd, Hamilton, New Zealand*
[2] *Department of Botany, University of Otago, Dunedin, New Zealand*
[3] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
Presenter email: max.buxton@plantandfood.co.nz

Global insect declines threaten ecosystem stability and food security, resulting in a recent increase of research on the contribution of wild pollinators in cropping systems. This research has predominantly focused on diurnal pollinators such as bees and butterflies, leaving the role of pollinators at night ("nocturnal pollinators") poorly understood. Here, we reviewed the literature on nocturnal pollinators for crops and plants of cultural significance. The evidence to support these claims is variable with most evidence of nocturnal pollination being inferred from observations of visitation and floral traits, with a lack of strong experimental evidence. We found interactions between plants and nocturnal pollinators for 48 plant families, with Cactaceae, Fabaceae, and Asparagaceae being mentioned most frequently. We identified 81 animal families as behaving as nocturnal pollinators, with Sphingidae and Noctuidae moths and Phyllostomidae bats being mentioned most frequently. Further experimental work is required to corroborate this, but we suggest that nocturnal pollinators may be more important in ecosystem function and food production than currently thought. I will present some preliminary results from field trials undertaken here in New Zealand and outline my proposed research on the role moths as pollinators.

09:42 – Thursday, April 8th

Does scale insect infestation affect the attractiveness of Mānuka to honey bees?

Bohorquez, J.[1,2], Robertson, A.W.[3], Millner, J.P.[3], Stephens, J.M.[4], Archer, R.[5]

[1] *Otago Museum, Dunedin, New Zealand*
[2] *Department of Botany, University of Otago, Dunedin, New Zealand*
[3] *School of Agriculture & Environment, Massey University, Palmerston North, New Zealand*
[4] *Comvita Innovations, Institute for Innovation in Biotechnology, University of Auckland, New Zealand*
[5] *Institute of Food Science and Technology, Massey University, Palmerston North, New Zealand*
Presenter email: jbohorquez@otagomuseum.nz

Leptospermum scoparium (Mānuka; Myrtaceae) is involved in crucial ecological interactions that might affect nectar production, and the New Zealand honey industry. First, these plants can be affected by scale insect infestation, which have the potential to affect plant health; second, they provide nectar for honey bees (mānuka honey). To better understand the significance of these interactions, a variety of methods, including behavioural observations, histological, and taxonomic techniques, were used in this research.

Findings showed that the number of eriococcids was reduced by the application of an Insect Growth Regulator (IGR) on six different cultivars in a split block designed experiment, but cultivars differed in response to the insecticide treatment. Using the same common garden design, but just the unsprayed plants, honey bees showed a preference for the cultivar with the highest nectar sugar content and nectar DHA content. However, sugar, rather than DHA, was the best predictor of visitation pattern. The survey around New Zealand indicated that *Acanthococcus campbelli* and *Acanthococcus leptospermi* are now the main species on *L. scoparium*, rather than *Acanthococcus orariensis*, which was the main causative agent of the mānuka blight in the 1940's and 1960's.

09:54 – Thursday, April 8th

Flower use by four species of bumble bees (Hymenoptera: Apidae) in the South Island of New Zealand, derived from pollen samples obtained from museum specimens.

Knowles, M.C.[1], Lester, P.[1], Xun, L.[2], Kasper, J.[3]

[1] *Victoria University of Wellington, Wellington, New Zealand*
[2] *GNS Science, New Zealand*
[2] *Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand*
Presenter email: julia.kasper@tepapa.govt.nz

Animal pollinators are experiencing declines worldwide, as are indigenous species in Aotearoa New Zealand. Four bumble bee species were introduced to Aotearoa New Zealand in 1885 specifically for pollination purposes. Pollen samples were collected and identified from museum specimens of three species of bumble bee (*Bombus terrestris, Bombus ruderatus,* and *Bombus hortorum*) that were collected between 1954 and 1972 in various locations across the South Island, New Zealand. Pollen identification found that all bumble bee species selected mostly introduced plant species at all locations, regardless of vegetation type, from indigenous forest cover to productive farmland. Historic pollination networks of introduced bumble bees are important to understand the state of the landscape of the time and the plant-pollinator interactions between native and introduced species.

10:30 – Thursday, April 8th

Using a gene silencing approach, with carbon quantum dot nanoparticles, to treat viral infections in honey bees

Smeele, Z.E.[1], Baty, J.W.[1], Lester, P.J.[1]

[1] *School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand*
Presenter email: zoe.smeele@vuw.ac.nz

Over the last several decades the ectoparasite *Varroa destructor* mite has driven the emergence of a viral pandemic in western honey bees (*Apis mellifera*). Deformed wing virus (DWV) is a widely distributed and common viral pathogen in *A. mellifera* and has historically existed at low levels within their host without causing disease. However, introduction of *Varroa* mites to western honey bee populations transformed this once benign viral infection to a pandemic. Together, *Varroa* and DWV now represent a major threat to honey bee health, occupying a near-global distribution that is closely associated with increasing overwintering colony losses. Currently, the only option available to beekeepers for controlling *Varroa* and DWV are a handful of miticides that if used too frequently can lead to mite resistance. A proposed alternative control strategy involves feeding honey bees double stranded RNA (dsRNA) targeting DWV or *Varroa*. This could be a promising avenue for control of these pathogens through gene silencing. We tested the efficiency of dsRNA, stabilised by carbon quantum dot nanoparticles, to induce gene silencing of DWV in *A. mellifera*. This strategy offers a promising avenue to use RNA interference-based control methods by overcoming some of the issues associated with its wide-spread application.

10:42 – Thursday, April 8th

Steps towards implementing a Gene Drive for invasive wasp species

Gilligan, J.B.[1], Dearden, P.K.[1]

[1] *Department of Biochemistry, University of Otago, Dunedin, New Zealand*
Presenter email: giljo070@student.otago.ac.nz

New Zealand's unique ecosystem and isolation has lead to a lack of predators, making invasive species spread in the last century incredibly impactful as our environment has not coevolved to deal with these threats.

The most troublesome invasive species are social wasps. The main culprits being from the Vespula and Polistes groups. These invasive species have been arriving through anthropogenic means since at least the 1940's (*Vespula germanica*) and the most recent addition in 2010 (*Polistes dominula*).

While baiting seems to be an effective strategy for reducing Vespula populations, this is yet to substantially impact them long term, especially in the Nelson region where the highest densities around the world can be found. In addition to this some of the recent arrivals from the Polistes group are not so easily baited because of differences in foraging.

Gene Drives are being researched world wide to eliminate pest populations, the general premise being to spread a genetic manipulation across a population eventually causing specific widespread control of a target species, but what steps would we need to take to create such a drive and how could we ensure to wouldn't spread to native populations where they are important?

10:54 – Thursday, April 8th

Molecular methods to manage wasps in New Zealand

McLaughlin, G.M[1] and Dearden, P. K.[1,2]

[1] *Department of Biochemistry, University of Otago, Dunedin, New Zealand*

[2] *Genomics Aotearoa, Dunedin, New Zealand*

Presenter email: mclge271@student.otago.ac.nz

Two social wasp species (*Vespula vulgaris* and *V. germanica*) are widespread invasive species, residing at their highest densities in New Zealand. These wasps dominate our beech forests, consuming over 90% of the honeydew produced by scale insects and restricting available diet for our native insects and birds. They also predate on native fauna to the point that the odds of their survival in a beech forest during wasp season is virtually nil. Other issues abound that affect our health, tourism and economy, with an estimated 133 million NZD in damages annually.

The use of Vespex poison is highly effective in suburban areas, overshooting the density reduction needed to counteract the damages such wasps incur. However, it is fairly labour intensive and cannot be deployed throughout beech forests at a national level. Here, I approach the issue at a genetic level, using RNA interference (RNAi) and Receptor-Mediated Ovary Transduction of Cargo (ReMOT Control) in an effort to find a genetic method of control that is species specific and can be distributed across both urban and suburban landscapes.

11:06 – Thursday, April 8th

Who defends the colony? Looking at the defence response of *Vespula* wasps

Busch, M.J.[1], Jandt, J.M.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
Presenter email: busme698@student.otago.ac.nz

Vespula wasps are eusocial insects that show temporal polyethism, moving from low risk tasks to higher risk tasks as they age. Defenders, who protect the nest when threatened, perform the riskiest task in an individual's life. Does a nest send out the same, (probably older) individuals, or are they all "opportune" defenders who are just foragers at the wrong place at the wrong time?

Here, I look at the behavioural and physiological links between foragers and defenders in *Vespula* wasps. I predict that there will be a mixture of 'opportune" defenders, who are usually foragers, plus a few "true" defenders, who come out when threatened several times. I will also use lipid extractions to assess fat content between foragers, opportune defenders, and true defenders. I discuss how the results from this will help in understanding temporal polyethism in *Vespula* wasps, and the physiological links that may influence it.

11:12 – Thursday, April 8th

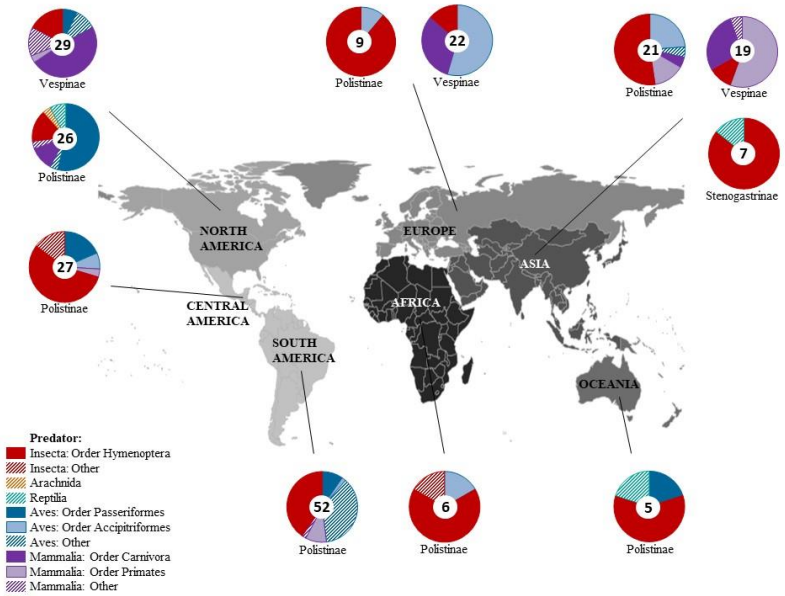
Evolutionary and ecological pressures shaping social wasps collective defences

Detoni, M.[1], Féas, X.[2], Jeanne, R.L.[3], Loope, K.L.[4], O'Donnell, S.[5], Santoro, D.[6], Sumner, S.[7], Jandt, J.M.[1]

[1] *Department of Zoology, University of Otago, New Zealand*
[2] *Academy of Veterinary Sciences of Galicia, Spain*
[3] *Department of Entomology, University of Wisconsin, Madison, USA*
[4] *Department of Biology, Georgia Southern University, Statesboro, USA*
[5] *Department of Biology, Drexel University, USA*
[6] *Department of Primary Industries, Government of New Zealand*
[7] *Centre for Biodiversity and Environment Research, Department of Genetics, Evolution and Environment, University College London, UK*
Presenter e-mail: matedetoni@hotmail.com

Social wasps are well known for their aggressive response to disturbance and provide a variety of defence mechanisms to exclude predators, including passive (e.g. nest construction, chemical deterrents) and active defences (e.g. alarm pheromones, coordinated stinging response). We performed a meta-analysis on the predators of social wasp colonies around the world, exploring the ecological and evolutionary pressures that shaped nest defence behaviours. We reviewed the literature and explored social media to compare direct and indirect evidence of predators of individuals and colonies of wasps. Wasp colony predators vary across subfamilies of Vespidae. Polistine wasps are predominantly preyed upon by ants (Order: Hymenoptera) and birds (Order: Passeriformes); whereas Vespines are predominantly preyed upon by badgers and bears (Order: Carnivora), and hawks (Order: Accipitriformes). Humans and other primates (Orders: Primates) were also common predators of Polistine and Vespine wasp colonies. Ants and hornets (Order: Hymenoptera) were the only predator observed attacking Stenogastrine colonies. The probability of predation by these five main Orders of predators varied across biogeographic landscapes. We discuss these results in terms of geographic distribution and the relationship between life history traits of the prey and its predators.

Relative frequency of direct evidence of predation events on social Vespid colonies from different subfamilies across the six continents where Vespidae are found.



From Detoni et al. (2021). "Evolutionary and ecological pressures shaping social wasps collective defenses". Annals of the Entomological Society of America, saaa063.

11:24 – Thursday, April 8th

Variation in responses to simulated predator attacks in ladybirds (Coleoptera: Coccinellidae)

Edirisinghe, H.M.[1], Leschen, R.A.B.[2], Dale, J.[1], Wignall, A.E.[1]

[1] *School of Natural and Computational Sciences, College of Science, Massey University, Auckland, New Zealand*
[2] *Maanaki Whenua – Landcare Research, New Zealand Arthropod Collection, Auckland, New Zealand*

Predators may have both short and long term non-lethal effects on prey behaviour, reproduction, and physiology. Changes in prey behaviour in response to predators can therefore have implications for pest management (e.g. on species establishment and dispersal). Ladybird beetles (Coleoptera: Coccinellidae) serve as an excellent model system to study responses to predators as they are often introduced into new ecosystems and are exposed to a range of predators (i.e. birds, other ladybirds and ants). Although there are many studies investigating chemical and visual communication in the predator-prey interactions of ladybirds, the majority examine ladybirds as the predator, and we have limited understanding of their short-term behavioural responses to their own predators. Here we compare the intra- and interspecific patterns in responses to a simulated predator attack across four species of ladybird introduced to New Zealand. We also compared their general activity levels before and after the simulated attack. We found that *Illeis galbula* had a shorter response duration to the simulated predator attack and moved faster than *Halmus chalybeus*. However, there was no difference in the level of intraspecific variation between species in the total distances travelled, mean velocities or the duration of responses to the simulated predator attack. We observed a strong positive correlation between overall body size and general activity levels in each species. We discuss how increased investment in general activity levels and anti-predator responses may provide insights into the establishment success and dispersal of introduced species.

11:36 – Thursday, April 8th

Novel biomarkers reveal landscape influences on linkages between aquatic and terrestrial food webs

Burdon, F.J.[1], Sargac, J.[1], Ramberg, E.[1], Popescu, C.[2], Nita, D.[2], Bradu, C.[2], Forio, M.A.E.[3], Witing, F.[4], Kupilas, B.[5], Lau, D.C.P.[1], Rîşnoveanu, G.[2], Goethals, P.[3], Friberg, N.[5], Johnson, R.K.[1], McKie, B.[1]

[1] *Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden;*
[2] *Department of Systems Ecology and Sustainability, University of Bucharest, Romania*
[3] *Aquatic Ecology Research Unit, @ of Animal Sciences and Aquatic Ecology, Ghent University, Belgium*
[4] *Department of Computational Landscape Ecology, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany*
[5] *Norwegian Institute for Water Research (NIVA), Oslo, Norway*
Presenter email: francis.burdon@slu.se

Stream and riparian habitats are strongly connected via the emergence of aquatic insects, which form an important prey subsidy for a wide range of terrestrial consumers. Human perturbations that impact these habitats can disrupt aquatic-terrestrial food-web linkages, but gaps in our knowledge remain about the relative strength of different drivers contributing to altered connectivity. We investigated how stream productivity gradients, aquatic invertebrate dispersal traits, and recipient terrestrial predators influence cross-ecosystem connectivity in temperate streams across four European catchments with varying levels of human disturbance. Stream algae exclusively produce specific fatty acids and we used these novel biomarkers to measure putative aquatic linkages to riparian spiders. Trophic connectivity, as measured by the proportion of eicosapentaenoic acid (EPA), was positively associated with abundances of 'aerial active' dispersing aquatic insects, although this influence was shared with changes in environmental context and spider beta diversity. Structural equation modelling helped further demonstrate the linkage between aquatic insect communities and trophic connectivity with riparian spiders after accounting for biological and environmental contingencies. Our study demonstrates that using trait-based ecology in conjunction with novel biomarkers provides a more comprehensive means to describe cross-ecosystem connectivity and assess the impacts of environmental change on food webs.

11:48 – Thursday, April 8th

Complex ecological impacts of the giant willow aphid invasion in New Zealand

Min-Tun, K.[1], Jones, T.[1], Minor, M.[1], Clavijo-McCormick, A.[1]

[1] *School of Agriculture and Environment, Massey University, Palmerston North, New Zealand*
[2] *Plant and Food Research, Palmerston North, New Zealand*
[*] *Presenter email: a.c.mccormick@massey.ac.nz*

The giant willow aphid (GWA), *Tuberolachnus salignus*, is an invasive pest species first recorded in New Zealand in 2013. Since then, it has spread rapidly, affecting over 50 species and hybrids of willow and poplar throughout the country. These trees and shrubs have high agricultural importance as forage, stabilizing slopes and riverbanks, preventing soil erosion, and are sources of nectar and pollen for bees. The GWA affects its surroundings in multiple ways. It has a direct detrimental effect on its host plants, but it also affects other organisms indirectly through the production of copious amounts of honeydew. Honeydew deposition attracts unwanted insects (such as wasps, ants, and flies), causes bee honey to crystalize (affecting apiculture), promotes the growth of sooty mould and alters soil composition and biota. Due to the extent of the invasion, eradication is no longer feasible, so it is essential to understand this pest species' environmental impacts to develop sustainable control strategies to mitigate them. This talk will summarise the results of a semi-field study conducted between 2016 and 2020, using 15 different willow clones, exploring the complex ecological impacts of the GWA invasion in New Zealand. Topics include the direct effects on plant reproduction, chemical communication and biomass, honeydew composition and its cascading effects on soil biota and chemical properties.

13:30 – Thursday, April 8th

Metabolomic fingerprinting of an edible insect species, *Prionoplus reticularis*, using Gas Chromatography Mass Spectrometry.

Birrell, N.W.[1], Walker, L.[2], Buckley, T. [3], and, Holwell, G.I.[1]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
[2] *Auckland War Memorial Museum Tāmaki Paenga Hira, Natural Sciences, Auckland, New Zealand*
[3] *Manaaki Whenua – Landcare Research, Auckland, New Zealand*
Presenter email: n.birrell@auckland.ac.nz

A global industry producing edible insects has developed in anticipation of increasing protein demand worldwide. The size and profitability of this industry has led to exploitation of wild insect populations and adulteration of insect products to increase bulk or value. This has led to "fingerprinting" of insect products to ascertain authenticity of a product being sold, for instance, if cricket flour has been adulterated with other insect species. However, geographical fingerprinting of a single species, which would assist in identifying businesses or individuals exploiting insects from a specific region has, so far, not been explored for an edible insect species.

Using GC-MS and metabolomics, we investigated whether the free amino acids and fatty acid profile of the endemic cerambycid, *Prionoplus reticularis*, better known as the edible huhu grub, changed with geography and latitude. We will discuss: (1) variation in free amino acid and fatty acid metabolites of the edible insect *P. reticularis* between individuals and locations, (2) whether the metabolites of *P. reticularis* larvae vary along a latitudinal gradient, and (3) if metabolites can be used to 'fingerprint' an individual to a geographic location. Future research will investigate sugar metabolites to complete the metabolomic suite of this charismatic edible insect.

13:42 – Thursday, April 8th

Is there male dimorphism in the iconic Helm's stag beetle?

Thomas, L. [1], Jandt, J.[1], Barratt, B.[2], Holwell, G.[3], Johnson, S.L.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
[2] *AgResearch Invermay, Biocontrol, Biosecurity and Bioprocessing, Mosgiel, New Zealand*
[3] *School of Biological Sciences, University of Auckland, Auckland*, New Zealand
Presenter email: thobe008@student.otago.ac.nz

Stag beetles (Lucanidae) are famous for having enlarged mandibles. The genus, *Geodorcus*, is a group of flightless endemic stag beetles. Most of the species have restricted ranges, with the exception of *G. helmsi*, which is widespread on the South Island. New Zealand stag beetles are threatened by habitat destruction, predation and illegal collection. Despite the clear need for conservation, we know little about their life history and behaviour. We measured specimens from entomological collections and from wild populations to determine whether the males of *G. helmsi* exhibit dimorphism in body length and mandible size. We used traditional allometric analyses using linear measurements and performed a principal component analysis. We also digitized landmarks onto images taken of specimens and used geometric morphometric analyses to determine whether different morphs vary by shape. We found that there is no clear evidence that there are any alternative morphs for *G. helmsi*. We also collected and measured specimens from the field, to ensure there was no sampling bias by only using museum specimens. Overall, our findings may offer some insight into stag beetle behavioural ecology, and the knowledge gained will help with the conservation for the more threatened species of *Geodorcus*.

Male *Geodorcus* on Ryan's creek track, Stewart Island. Photo taken by Luna Thomas.

13:54 – Thursday, April 8th

Exaggerated sexually selected weapons maintained with disproportionately low metabolic costs in a weevil with extreme size variation

Somjee, U.[1], Powell, E.C.[2], Hickey, T.[2], Harrison, J.F.[3], Painting, C.J.[4]

[1] *Smithsonain Tropical Research Institute, Balboa, Panama*
[2] *School of Biological Science, University of Auckland, Auckland, New Zealand*
[3] *School of Life Sciences, Arizona State University, Tempe, Arizona, USA*
[4] *Te Aka Mātuatua School of Science, Univeristy of Waikato, Hamilton, New Zealand*
Presenter email: chrissie.painting@waikato.ac.nz

Larger individuals typically have lower mass-specific metabolic rates compared to small individuals. Within-species studies are critical to decipher the mechanisms responsible for this pattern, but the relatively small size range of most species precludes such intra-specific comparisons. Sexually selected weapons are among the most exaggerated traits in nature and can contribute to whole-body energetic maintenance costs, yet little is known about how large individuals meet the predicted increased energetic demands of maintaining disproportionately large weapons. New Zealand giraffe weevils, *Lasiorhynchus barbicornis* exhibit a 30-fold range in male body mass and hypermetric scaling of rostra used as weapons. We compare intra- and inter-specific resting metabolic rates in *L. barbicornis* and by compiling metabolic measurements across 26 arthropod species. The scaling of metabolic rate across species was identical to the intraspecific metabolic scaling in *L. barbicornis*. Male and female *L. barbicornis* had similar metabolic scaling, despite differing substantially in appendage scaling. However, the largest males invest ~60% less metabolically active tissue into weapons compared to the smallest males. These findings reveal a tremendous difference in weapon architecture as individuals scale up in size, perhaps acting as a cost-saving mechanism that plays a key role in shaping the hypermetric scaling of weaponry.

14:06 – Thursday, April 8th

Male coercion and female injury in the sexually cannibalistic Springbok mantis

Burke, N.W.[1], Holwell, G.I.[1]

[1] *School of Biological sciences, University of Auckland, Auckland, New Zealand*
Presenter email: nathwilliamb@runbox.com

Sexual conflict can generate coercive traits in males that enhance mating success at the expense of female fitness. Pre-copulatory sexual cannibalism—where females consume males without mating—typically favours cautious rather than coercive mating tactics, and few examples of the latter are known. Here, we show that males of the highly cannibalistic Springbok mantis, *Miomantis caffra*, wrestle females during pre-mating interactions. We find that most initial contacts between males and females involve a violent struggle whereby each sex tries be the first to grasp hold of the other with their raptorial forelegs. When females win the struggle, they always cannibalise males. However, when males grasp females first, they dramatically increase the chance of mating. We also find striking evidence that, on some occasions, males wound females with their fore-tibial claws during struggles, resulting in haemolymph loss and scar tissue formation. Taken together, our results show how males can overcome the threat of cannibalism by coercively wrestling females. We argue that pre-copulatory injury in this species is likely to be a negative pleiotropic side-effect of coercive mating behaviour and foraging morphology.

14:18 – Thursday, April 8th

Biomechanics of sexually selected weapons in New Zealand harvestman

Harmer, A.M.T.[1], Painting, C.J.[2], Holwell, G.I. [3]

[1] *School of Natural and Computational Sciences, Massey University, Auckland, New Zealand*
[2] *School of Science, University of Waikato, Hamilton, New Zealand*
[3] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
Presenter email: a.harmer@massey.ac.nz

Sexual selection acting both within and between the sexes has resulted in the evolution of remarkably diverse and exaggerated traits. While some secondary sexual traits are adapted for courtship, others are used in conflict and selected for their mechanical performance. Here we present data on the mechanical performance of the absurdly exaggerated chelicerae of dueling harvestman (*Pantopsalis listeri*). This species is remarkable in that males exhibit weapon trimorphism, with two exaggerated morphs and a third reduced morph. Males with different exaggerated morphs employ different behavioural strategies during fights. We demonstrate how behavioural strategies used during sexual conflict correlate with mechanical performance of chelicerae, and have likely shaped the evolution of their extreme weaponry.

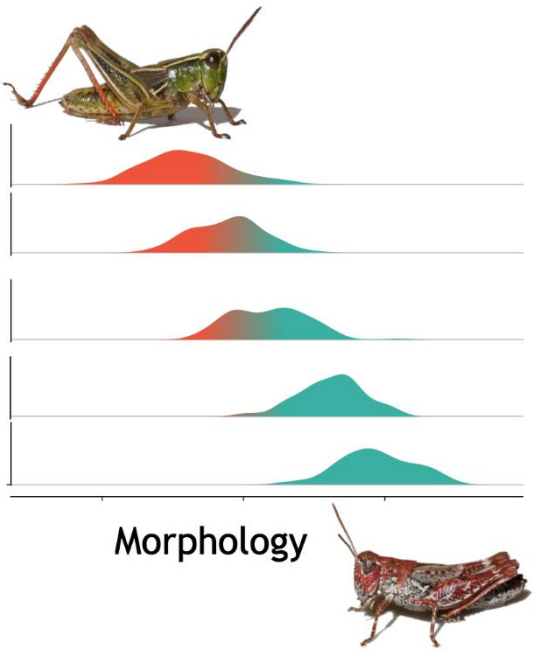
14:30 – Thursday, April 8th

Lack of assortative mating in a modified landscape leads to a hybrid swarm

Morgan-Richards, M.[1], Vilcot, M.[2], Trewick, S.A.[1]

[1] *Wildlife & Ecology, SAE, Massey University, Palmerston North, New Zealand*
[2] *University Master de Biologie, École Normale Supérieure de Lyon, Université Claude Bernard Lyon I, Université de Lyon, Lyon Cedex, France*
Presenter email: m.morgan-richards@massey.ac.nz

Hybridization is a central theme of evolution as a source of variation for adaptation or as a substantial fitness cost leading to extinction. Here, we focused on hybridization between two species of New Zealand grasshopper where genetic introgression has been detected subsequent to habitat modification. In contrast to observations from 40 years ago, our sampling of wild pairs in copula provided no evidence of assortative mating with respect to species in the grasshoppers *Phaulacridium marginale* and *Phaulacridium otagoense*. Geometric morphometrics on pronotum shape of individuals from areas of sympatry detected phenotypically intermediate specimens (putative hybrids), and the distribution of phenotypes in most areas of sympatry was found to be unimodal. These results suggest that hybridization associated with anthropogenic-induced habitat changes have led to these closely related species forming a hybrid swarm, with random mating. Without evidence of hybrid disadvantage, a novel hybrid lineage is the likely result of these two species merging.



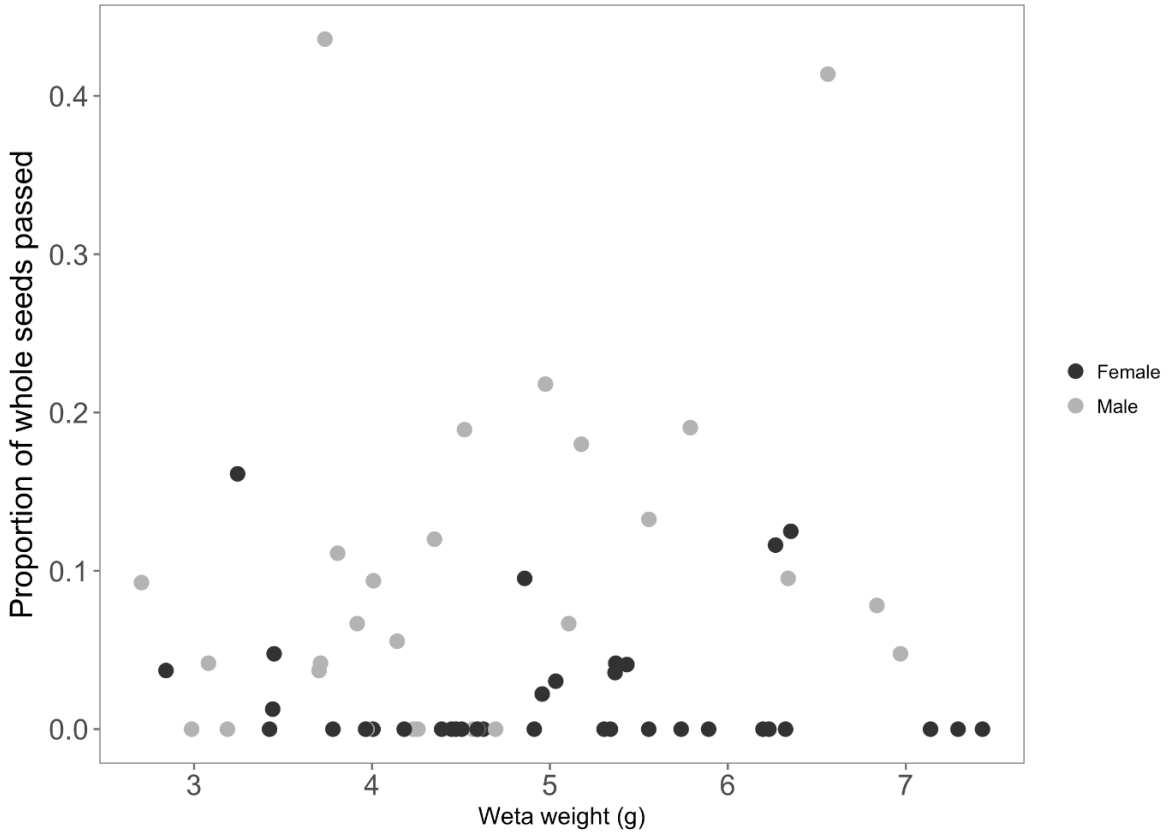
14:42 – Thursday, April 8th

Eco-evolutionary dynamics between sexually selected weaponry and foraging in tree wētā (Orthoptera).

Wehi, P.M.[1], Morgan-Richards, M.[2], Nakagawa, S[3].

[1] *Centre for Sustainability, University of Otago, Dunedin, New Zealand*
[2] *School of Agriculture and Environment, Massey University, Palmerston North, New Zealand*
[3] *School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW, Australia*
Presenter email: priscilla.wehi@otago.ac.nz

Exaggerated weaponry may evolve as a result of sexual selection and provide a reproductive advantage in contests for mates. Weapons such as the huge mandibles seen in male tree wētā (*Hemideina* spp.) and used for fighting can attain enormous size. However, developing and bearing large weaponry can include tradeoffs such as increased predation risk, impaired locomotion or reduced immune responses. Tree weta are a New Zealand endemic genus of crickets that are classed as herbivores, but eat a variety of foods including fruit. We examined fruit eating and potential foraging costs in one species of the tree wētā genus, *Hemideina crassidens*. We hypothesised that male foraging might differ from females because of potential foraging costs as a result of their large mandibles. In laboratory trials, adult males took longer than females to ingest fruits from five common plant species, suggesting a handling penalty. In addition, more than 90% of seeds were destroyed during passage, but males were more likely than females to pass seeds intact. Time in the gut did not influence the number of whole seeds passed. Increased handling time suggests that it may be more difficult for male tree wētā to manipulate food items, although the effects of reduced force from large levers (mandibles) are not yet quantified. Finally, we examined allometry in *H. crassidens* to see if we could identify a tipping point where the costs of such mandibular weaponry might outweigh its benefits in this species. The ecological costs of weaponry in these insects include slower foraging rates on at least some high quality foods, and reduced nutritional benefits from high quality seed sources.



15:30 – Thursday, April 8th

Who is laying eggs? Reproductive skew in native NZ ants

Lancaster, E.F.[1], Jandt, J.M.[2]

[1] *Ecology Programme, Department of Botany, University of Otago, Dunedin, New Zealand*
[2] *Department of Zoology, University of Otago, Dunedin, New Zealand*
Presenter email: lanel474@student.otago.ac.nz

A large number of ant species are polygynous. Multiple queens in one nest can produce more workers than a single queen, which leads to better access to resources, increased labour, and generally facilitates ecological dominance. However, polygynous colonies are less genetically related compared to monogynous colonies, their queens less resilient and their workers less aggressive to intruders. There are many different forms of polygyny. Even if there are multiple queens, not all of them contribute equally to reproductive output. The Southern ant *Monomorium antarcticum* is a multi-queen species that can range from one to thirteen queens within one nest. However, it is not yet understood if all these queens contribute to colony reproduction. Through a series of lab-based egg laying experiments, I am investigating *M. antarcticum's* reproductive skew to determine whether the species is monogynous, polygynous, or something in-between. This can help us paint a better picture of the ecology of our most ubiquitous native ant.

15:40 – Thursday, April 8th

Monogyny and introgression in New Zealand fishing spiders (*Dolomedes*)

Connolly, S.J.[1]

[1] *Department of Biological Sciences, University of Waikato, Hamilton, New Zealand*
Presenter email: sc455@students.waikato.ac.nz

Monogyny is the mating system whereby males will only mate with one female in their lifetime. Spiders are often used as a study group for the evolution of monogyny. In spiders, monogyny is associated with sexual cannibalism, genital damage, male-biased sex ratios, protandry and female-biased sexual size dimorphism. Whilst these factors are strongly related, their exact causal relationships with each other and with monogyny are unclear. Related to mating behaviour is introgression, the movement of genes from one species to another. Both monogyny and introgression require further study via model systems.

Dolomedes (fishing spiders) is a genus of Pisauridae represented by four species in New Zealand, including two sister species: *D. aquaticus* and *D. minor*. Whilst study on these species has been limited, evidence suggests that *D. aquaticus* is monogynous and *D. minor* is polygynous (males will mate with multiple females). Additionally, there is a one-way introgression between the two species, which is also geographically restricted. I will report on the results of field observations and crossing experiments investigating the introgression between these two species, and how the limitations upon it are maintained. Implications for their mating systems will also be discussed.

15:52 – Thursday, April 8th

Evolution of the thermal plasticity in different traits across New Zealand stick insects (Phasmatodea)

Cubillos, C.A.[1,2], Augustine, K.E.[2], Sinclair, B.J.[3], Buckley, T.R.[1,2]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
[2] *Landcare Research, Auckland, New Zealand*
[3] *Department of Biology, The University of Western Ontario, London, Ontario, Canada*
Presenter email: ccub151@aucklanduni.ac.nz

Temperature strongly influences biological systems at all levels of complexity. Thus, organisms must evolve different strategies to cope with temperature changes to survive and thrive in their respective thermal habitats. In this work, we measured developmental thermal reaction norms (DTRN) and thermal performance curves (TPC) for different traits in organisms acclimated to 10 and 20 °C. Ten species of phylogenetically related New Zealand phasmids spanning subtropical to temperate climates were used as a study system. We aim to characterize the thermal sensitivity and phenotypic plasticity to test three hypotheses: 1) Species inhabiting lower latitudes encounter less thermal fluctuation, and thermal specialization is expected to evolve for those species. 2) Acclimation beneficially increases performance around the corresponding acclimation temperature, shifting the optimum temperature accordingly. 3) Thermodynamic effects constraint organisms more strongly from colder habitats/cold acclimated, being outperformed by warm adapted/warm acclimated organisms. Our TPC experiments suggest that the 20 °C acclimated organisms outperform the 10 °C ones, except for *Acanthoxyla geisovii*; however, overall, we found no plasticity for the optimal temperature. Strikingly, the DTRNs reveal that *A. geisovii* is the only species showing plasticity for the size reached at maturity.

16:04 – Thursday, April 8th

The impact of temperature acclimation on metabolic rate of New Zealand stick insects

Grosmann, A. [1]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
Presenter email: agro798@aucklanduni.ac.nz

New Zealand has a high proportion of species endemism; however, this is being threatened by temperature increases due to climate change. Stick insects are sensitive to temperature and drought and we are therefore investigating the effects of temperature acclimation on metabolic rate and water loss. We will use flow through respirometry to record respiratory water loss and CO_2 production, a measure of metabolic rate. We will measure the effects that temperature acclimation has on Metabolic rate, by treating individuals to an acclimation at either 10°C or 20°C for seven days prior to the experiment. We are further interested in the effects that latitude and species variation have on metabolic rate and will thus use six stick insect species that span the phylogenetic diversity and latitude of New Zealand.

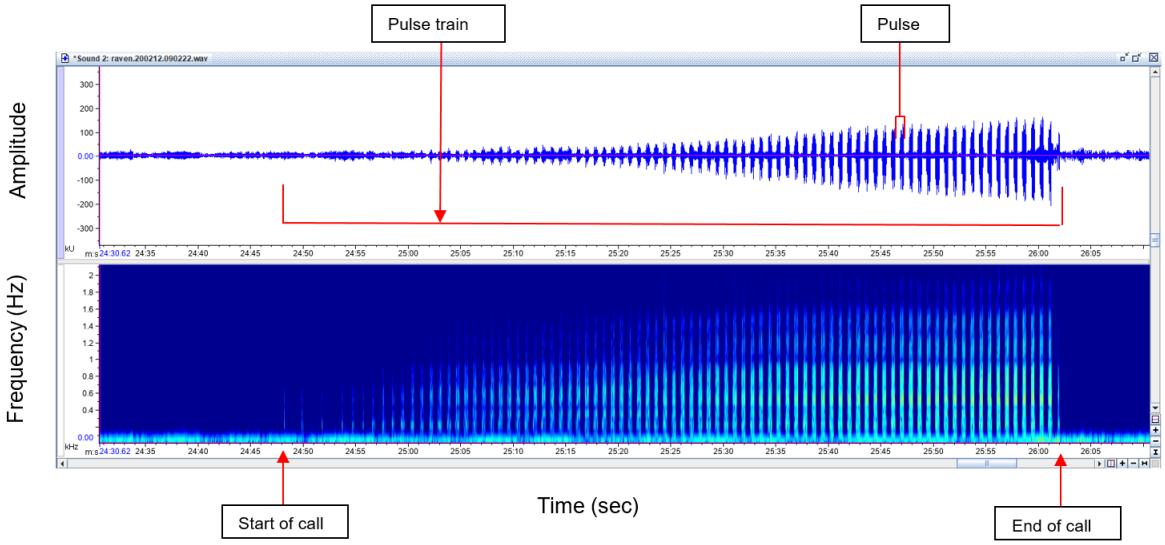
16:10 – Thursday, April 8th

Vibrational communication in passionvine hopper (*Scolypopa australis*) – potential for residue-free pest management

Sullivan, N.J.[1], Avosani, S.[2,3] , Stringer, L.D. [1]

[1]*The New Zealand Institute for Plant and Food Research Limited, Christchurch, New Zealand*
[2] *DICAM Department of Civil, Environmental and Mechanical Engineering, University of Trento, Trento, Italy*
[3] *Research and Innovation Centre, Fondazione Edmund Mach, San Michele all'Adige, Trento, Italy*
Presenter email: Nicola.sullivan@plantandfood.co.nz

Passionvine hopper (*Scolypopa australis*, PVH) is a significant pest insect in New Zealand kiwifruit orchards. PVH feeds on the phloem of kiwifruit plants in large numbers, producing honeydew, which can promote the growth of sooty mould resulting in rejected fruit. Insecticidal sprays are not a suitable option in kiwifruit because of the risk of high residue rate on kiwifruit skins. Developing tools that interfere with the vibrational communication of insects could offer a new residue-free pest management technique for PVH, and other insects. Globally, the identification of characteristic vibrational calls and implementation of technology to manage pests by targeting substrate-borne vibrational communication is in its infancy. In this study, we investigate the vibrational calls produced by PVH by characterising a male call, identifying a female call, and investigating the behavioural purpose of these communication signals.



An example oscillogram (top) and spectrogram (bottom) of a male *Scolypopa australis* calling signal.

16:22 – Thursday, April 8th

Lichen moths do not benefit from lichen masquerade in the absence of a matching background

Mark, C.J.[1], Painting, C.J.[2], O'Hanlon, J.C.[3], & Holwell, G.I.[1]

[1] Te Kura Mātauranga Koiora | School of Biological Sciences, Te Whare Wānanga o Tāmaki Makaurau | The University of Auckland, Auckland New Zealand
[2] Te Aka Mātuatua School of Science, University of Waikato, Hamilton New Zealand
[3] School of Science and Technology, University of New England, Armidale, NSW, Australia
Presenter email: cmar167@aucklanduni.ac.nz

Camouflage provides some of the most striking examples of defensive colouration in the animal kingdom, with the strategies employed both diverse and extraordinary. While most of these strategies reduce the probability of being detected by predators, others function to prevent correct recognition. Masquerade is a form of camouflage that deceives predators into misidentifying prey as the unprofitable object that it resembles, such as a leaf or twig, rather than as food. Thus, instead of blending into the background, masquerading prey conceal themselves in plain sight. We assessed a putative case of masquerade in the North Island lichen moth, *Declana atronivea*, which possess intricate black and white forewings that appear to resemble lichen. Through a series of behavioural experiments, we compared the responses of naïve and experienced (had prior exposure to lichen) chicks (*Gallus gallus domesticus*) to *D. atronivea*, hypothesising that if the moths do benefit from masquerade, experienced chicks would be more cautious and take longer to attack. Our results did not support this prediction; there was no significant difference in chick interaction with the moths regardless of prior experience, suggesting that *D. atronivea* do not benefit from masquerading as lichen, at least in the absence of a matching background.

16:34 – Thursday, April 8th

Importing foreign butterflies into New Zealand: Ethics, biosecurity, and sustainability

Stumbo, A. D.[1]

[1]Otago Museum, Dunedin, New Zealand
Presenter email: anthony.stumbo@otagomuseum.nz

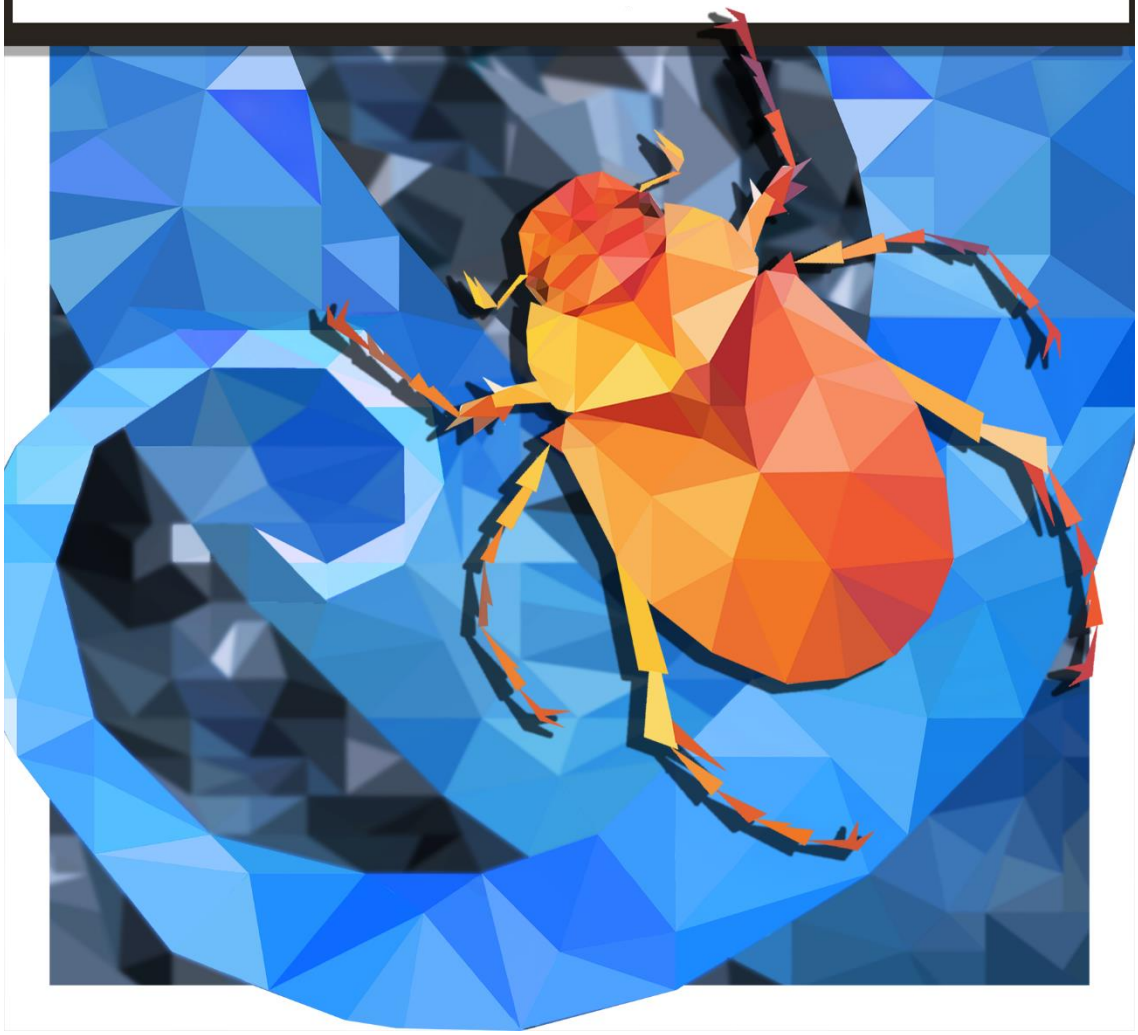
The global butterfly house industry has seen a massive rise over the last 30 years, with a global turnover of over $100 million USD annually. With butterfly houses obtaining pupae from tropical regions – predominately Central America and Southeast Asia – there is a growing spotlight on the risks and benefits of the Butterfly House Industry displaying wildlife for entertainment, the effect on biodiversity and conservation where the pupae are farmed, and the long-term sustainability of the industry itself.

Otago Museum's Tūhura Tropical Forest has been a part of this industry for over ten years, displaying tropical butterflies from Costa Rica and the Philippines. Behind its beautiful exterior, the Museum must weigh these risks and benefits while being cognisant of the biosecurity risks present when importing foreign organisms into Aotearoa New Zealand for public display.

Submitted Talk Abstracts

(in order of schedule)

Friday 9th April



09:30 – Friday, April 9th

Mosquitoes in New Zealand – The endemics and the intruders. Monitoring tools and citizen science to compare invasive with endemic mosquito species over time – outcompeting, pathways and health issues

Kasper, J.[1], Tomotani, B. M. [2]

[1] *Museum of New Zealand Te Papa Tongarewa, Wellington*
[2] *Netherlands Institute of Ecology, NIOO-KNAW, Wageningen, The Netherlands*

New Zealand has 13 endemic species of mosquitoes (Diptera: Culicidae), which are mainly bird-biters, have a very low vector competence and are important for Aotearoa's ecosystem. Due to competition with introduced mosquito species over their habitats, some of the endemic species are potentially threatened and possibly declining in abundance.

The cosmopolite *Culex quinquefasciatus* Say, closely related to the endemic *Cx. pervigilans (Bergroth)*, has been introduced to New Zealand more than 180 years ago with no noticeable effect on the latter one. Only recently, due to the National Mosquito Surveillance at points of entries (POE) over the last fifteen years, the distribution of these two species in New Zealand could be recorded and analysed. This enabled us to find out that numbers of *Cx. quinquefasciatus* have increased in quantity over time with populations spreading southwards which has an effect on *Cx. pervigilans.* The citizen science project "NZ Mozzie Census" is now helping us-to fill the blanks on the map, improving our dataset and thus our conclusions.

09:42 – Friday, April 9th

Exclusion of exotic mosquitoes in New Zealand

Musicante, M.L.[1], McKenzie, R.[1], Edgecumbe, C.[1], & Singe, M.[1]

[1] *New Zealand BioSecure Entomology Laboratory – Southern Monitoring Services*
Presenter email: mariana.musicante@smsl.co.nz

Mosquitoes in New Zealand currently do not pose a human health risk, with endemic species feeding mainly on birds and introduced vectors separated from sources of diseases. The Ministry of Health, supported operationally by Public Health Units, has in place a programme to exclude exotic mosquitoes of public health significance. PHUs conduct routine monitoring for mosquitoes in international Points of Entry airports and seaports. New Zealand BioSecure Entomology Laboratory, under contract to MoH, identifies mosquito samples, provides training and technical advice regarding Routine Surveillance and response in the event of suspected exotic mosquito/s found during RS or associated with imported goods or passengers at the border. Each POE has in place a suite of mosquito traps designed to target unwanted mosquitoes. Traps are checked weekly during the warmer months and fortnightly during the cooler months. Of the 15 mosquito species occurring in New Zealand, the main species collected during RS are the introduced mosquitoes *Culex quinquefasciatus* and *Aedes notoscriptus*, and the endemic *Culex pervigilans*. During the period 2001-2020, there were 148 reported events, in which exotic mosquitoes were collected, 86% associated with imported goods/passengers, 7% were caught in RS and response traps, and 7% were intercepted flying around in airports.

10:30 – Friday, April 9th

Can sterile parasitoids be employed for eradication by mitigating potential risk of non-target impacts?

Horrocks, K.J.[1], Avila, G. A.[2,4], Holwell, G.I.[1], Suckling, D.M.[1,3,4]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
[2] *The New Zealand Institute for Plant and Food Research Limited, Auckland New Zealand*
[3] *The New Zealand Institute for Plant and Food Research Limited, Christchurch, New Zealand*
[4] *Better Border Biosecurity, Auckland, New Zealand*

Ongoing pest management costs can be avoided through eradication. Classical biological control (CBC) involves the release of imported natural enemies to control pests. The sterile insect technique (SIT) involves the mass release of sterilised insects to disrupt fecundity in a pest population. The combination of SIT and CBC can exert a synergistic impact on pest populations and improve eradication. However, owing to perceived risk of non-target impacts, regulation surrounding the release of CBC agents limits their use in eradication. We propose a novel tool comprising the combined application of sterile parasitoids with SIT. Sterile parasitoids could mitigate the risk of ongoing non-target impacts as their population will not persist, and regulatory constraints to CBC releases in eradication could therefore potentially be bypassed. To assess the feasibility of this technique, we investigated irradiation-induced sterility in the egg parasitoid *Trissolcus basalis*. Irradiated females killed *Nezara viridula* host eggs without the emergence of their own offspring. We are currently examining the host-searching ability and longevity of irradiated *T. basalis*. Future experiments will investigate whether the combination of sterile parasitoids and SIT exerts a synergistic impact on the pest. Sterile parasitoids could facilitate the contribution of CBC agents to improve insect eradication programmes globally.

10:42 – Friday, April 9th

Exploring host-specificity through chemical ecology to gain insights into the ecological host ranges of three *Trissolcus* (Hymenoptera: Scelionidae) parasitoids in New Zealand

Saunders, T.E.[1,3], Avila, G.A.[2,3,] Holwell, G.I. [1]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
[2] *The New Zealand Institute for Plant and Food Research Limited, Auckland New Zealand*
[3] *Better Border Biosecurity (B3), New Zealand*
Presenter email: tsau017@aucklanduni.ac.nz

Screening natural enemies for potential non-target risks is fundamental to safe and effective classical biological control programmes. Traditional methods, such as no-choice tests, provide compelling evidence of a candidate agent's physiological host range. However, once a biological control agent is released, a variety of sensory filters narrow the pool of attractive hosts to a list of species the agent will actually attack (its ecological host range). Understanding how and why a parasitoid chooses which hosts to attack would help to reduce uncertainty during pre-release host range testing. Here we present an overview of our work on the chemical ecology of three Trissolcus species in New Zealand, including Trissolcus japonicus Ashmead (Hymenoptera: Scelionidae), a biological control agent conditionally approved for release against brown marmorated stink bug (Halyomorpha halys Stål), should it establish in New Zealand. We conducted electrophysiological experiments (GC-EAD) to identify compounds associated with adult stink bugs which elicit antennal responses. We also exposed parasitoids to non-target egg masses to measure the outcomes of competitive interactions between adults and larvae. Finally, we observed arrestment responses in relation to both host and non-host odours. Incorporating chemical-ecological data in host range testing will support decision makers evaluating applications to release new organisms.

10:54 – Friday, April 9th

2 species in 1 sample: RNAseq of a parasitoid within its host

Inwood, S.N.[1], Harrop, T.W.[1], Dearden, P.K.[1]

[1] *Department of Biochemistry, University of Otago, Dunedin, New Zealand*
Presenter email: inwsa043@student.otago.ac.nz

The Argentine stem weevil (*Listronotus bonariensis*, ASW) is an economically significant pasture pest in New Zealand primarily controlled by *Microctonus hyperodae*, an endoparasitoid wasp biological control agent. Initial parasitism rates were as high as 80% but they are now declining significantly, resulting in severe pasture damage costing an estimated NZ$160M per annum. This is the first reported example of developed resistance in a previously successful biological control system worldwide, and a genetic basis for this parasitism resistance is suspected. Resistance to parasitism is most likely to be either a host-mediated immune response towards the oviposited parasitoid egg, or a barrier preventing the parasitism event itself such as a host behavioural change.

Dual-species RNAseq was used to simultaneously examine gene expression of parasitized ASW and the internally developing parasitoid within a single sample; investigating the possibility of a host-mediated cellular immune response toward the *M. hyperodae* egg. Both a lack of cellular immune system genes being expressed in ASW, and continued expression of developmental genes by *M. hyperodae* suggests that parasitism resistance is unlikely to be a result of a post-parasitism immune response, and that there may instead be a barrier to the parasitism event itself.

11:06 – Friday, April 9th

Diversity of entomopathogenic fungi in New Zealand and their potential for pest management

Guerrero, M.S.[1], Trewick, S.[1], Glare, T.[2], Minor, M.[1]

[1] *Wildlife and Ecology Group, School of Agriculture and Environment, Massey University, Palmerston North, New Zealand*

[2] *Bio-Protection Research Centre, Lincoln University, Lincoln, New Zealand*

Entomopathogenic fungi (EPF) are disease-causing fungi infecting insects. EPF are emerging as environmentally safe and effective components of insect pest management. These fungi occur naturally in soil, but despite their potential for biological control, the diversity and distribution of EPF in New Zealand soils is understudied. We are investigating the diversity of New Zealand EPF focusing on the North Island across exotic pasture and native forest transitions. This comparative approach involved insect baiting, direct plating and next generation sequencing (NGS) of soil DNA. The associated diversity of soil invertebrates was also studied.

Using insect baiting with *Tenebrio molitor*, a total of 63 larvae (23.33%) were successfully infected. Of these, 58 dead larvae (92.06%) hosted *Beauveria* sp., while only five (7.94%) hosted *Metarhizium* sp. Based on the number of colony forming units (CFU) per gram of soil, there was significantly higher density of EPF in forest soils vs. pastures ($P<0.001$) across pasture-forest transitions. A similar trend was seen for soil microarthropods, with significantly higher abundance in forest soils compared to pastures. Native EPF will be used to conduct laboratory bioassays to test efficacy against target insect pests.

11:18 – Friday, April 9th

Impact of the gall fly, *Urophora stylata*, on seed production of *Cirsium vulgare* in New Zealand

Cripps, M.G.[1]

[1] *AgResearch, Lincoln Science Centre, Lincoln, New Zealand*
Presenter email: mike.cripps@agresearch.co.nz

The gall fly, *Urophora stylata* (Diptera: Tephritidae), was released in 1998 as a biocontrol agent for the thistle weed, *Cirsium vulgare* (Scotch thistle), in New Zealand. In the summer of 2018, a survey was carried out to assess the impact of the gall fly on seed production of the weed. The gall fly was found at 14 of the 20 *C. vulgare* populations surveyed. Where the biocontrol agent was present, it reduced the number of seeds per seedhead by 47%, individual seed weight by 21%, and seed germination rate by 30%. Within populations, seed reduction was estimated to range from 11% to 61%. The impact of the gall fly significantly increased from southern to more northern latitudes of *C. vulgare* populations in New Zealand. Attack on other thistle species present within the surveyed *C. vulgare* populations was also assessed, and was recorded on the closely related thistle weeds, *Cirsium arvense* (Californian thistle) (17% of seedheads), and *Cirsium palustre* (marsh thistle) (1% of seedheads). This research represents the first assessment of *U. stylata* in New Zealand and indicates that it can have a significant impact on *C. vulgare*, especially in northern New Zealand where attack intensity is greatest.

11:30 – Friday, April 9th

Paropsine defoliation within *Eucalyptus* species

Pawson, S.[1], Morgenroth, J.[1], Mann, L.[1]

[1] *Canterbury University, Christchurch, New Zealand*
Presenter email: leslie.mann@pg.canterbury.ac.nz

A wide range of Australian insects infest *Eucalyptus* trees in New Zealand. The most damaging defoliators are the paropsine beetles, particularly *Paropsis charybdis* and *Paropsisterna cloelia* (EVB). In 2018 EVB was confined to the eastern and southern North Island. However, EVB spread to the upper South Island during the 2019-2020 summer and now causes considerable damage to *Eucalyptus* plantations in Marlborough. Understanding paropsine preferences is crucial to establishing the impact they may have on durable *Eucalyptus* timber industry in New Zealand.

The aim of my study is to determine how introduced paropsines interact with plantation eucalypts in New Zealand. Specifically I ask the question, are some *Eucalyptus* species or families (genetic lines) more resistant or tolerant to paropsine herbivory.

I assessed *Eucalyptus* defoliation at sites in Marlborough over the 2019-2020 and 2020-2021 summers. This included over 1,000 *E. bosistoana* trees, 120 trees from the *E. tricarpa* families, and approximately 300 trees from 7 different species to quantify the paropsine feeding preferences to assess resistance. For each tree, I measured height, DBH, and defoliation level using the CDI (Crown Damage Index) method and the length of new foliage. Comparing feeding damage and growth between the two years enables an assessment of tolerance.

Results from my CDI data show that defoliation is low for *E. cladocalyx*, *E. macrorhyncha* and *E. globoidea*. These trees can be considered more resistant than the other trees sampled. Even though other species were more defoliated, some still produced the longest new shoots that suggests a level of tolerance. For the height and DBH gain over 12 months between the first and second assessment, *E. globoidea* and *E. macrorhyncha* had the highest DBH gain and *E. cladocalyx* and *E. macrorhyncha* had the highest height gain. These species were the less defoliated than others and suggests that paropsine herbivory could impact negatively the growth rate of *Eucalyptus*.

11:42 – Friday, April 9th

Granulate ambrosia beetle: a new threat to broadleaf trees in New Zealand

Sutherland, R.[1], Meurisse, N.[1], Withers, T.[1]

[1] *Scion, New Zealand Forest Research Institute, Rotorua, New Zealand*
Presenter email: Roanne.sutherland@scionresearch.com

The granulate ambrosia beetle *Xylosandrus carriusculus* (Coleoptera: Scolytinae) was first detected in New Zealand in February 2019. This tiny beetle, native to East Asia, is known as one of the most successful colonisers of broadleaf trees, attacking over 100 species across at least 40 families. In its invaded range, the beetle is regarded as a serious pest to nurseries and orchards, and concerns emerge whether it poses a risk to trees in natural environments.

X*ylosandrus crassiusculus,* like other typical ambrosia beetles, is a xylomycetophagous wood borer. Both the larvae and the adults feed on a symbiotic fungus that is inoculated by the adult females as they bore galleries into the host tree. 'Toothpicks' or 'noodles' of compacted frass extruding from host trees are often the first sign of an attack. *Xylosandrus crassiusculus* are known to produce multiple generations throughout the year.

We report here on the introduction of *X. crassiusculus* in West Auckland and present some of the methods recently trialled to monitor its phenology in New Zealand. We also discuss its current status and potential impacts.

13:30 – Friday, April 9th

Mason wasps (*Pison* spp.; Hymenoptera: Crabronidae) in New Zealand

Early, J.W.[1]

[1]*Auckland Museum, Auckland, New Zealand*
Presenter email: jearly@aucklandmuseum.com

Four species of these spider-hunting wasps are now present in New Zealand. The endemic *P. morosum* and the long-established, well-known adventive Australian *P. spinolae* have been joined recently by two further Australian species *P. "ruficorne"* and a yet to be identified species. Information on nests of *P. "ruficorne"* is presented but nests and biology of *Pison* sp. remain to be discovered.

13:42 – Friday, April 9th

High alpine sorcerers: the cave wētā genus *Pharmacus* Pictet & de Saussure, 1893

Hegg, D.[1], Morgan-Richards M.[2] and Trewick, S.A. [2]

[1] *Dunedin, New Zealand*
[2] *Ecology Group, Massey University, Palmerston North, New Zealand*
Presenter email: danilo_hegg@hotmail.com

The alpine cave wētā genus *Pharmacus* was first described in 1893 based on one adult male specimen, assigned to the species *Pharmacus montanus*. The genus was revised by Richards in 1972, with the addition of three new species. Two of these species were also described based on one specimen each. During the past five years, we have collected over 300 *Pharmacus* specimens throughout the high alpine regions of the South Island of New Zealand, from Fiordland to Kahurangi. With analysis of mitochondrial DNA and microscopy on fresh specimens, combined with the examination of other genera of New Zealand Rhaphidophoridae, we reveal a more complex set of relationships. We also discuss the habitat and ecology of these sorcerers*, adapted to survival in extreme environments, above the permanent snowline and up to 2,500m of elevation.

**Pharmacus* is latin for 'sorcerer'

13:54 – Friday, April 9th

The Opiliones of New Zealand: Revisionary synthesis and application of species delimitation for testing biogeographic hypotheses – post-ICA 2019 update

Sirvid, P.J.[1], Giribet, G.[2] , Boyer, S.L. [3]

[1] *Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand*
[2] *Museum of Comparative Zoology, Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, USA*
[3] *Biology Department, Macalester College, St. Paul, MN, USA*
Presenter email: phils@tepapa.govt.nz

New Zealand is widely viewed as an ideal place to combine systematics and biogeography on the basis of its isolation and geological history. The New Zealand Opiliones fauna includes an endemic family and comprises 221 currently known endemic species and subspecies (plus two recent anthropogenic introductions), most of which were described by Ray Forster more than 60 years ago. Their nearest known relatives are found on other former Gondwanan landmasses.

The key goals of the project are to revise and document the entire New Zealand Opiliones fauna and to study the evolutionary processes that shaped it. A combination of conventional taxonomic methods in concert with leading-edge molecular approaches is being utilized to understand the evolutionary history and diversity of these fascinating animals.

This project was first announced locally at the 2019 International Congress of Arachnology held in Christchurch, and this talk will provide an update on progress since then.

14:06 – Friday, April 9th

The rise and fall of two orbweb spiders

Vink, C.J.[1,2], Curtis, K.M.[1], Framenau V.W. [3,2], McQuillan B.N. [4], Simpson A.H. [4]

[1] *Department of Pest-management and Conservation, Lincoln University, New Zealand*
[2] *Centrum für Naturkunde, Universität Hamburg, Hamburg, Germany*
[3] *Harry Butler Institute, Murdoch University, Western Australia, Australia*
[4] *Bryce McQuillan Photography, Rotorua, New Zealand*
Presenter email: cor.vink@lincoln.ac.nz

Philoponella congregabilis and *Neoscona orientalis* are two orbweaving spiders found in Aotearoa New Zealand with almost nothing else in common.

Philoponella congregabilis is a recent arrival from Australia that has established in the south of Christchurch. It is in the family Uloboridae, which build cribellate (hackled) orwebs and have no venom glands. It is likely to continue spreading further north but could well go unnoticed because it is one of the smallest orbweavers in New Zealand. However, it builds messy, interconnected webs in low vegetation, on fences and around buildings, so it may be seen by observant gardeners and entomologists.

It is unknown how long *Neoscona orientalis* has been in New Zealand. It has no close relatives here and is only found in North Island scrub and forest margins; these characteristics led to the assumption that it was introduced, either naturally or by humans, probably from Australia. However, the morphology of its pedipalp is nothing like any other Australian species in the family Araneidae and it also does not belong in the genus *Neoscona*. It is the largest orbweb spider in New Zealand and it is quite possible that it is much less common due to the arrival of Pākehā.

14:18 – Friday, April 9th

A preliminary phylogeny of *Porrhothele* (Porrhothelidae) based on mitochondrial DNA

Thompson, S.A [1]

[1] *The Museum of New Zealand, Te Papa Tongawera, Wellington, New Zealand*
Presenter email: shaun.thompson@tepapa.govt.nz

New Zealand's iconic *Porrhothele* are a group of Mygalomorphs that are very morphologically conserved. Due to this, species are very difficult to identify by morphology alone and thus there are likely to be undescribed species. Additionally, it is currently unknown whether the unusually widespread *P. antipodiana* represents one species or several undescribed species. Using the COI mtDNA gene, a preliminary phylogeny of *Porrhothele* has been produced in an attempt to resolve the species taxonomy of this group. The results indicate that there are several undescribed species of *Porrhothele* in New Zealand, which appear to be supported by subtle differences in reproductive morphology. Additionally, the results suggest that *P. antipodiana* represents a single widespread species, rather than several undescribed species. Further sampling and the usage of additional genes is required to validate the existence of the potential species found by this study.

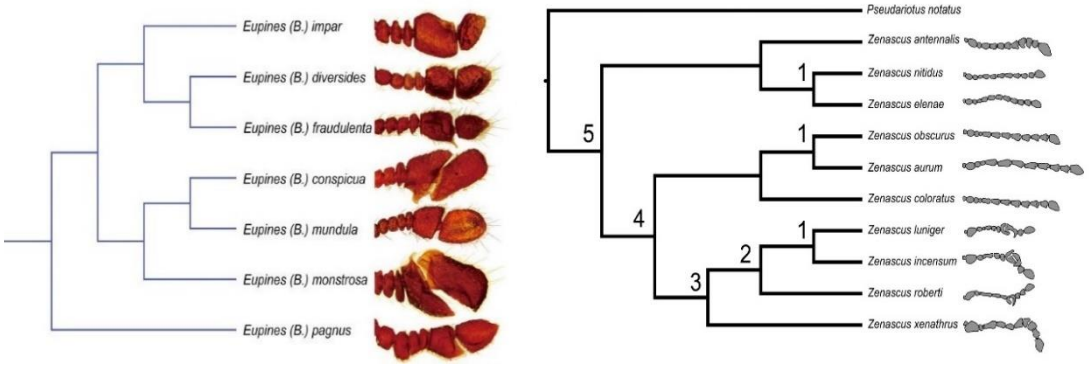
15:00 – Friday, April 9th

Male antennae of beetles

Leschen, R.A.B.[1], Grzymala, T.L.[2], Shen, J.[1,3]

[1] *Manaaki Whenua – Landcare Research, New Zealand Arthropod Collection, Auckland, New Zealand*
[2] *University of California, Berkeley, Environmental Science, Policy, & Management, Berkeley, CA, USA*
[3] *School of Biological Sciences, The University of Auckland, Auckland, New Zealand*
Presenter email: leschenr@landcareresearch.co.nz

Antennae function in touch, smell and taste; but why are antennae more exaggerated in some insects and not in others? Does one sense dominate over another? In beetles, antennae are often sexually dimorphic. The males may have longer antennae, or the antennomeres are highly modified, like plumose forms present in many wood-boring species. In these cases, cuticular surface area is increased and there is a profusion of sensillae that facilitate detection of female pheromones. We explore the diversity of male antennal forms in plant-dwelling puppet beetles (Aderidae: *Zenascus*) and leaf litter rove beetles (Staphylinidae: Pselaphinae: Brachyglutini: *Eupines*). Antennal characters optimised onto molecular (*Eupines*) and morphological (*Zenascus*) phylogenies reveal that antennal modifications arose after the origin of sexually dimorphic leg and abdominal structures. While we can't determine the true sensorial function of male antennae, we suggest that the modified forms may operate at close-range and may be involved with species recognition. This hypothesis is supported by the existence of sympatric species and the presence of multiple species of aderids collected from a single tree. Alternatively, complexity of courtship behaviour has increased: aderids with extremely modified male antennae also exhibit a profusion of glandular pores contained in specialized structures of the metafemora.



15:12 – Friday, April 9th

Genomics reveals widespread ecological speciation in flightless insects

McCulloch, G.A.[1], Foster, B.J.[1], Dutoit, L.[1], Harrop, T.W.R.[2], Guhlin, J.[2], Dearden, P.K.[2], Kroos, G.E.[1], Waters, J.M.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
[2] *Genomics Aotearoa and Department of Biochemistry, University of Otago, Dunedin, New Zealand*

Wing reduction and flight loss have apparently evolved repeatedly in montane insect assemblages, and have been suggested as important drivers of hexapod diversification. We tested this hypothesis using genomic analyses of a widespread wing-polymorphic stonefly species complex in New Zealand (*Zelandoperla fenestrata*). We sampled stoneflies at eight sites across the lower South Island, and assessed genetic relationships within and among localities using over 50,000 polymorphic SNP markers. Our results revealed widespread parallel speciation between sympatric full-winged and wing-reduced ecotypes. Rather than the existence of a single, widespread, flightless taxon (*Zelandoperla pennulata*), evolutionary genomic data reveal that wing-reduced upland lineages have speciated repeatedly and independently from full-winged *Z. fenestrata*. These findings highlight the role of natural selection in driving rapid and repeated ecological speciation.

15:24 – Friday, April 9th

Georeferencing your collection: I'm sure it was somewhere in that valley

Ridden, J.D. [1]

[1] *Canterbury Museum, Curatorial Team, Christchurch, New Zealand*
Presenter email: jridden@canterburymuseum.com

As collection institutions work through cataloguing their backlog, large amounts of data are generated. This data can be uploaded to different biorepositories (e.g. GBIF and ALA) for a broad range of uses by the biodiversity research community. One key component is accurate specimen locality information. Knowing the extent of where something is collected from is important. Historic collection labels don't often record map grid references or GPS locations.

There are tools and guidelines available to assist the georeferencing process. I will outline some initial work being done to georeference collections at Canterbury Museum. One example is the Peter Johns collection consisting of over 140,000 specimens collected since the late 1950s.

The georeferencing workflow will be discussed, using the Collaborative Georeferencing Client on the GEOlocate website (https://www.geo-locate.org/default.html), the Georeferencing Best Practices guides and the official LINZ Gazetteer of New Zealand. The outcome will result in the specimen records having a collection co-ordinate assigned with an associated error radius for the collection point. This will improve the usability of the collections for biodiversity research purposes.

15:30 – Friday, April 9th

Geography and local environment as important drivers of coastal Diptera community variation throughout Aotearoa|New Zealand

Le Grice, R. J.[1]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
Presenter email: rleg010@aucklanduni.ac.nz

Species and communities vary biogeographically, with patterns of variation linked to numerous geographic and environmental drivers. Understanding the drivers of spatial variation can be complex, as the importance of many potential drivers may vary over different geographic scales. Coastal communities may be particularly complex in their biogeography as they lie on the marine-terrestrial interface which creates a dynamic environment, which can result in significant spatial variation. Here I assess the biogeographic variation in coastal Diptera communities, and consider how geography and environmental conditions affect the distribution of species and communities from New Zealand. I found that coastal Diptera communities that specialise on wrack (marine macroalgae and other debris washed ashore) are essentially homogeneous, not driven by large-scale biogeographical patterns but responding more to variation in the local wrack environment. However, the more general coastal Diptera community shows some large-scale, but relatively weak, patterns with latitude and between the east and west coasts of New Zealand. Communities from each coast, and extreme southerly latitudes, have a number of associated 'faithful' species which are likely to be adapted to different coastal conditions. This study provides an initial insight into the biogeography of New Zealand's diverse coastal Diptera communities.

15:42 – Friday, April 9th

Scavenger hunt; Reconnecting historical terrestrial invertebrate collections from Rangitāhua (Kermadec Islands)

Walker, L.A.[1]

[1] *Collections and Research, Natural Sciences, Auckland War Memorial Museum, Auckland, New Zealand*
Presenter email: leilaniwalker@aucklandmuseum.com

"Te mana o Rangitāhua" is a five-year research program led by Ngāti Kuri, in partnership with Auckland Museum, to enable transformative, iwi-led approaches to environmental management. In order to create a holistic understanding of the ecosystem of Rangitāhua (Kermadec Islands), a vital component of this project is accounting for historic activities on and around the islands including scientific collecting. These detailed accounts will help the research team to understand the origins of the islands' current environmental state and, potentially, inform future management.

The terrestrial invertebrate fauna of Rangitāhua is generally considered poor and fragmentary with a low rate of endemicity, most likely a result of frequent disturbances, isolation and small island sizes. Nevertheless, they have been extensively sampled from certain locations and aggregating data on the contents and state of these historic collections at both domestic and international institutions will support Ngāti Kuri as the environmental managers and stewards.

While the broader work plan encompasses all major natural history collection areas, this presentation will outline key approaches, preliminary findings, and challenges associated with aggregating data on terrestrial invertebrate collections.

15:54 – Friday, April 9th

Freshwater invertebrate monitoring and citizen science with Ngati Kuri schools in the Far North

Moore, R.B.[1]

[1] *Auckland War Memorial Museum, Natural Sciences Department, Auckland, New Zealand*
Presenter email: rmoore@aucklandmuseum.com

The relationship between scientists from the Auckland Museum and the Ngati Kuri schools in the Far North (Ngataki and Te Hapua Schools) has been well established through a number of hui, bioblitzes and zoom classes. There are many shared values, with kaitiakitanga of the natural environment being important to both. Initially a 2017 hui freshwater issues were identified as a major area in interest, and the schools requested assistance with setting up monitoring programmes.

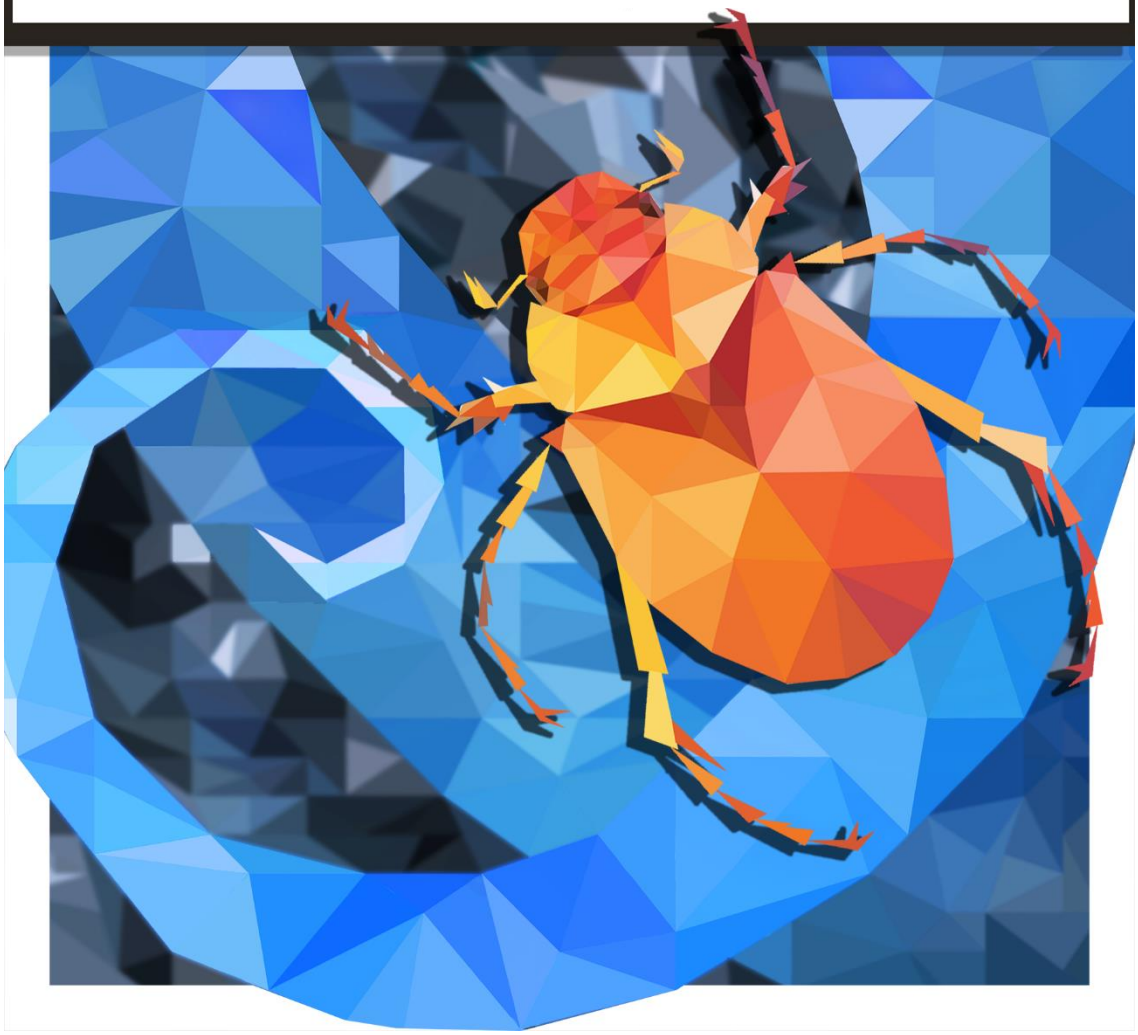
Freshwater invertebrates are a useful indicator of water quality, as some taxa are only associated with unpolluted water and undisturbed habitat, whilst other taxa are able to tolerate a range of conditions. Surveying the invertebrate communities can give a general measure for water quality and stream "health". The goal of this project was to help set the students up as citizen scientists. Online classroom sessions were held with the students as well as a number of site visits.

In 2019, we did a baseline survey of the Peterahema Stream near North Cape. The taxa found included mayflies and caddisflies which are general indicators of good water quality. One of the mayfly specimens requires further taxonomic work, as it does not key out to a known species.

Submitted Poster Abstracts

(in order of first author's last name)

Poster Session: Wednesday 7th April, 5:30-6:30



One step closer to resolving the taxonomy of *Pericoptus* (Scarabaeidae, Dynastinae)

Baber, M.[1], Braid, H.E.[1], Bolstad, K.S.R.[1], Buckley, H.[1]

[1]*Department of Applied Ecology, School of Science, Auckland University of Technology, Auckland, New Zealand*
Corresponding email: hannah.buckley@aut.ac.nz

The sand dune ecosystems in Aotearoa New Zealand are currently classified as endangered due to extensive reductions in their ecological function and distribution. These ecosystems are the sole known habitat of the endemic scarab beetle genus *Pericoptus* (Scarabaeidae, Dynastinae), which is additionally threatened by habitat disturbances, climate change, and an invasive parasitic wasp. Understanding the taxonomy and distribution of the species in this genus will be essential for their conservation; at present, five named species are accepted but the presence of undescribed taxa is suspected. We sequenced the DNA barcode region (cytochrome c oxidase subunit I) from 326 specimens (adults and larvae) from 43 locations around the North and South Islands, which yielded 15 BINs (Barcode Index Numbers, which are generated using a clustering algorithm that groups barcodes in a way that has shown high concordance with species). Most locations had sympatric species, and some taxa appear restricted to either the North or South Island. Based on genetics, this genus appears to have substantially more species than previously suspected. More specimens and additional gene regions (in combination with morphology) will be required to review *Pericoptus*, a vital step in forming conservation management plans for its unique species.

Investigating the molecular basis of water seeking behaviour in earwigs (*Forficula auricularia*) due to nematode (*Mermis nigrescens*) infection

Bhattarai, U.R.[1], Dowle, E.[1], Poulin, R.[2], Gemmell, N.J.[1]

[1] *Department of Anatomy, University of Otago, Dunedin, New Zealand*
[2] *Department of Zoology, University of Otago, Dunedin, New Zealand*
Presenter email: bhaup057@student.otago.ac.nz

The nematode (*Mermis nigrescens*) induces water-seeking behaviour in earwig (*Forficula auricularia*) at the end of parasitisation so that they can emerge in water to continue their lifecycle. Here we seek to study the underlying mechanisms behind this manipulation through genomics and transcriptomic approaches. The genomes of both the host and the parasite are sequenced using Oxford nanopore and 10x chromium sequencing technologies. The preliminary genome assembly produced for *M. nigrescens* has 16642 contigs with an N50 of 94446 bp. The assembly has 86.8 % complete and 5.61 % partial BUSCO gene representation. Similarly, the genome assembly for *F. Auricularia* has 69786 contigs with N50 of 28931 bp and BUSCO score of 62.38% complete and 7.59% partial genes. Genome annotation will be followed by their comparative analysis to look for the evidence of gene duplication, gene losses, and horizontal gene transfer during host-parasite coevolution. Comparative transcriptomic analysis during different stages of manipulation (Figure 1) for both host and parasite are being conducted to identify differentially expressed genes and pathways during the behaviour change. Using this combination of approaches, we aim to determine the underlying genetic mechanism of the water seeking behaviour and explain the genetic association and exchanges during host-parasite coevolution.

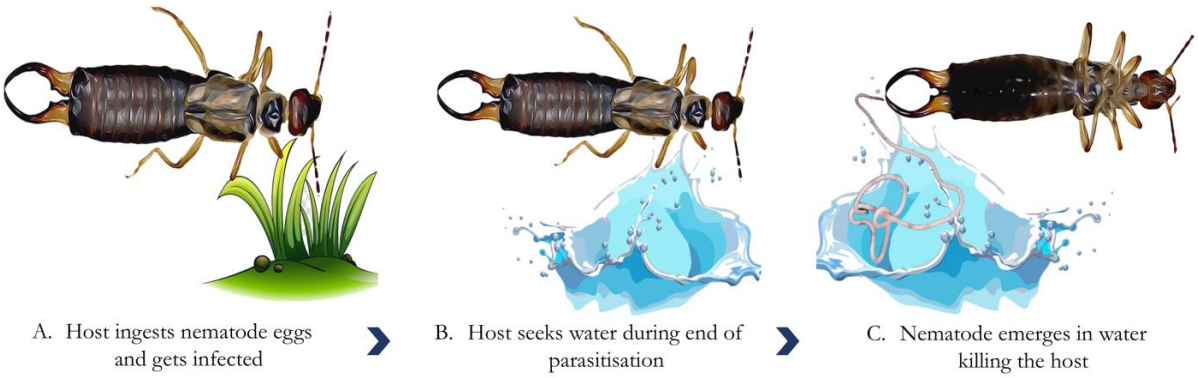


Figure 1. Induction of water seeking behaviour in earwig (*Forficula auricularia*) infected by mermithid nematode (*Mermis nigrescens*).

Quantifying the magnitude of edge effects on invertebrate communities in Waikato forests

Chapman, B. T.[1]

[1] *School of Science, University of Waikato, Hamilton, New Zealand*
Presenter email: btc17@students.waikato.ac.nz

With human expansion into forests and other natural ecosystems being a common practice globally, it is important for ecologists to understand the impacts that land use alterations have on the species that reside in these habitats. Although debate still occurs on whether edge effects are overall a positive or negative influence on populations and communities, it is well supported that edge effects are often a significant driver in the composition of affected ecosystems.

This research aims to utilise leaf-litter invertebrate samples taken from three forests within the Waikato region to quantify the edge response experienced by invertebrates from different orders and the subsequent response of morphological traits (e.g. flightlessness, body size). These samples will be paired with analysis of environmental variables to identify the primary environmental driver(s) influencing invertebrate community composition.

This research will inform land-use changes that would alter the shape and size of forest fragments harbouring valuable invertebrate communities that provide a foundation for functional ecosystems. If significant environmental drivers are identified, it may even be possible to find means of compensating for alterations to these variables and implement solutions to help protect vulnerable populations in habitats with adversely affected conditions.

Poplar sawfly: a new threat to poplars in New Zealand

Chen, J.[1], O'Connor, B.[2], Withers, T.M.[3]

[1] *Department of Conservation, New Zealand*
[2] *Scion, New Zealand Forest Research Institute, Christchurch, New Zealand*
[3] *Scion, New Zealand Forest Research Institute, Rotorua, New Zealand*
Presenter email: JBSmith@URS.edut

The hairy poplar sawfly (*Cladius grandis* (Serville)) (Hymenoptera: Tenthredinidae) was discovered for the first time in the southern hemisphere in Abbotsford, Dunedin in January 2019. Native to the Palearctic region and most of Eurasia, it is an occasional outbreak species that invaded the east coast of north America in 1887, and the west coast in 1914. It can seriously defoliate *Populus nigra*, *P. deltoides*, *P. tremula*, and *P. tremuloides* during outbreaks. *Populus nigra* and *P. deltoides* and their various hybrids (including Lombardy and Carolina poplar), are commonly grown in New Zealand. We monitored the lifecycle in Dunedin revealing that emerged adult sawflies were first seen at the end of October and egg laying was observed between the first week of November and first week of January. Eggs are laid in rows within the leaf petioles. Young larvae feed gregariously on the leaf surface whilst older larvae feed singly or in small, scattered groups, leaving just the leaf veins uneaten. Larvae of a range of instars were recorded feeding from December to March, and we conclude poplar sawfly has one extended generation per annum in Dunedin (Univoltine). An egg parasitoid was observed ovipositing into poplar sawfly eggs, but no parasitoids emerged from those parasitised, suggesting *C. grandis* is not a physiological host. Spider feeding was the only observed predator. Observations of poplar sawfly can be uploaded to INaturalist or using the Find-a-Pest App to assist entomologists with tracking its spread.

Table. Life Stages of the hairy poplar sawfly present on *Populus* species in Dunedin: A Adult, E viable eggs, LG gregariously feeding early instar larvae, LS singular feeding late instar larvae

	OCT	NOV	DEC	JAN	FEB	MAR
Site 1	A	A E	A E LG	A E LG LS	LG LS	LG LS
Site 6		A E	A E LG	E LG LS	LG LS	LS

Historical Araneae data as a tool for measuring how spider populations react to long term shifts in the New Zealand habitat

Crofts-Bennett, J.D.[1], Vink, C.J.[2], Barratt B.[3], Lord, J.M.[1]

[1] *Department of Botany, University of Otago, Dunedin, New Zealand*
[2] *Department of Pest Management and Conservation, Lincoln University, Lincoln, New Zealand*
[3] *AgResearch Invermay, Biocontrol, Biosecurity and Bioprocessing, Mosgiel, New Zealand*
Presenter email: croja073@student.otago.ac.nz

Rising concerns with global declines in invertebrate numbers is a wakeup call for experts the world over to start reviewing their own groups of interest. Spiders are a crucial ecological key group that are overlooked with regards to the impact of changing environments and have only recently entered the global spotlight as a potentially at-risk group. Establishing any solid data on spider populations will require an extensive review of previous collections, particularly historical collections such as the Forster spider collection, held at Otago Museum. Raymond Robert Forster's (1922-2000) lifetime of work was dedicated to New Zealand spider taxonomy, and expanded significantly upon the earlier works of New Zealand arachnologists such as Charles Walckenaer. The Forster collection could play a crucial role in understanding how spiders have been affected by environmental changes in New Zealand. Major long-term environmental shifts in New Zealand range from anthropogenic impacts on habitat availability (urbanization, resource collection, agriculture) and the introduction of exotic mammals (rats, mice and cats) to impacts of global climate change. The overall effect of these factors on New Zealand's spider populations is largely unknown. This reflects the lack of information available on spider ecology in New Zealand and is exacerbated by the gaps in the taxonomic record (between 30 to 40% of New Zealand's spiders are not formally described). An analysis of the information provided by historic collections, combined with a deeper understanding of spider diversity and endemism could provide urgently needed information on the presence and patterns of spider decline in New Zealand

The effect of warming temperatures on the physiology and behaviour of pollinating insects

Devenish, R.[1], Painting, C.J.[1], Barnes, A.[1]

[1] *University of Waikato, Te Aka Mātuatua School of Science, Hamilton, New Zealand*
Presenter email: rd93@students.waikato.ac.nz

Pollination is a vital ecosystem service that is at risk of changes driven by climate change. Most research on this issue has focused on phenological shifts (resulting in temporal mismatches between pollinators and plants), while the influence of warming on insect metabolism and pollination behaviour has not received equal attention. Additionally, the effect of warming on metabolic and behavioural niche complementarity among multiple pollinator species is unknown. Identifying complementary physiological (e.g., metabolism) and behavioural traits, and their responses to warming could allow the prediction of the stability of pollination services in a warming world. Our research will test the hypothesis that changing temperatures will differentially affect pollinator metabolism and behaviour, thus driving physiological and behavioural niche complementarity. I will examine this hypothesis by experimentally studying the patterns of visitation behaviour and metabolic scaling in four different pollinator species (*Apis mellifera*, *Bombus terrestris*, *Eristalis tenax*, and *Lucilia sericata*) across a range of temperatures that represent a rise in average and maximum temperatures across New Zealand. Ultimately, our results could provide meaningful insights into individual responses of pollinator behaviour and physiology to climate warming, and the resulting consequences for physiological and behavioural niche complementarity that controls pollination rates.

Cued in: detecting prey and locating nests by mason wasp *Pison spinolae*

D'Souza, K.[1]

[1] *School of Biological Sciences, University of Auckland, Auckland, New Zealand*
Presenter email: kdso828@aucklanduni.ac.nz

Sensory cues provide crucial information for navigating environments and maintaining predator-prey interactions. Cues received by predators in prey detection and those by which habitats are located have yet been compared, begging the question: are the cues used for prey detection the same as those used to remember habitat locations?

The New Zealand native mason wasp, *Pison spinolae*, provisions nests with orb-weaver spiders, requiring multiple trips to acquire building materials and prey. This project investigates the sensory mechanisms by which prey are identified, and nests are located by female mason wasps. Citizen science will provide nest locations, accompanied by observational studies, nest content surveys and nest site manipulation. Morphological and spectrophotometry measurements of prey and non-prey specimens, as well as chemical assays, will be used to determine and compare cues used for prey detection and nest location.

We hypothesise chemical cues of prey species guide prey detection, but visual markers near nest sites indicate nest location. This research is novel to the species, provides an understanding of the selective role mason wasps play in the ecology and evolution of orb-weavers, and may be broadly applied to studies of nest-location in apoid wasps.

Effect of honey bee abundance on foraging behaviour of New Zealand native bees on mānuka flowers

Fale, G. [1,2], Mortensen, A.N.[1], Sainsbury, J.[1], Pattemore, D.[1], Painting, C.J.[2]

[1] *The New Zealand Institute for Plant and Food Research, Ruakura, New Zealand*
[2] *Te Aka Mātuatua School of Science, University of Waikato, Hamilton, New Zealand*
Presenter email: grant.fale@plantandfood.co.nz

Honey bees *(Apis mellifera)* are effective invaders of new habitats, and, with human assistance, are present on every continent except Antarctica. The impacts of introduced honey bees on native flora and fauna is both popular and complex, especially when considering the economic benefits of honey bee pollination and honey production. Interspecific competition between introduced honey bees and native fauna is unavoidable and likely to occur more with species with similar resource requirements, traits and behaviours, such as native bee species. This study investigates the impact of honey bee abundance on the foraging behaviour of native *Leioproctus* bees on mānuka *(Leptospermum scoparium)* flowers. If competition is present we expect to observe interference competition (interspecific displacement) and exploitative competition (shared pollen and nectar sources) that interplay to expose niche partitioning. Honey bee and *Leioproctus* foraging behaviours and potential competitive interactions were observed at the beginning, middle and end of the flowering season via focal insect observations recording flower visits and insect interactions. Additionally, hourly insect abundance surveys were conducted on transects at each site on the days that behavioural observations were made. Results from the 2020/2021 mānuka flowering season will be presented, and continued work in 2021/2022 will build on the findings.

Web-use and web co-habitation in a sombrero spider (*Stiphidion facetum*) population in Dunedin, New Zealand

Godfrey, S.S.[1], Kemner, P.R.

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
Presenter email: stephanie.godfrey@otago.ac.nz

The sombrero spider (*Stiphidion facetum*) is an Australian sheet web spider that also occurs in New Zealand, and little is known of its behaviour or ecology. In this opportunistic study carried out during the 2020 COVID Lockdown, we observed web use and co-habitation in a population of sombrero spiders in Dunedin, New Zealand. From 25th March to the 28th May 2020, web occupation and co-habitation by sombrero spiders was recorded in daily surveys. Spiders were photographed, and individuals were identified based on the unique pattern markings on their abdomen. Spiders were found co-habiting webs on 11% of observations, and co-habiting spiders were usually male-female pairs. Females were observed more frequently, and, spent longer in a single web, than males. Males spent an average of two days (range 1 - 7 days) co-habiting with a female. The resulting social network was strongly assorted, with male-female dyads making up over 90% of the edge weights in the social network. Our results suggest that sombrero spiders have a prolonged searching polygyny mating system, where males visit multiple female webs and co-habit with females for short periods. Our results provide some of the first insights into the behaviour of this species.

Genomic loupe: using comparative genomics and microbiome analysis to dig into host-parasitoid interaction

Katuwal Bhattarai, M.[1], Doyle, E.[1], Phillips, C.[2], Gemmell, N.J.[1]

[1] *Department of Anatomy, University of Otago, Dunedin, New Zealand*
[2] *AgResearch Lincoln Research Centre, Lincoln, New Zealand*
Presenter email: katma889@student.otago.ac.nz

Sitona obsoletus (CRW), *Listronotus bonariensis* (ASW) and *S. discoideus* (LW) are among the three most invasive exotic forage pests in New Zealand, causing an estimated annual loss up to $600 million. Introduced biocontrol agents, *Microctonus* spp. have varying parasitism success rates and their debilitating performance across these weevils is challenging their stability and sustainability in this unique ecosystem. We are assembling the genome of CRW and LW using short, long and linked reads. Primary assembly of CRW from long reads using wtdbg2 assembler produced total of 12,635 contigs with N50 of 17,442 bp, Megahit assembler from short reads produced 996,405 contigs with N50 of 4,679 bp and a hybrid assembly of long and short reads with Haslr produced 13,739 contigs with N50 of 6,421 bp. Comparative genomics analysis across the completed genomes will enable us to identify the genomic loci for their parasitoids' resistance/susceptibility. Furthermore, comparative microbiome analysis between parasitized vs unparasitized weevils to seek the correlation between host endosymbiont profiles and their susceptibility/resistance to their parasitoid species will be employed. This will be followed by manipulative studies via introducing or removing key endosymbionts. Together, this will provide a comprehensive genomic understanding of these destructive pests for better control strategies.

The effects of population density on mating dynamics in the New Zealand giraffe weevil

Lambert, M.[1], Painting, C. J.[1]

[1]*School of Science, University of Waikato, Hamilton, New Zealand*
Presenter email: ml254@students.waikato.ac.nz

Population density has only recently been considered as a factor influencing mating dynamics. Males may respond to increased levels of population density by increasing their ejaculate size and extending their copulation duration to compensate for increased levels of competition for fertilisation opportunities. However, other studies have shown that some insects decrease their copulation duration in response to high population density, furthering the need for more research. The New Zealand giraffe weevil (*Lasiorhynchus barbicornis*) is a highly sexually dimorphic beetle endemic to New Zealand. Females are polyandrous, and as such males have evolved a large rostrum to be used as a weapon against other males to secure mating opportunities. While males use their rostrum to gain access to females and maintain guarding after copulation, it is not known how variation in population density affects their mating dynamics. Do males adjust their ejaculate size or copulation duration when they perceive differing levels of male competition? Here, I look at how population density affects mating dynamics in the New Zealand giraffe weevil. Males were housed at differing densities and then mating assays were run to measure copulation duration and ejaculate size. Males were fed rhodamine B, a xanthene dye, in a sucrose solution to quantify the ejaculate size by measuring the fluorescent signal emitted in the stored sperm within the female's spermatheca following mating assays. These findings will increase our understanding of how variation in population density can affect the strategies males employ to secure mating and fertilisation opportunities.

Now you see me, Now you don't: Multi-modal camouflage in New Zealand stick insects

Merien, M.[1], Buckley, T. [2], Holwell, G.I.[1]

[1] *University of Auckland, School of Biological Sciences, Auckland, New Zealand*
[2] *Manaaki Whenua – Landcare Research, Auckland, New Zealand*
Presenter email: morganemerien@gmail.com

The appearance of an animal plays an important part in its survival. Camouflage and colour polymorphism has been observed in many species of New Zealand phasmids. However, very little research has been conducted. My research aims to investigate how various species of New Zealand phasmids use camouflage and colour variation. In particular, I am interested in how phasmids are perceived by other animals, especially predators such as birds. Are the stick insects blending into their environment and going undetected, which is a strategy called background matching, or are they mimicking a stick and being mistaken for one, which is a different strategy called masquerade. To find out, I wanted to be able to understand what other animals see when looking at a stick insect in its natural environment. Using a modified camera, UV & UV-pass filters and a specialised software, we were able to model various animal vision onto photos. We can then objectively measure the colour of the background to the colour of the stick insects and understand what an animal such as a bird would see. We also modelled human vision to compare between the two.

The role of personality and assessment strategy switching in shaping the contest dynamics of *Teleogryllus commodus* crickets

Mills, L.D.[1], Painting, C. J.[1]

[1] *Te Aka Mātuatua School of Science, University of Waikato, Hamilton, New Zealand*
Presenter email: laramills987@gmail.com

Physical conflict between conspecifics due to competition over limited resources are common in many species. Contests tend to end before fatality, indicating that rivals employ a strategy to decide when to pull out of the contest. Evolutionary game theory has been used since the 1970's to model strategies for when an individual should give up during a contest. Currently, there are two main categories for these models, self-assessment and mutual assessment. The primary difference in these models is whether individuals are able to judge the resource holding potential (RHP) of their rival or withdraw when they reach an internal threshold. Empirical studies of the models have led to mixed results as to whether species use self-assessment models or mutual assessment models to inform their withdrawal decisions. These inconsistent results may be due to the possibility that individuals switch between assessment strategies as contests escalate. Additionally, very few studies have investigated the role that personality has in affecting contest dynamics and the assessment strategy used. In this study I will investigate the effect of personality on the assessment strategy used by *Teleogryllus commodus* during conflict, as well as examining whether a switch in assessment strategy occurs when contests are escalated.

Rapid evolution of olfactory degradation in recently flightless insects

Neupert, S.[1], McCulloch, G.A.[1], Foster, B.J.[1], Waters, J.M.[1], Szyszka, P.[1]

[1] *Department of Zoology, University of Otago, Dunedin, New Zealand*
Presenter email: paul.szyszka@otago.ac.nz

Fast-moving animals need fast-acting sensory systems. Flying insects have thus evolved exceptionally fast senses. For example, flighted insects can track the temporal structure of odour plumes at rates above 100 Hz. The evolutionary lability of this temporal olfactory acuity, however, remains unknown. We test for evolutionary shifts in olfactory acuity associated with flight loss, through comparisons of sympatric flighted versus flightless lineages within a wing-polymorphic stonefly species.

Our analyses of olfactory receptor neuron responses reveal that recently-evolved flightless lineages have degraded olfactory acuity. By comparing flighted versus flightless ecotypes with similar genetic backgrounds, we eliminate other confounding factors that might have affected the evolution of their olfactory reception mechanisms. Our detection of different patterns of degraded olfactory response strength and speed in independently wing-reduced lineages suggests parallel evolution of sensory degradation.

These reductions in sensory acuity also echo the rapid vestigialization of wings themselves, and represent a neurobiological parallel to the convergent phenotypic shifts seen under sharp selective gradients in other systems (e.g. parallel loss of vision in cave fauna). Our study provides evidence for the hypothesis that flight poses a selective pressure on the speed and strength of olfactory receptor neuron responses.

Are there differences in antipredatory behaviours between the two colour morphs of the mountain stone wētā?

Thompson, C.[1], Wehi, P.[2], and Johnson, S.L.[1]

[1] *Department of Zoology, University of Otago, New Zealand*
[2] *Centre for Sustainability, University of Otago, New Zealand*
Corresponding email: sheri.johnson@otago.ac.nz

A robust understanding of an organisms behavioural and ecological characteristics is an integral part of conservation; unfortunately, many of New Zealand's native insect fauna still show a degree of data deficiency in these areas. The mountain stone wētā (*Hemideina maori*) possesses two distinct colour morphs, melanic and yellow, though the reason for this distinction is unclear. This study aims to compare the antipredatory behaviours of the two morphs, in order to infer how both morphs may respond to predation in the wild. 42 wētā were collected from the Rock and Pillar Range in Otago and housed at the University of Otago. Video recordings were used to record activity and refuge seeking behaviours, and will be processed using EthoVison XT, behavioural quantification software. Defensive behaviours were also measured using a "poke test", where individuals were probed until a defensive behaviour was displayed. We anticipate that this study will provide important insight into how this species responds to predation, and will help inform future conservation of these two wētā morphs.

A modern revision and identification guide for endemic *Mycetophila* (Mycetophilidae)

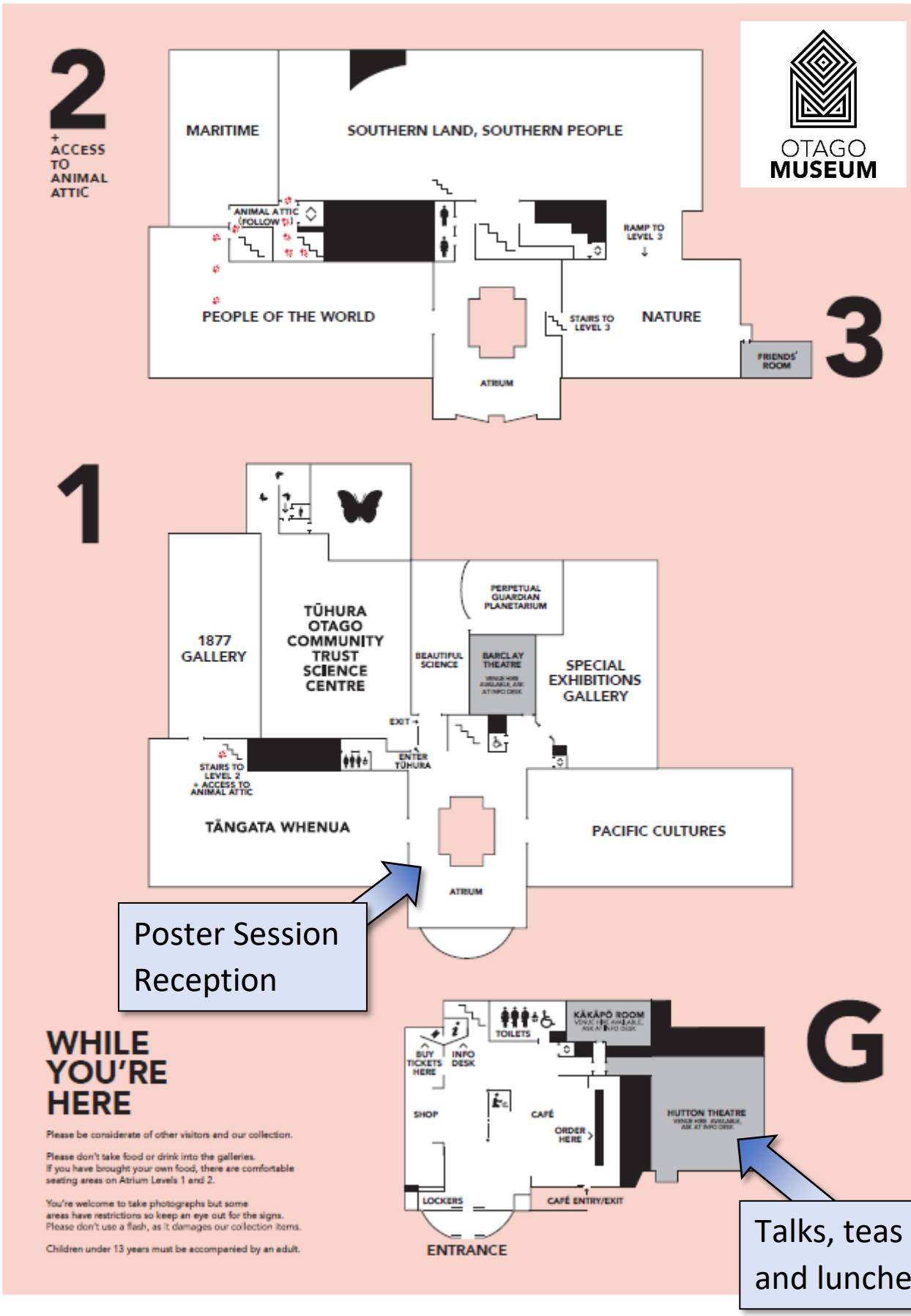
Thompson, S.A.[1], Kasper, J.[1],

[1]*The Museum of New Zealand Te Papa Tongawera, Wellington, New Zealand*
Presenter email: shaun.thompson@tepapa.govt.nz

The genus *Mycetophila* is a globally widespread group of fungus gnats. While New Zealand has a rich fauna of endemic species, they show a poor morphological variety. This makes the identification on species level difficult. Introduction of exotic fungus gnats could be unnoticed as well as the abundance of undescribed endemic species due to little research on this group, and a lack of sampling records.

Taxonomic and genetic work for this group that leads eventually to a new identification key and a phylogenetic tree is needed because fungus gnat diversity could be an indicator for forest health as some species are host specific when it comes to pollination of native of plants such as orchids. The loss of these endemic species could lead to the loss of their host plants, whereas the presence of introduced fungus gnats could be a risk to our plants and agriculture. Larvae, can damage mushrooms, roots and stunt plant growth.

Therefore, we are sampling systematically across New Zealand to better understand their distribution. Additionally, we are using Lucid software to create a simple identification guide for New Zealand's *Mycetophila* with clear photographs of every species, to allow easier identification. Once completed, the digital identification guide will be freely available online.


2
+ ACCESS TO ANIMAL ATTIC
MARITIME
SOUTHERN LAND, SOUTHERN PEOPLE
ANIMAL ATTIC (FOLLOW)
RAMP TO LEVEL 3
PEOPLE OF THE WORLD
STAIRS TO LEVEL 3
NATURE
FRIENDS' ROOM
ATRIUM
3
OTAGO MUSEUM
1
1877 GALLERY
TŪHURA OTAGO COMMUNITY TRUST SCIENCE CENTRE
PERPETUAL GUARDIAN PLANETARIUM
BEAUTIFUL SCIENCE
BARCLAY THEATRE
SPECIAL EXHIBITIONS GALLERY
EXIT
ENTER TŪHURA
STAIRS TO LEVEL 2 + ACCESS TO ANIMAL ATTIC
TĀNGATA WHENUA
PACIFIC CULTURES
ATRIUM
Poster Session Reception
WHILE YOU'RE HERE
Please be considerate of other visitors and our collection.
Please don't take food or drink into the galleries. If you have brought your own food, there are comfortable seating areas on Atrium Levels 1 and 2.
You're welcome to take photographs but some areas have restrictions so keep an eye out for the signs. Please don't use a flash, as it damages our collection items.
Children under 13 years must be accompanied by an adult.
TOILETS
KĀKĀPŌ ROOM
BUY TICKETS HERE
INFO DESK
SHOP
CAFÉ
ORDER HERE
HUTTON THEATRE
LOCKERS
CAFÉ ENTRY/EXIT
ENTRANCE
G
Talks, teas and lunches

Conference Venues