Who is looking after our entomological “canary” in the agrochemical coal mine?

John A. McLean [*1]

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The honey bee is the major pollinator among a cadre of insects which perform the important function of pollination that provides us with much of our food supply. A current estimate is that the honey bee contributes food and services supporting $5.1 billion of primary production in New Zealand. The honey products we all enjoy are just a fraction of the value of pollination of fruits, flowers and nitrogen fixing clovers in agriculture that bees perform. Packages of New Zealand bees are regularly sent to North America to support their pollination industry. In New Zealand, the Varroa mite, accidentally introduced to New Zealand in 1990, has every beekeeper maintaining strict hive hygiene supplemented by the use of synthetic pyrethroids and organic compounds such as thymol and oxalic acid to keep the mite under control. Hives are also regularly inspected for American Foul Brood and other diseases. The in-hive regime is a stressor that amplifies any other stressor that is brought back to the hive by foragers as they harvest pollen and nectar from plants treated with systemic insecticides. Little notice seems to be given to the critical role that non-volatile pheromones of bees play in keeping a hive operating smoothly. An example will be given of the threat that a registered product that accumulates in crop pollens has on brood health in a beehive.

Like fire, can computer technology be a good servant, but a bad master? A Referee's experience with on-line reviewing

Alan Eyles [*1]

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Overall the editing process/reviewing system is very good. I like it. The various authors are at different stages: some beginners or relative beginners, some 'journeymen,' and some very experienced with a good record of good published papers. Yet all authors need and appreciate helpful suggestions/comments on ways of improving the MS because one person can't (always) think of everything. That is why the system is so good, with two referees and Editor/Associate Editor looking at things, sometimes from slightly different angles, all leading to improvements. If only authors would pay the same meticulous attention to detail in the preparation of the MS as they do to the study of the insects. That is the outcome we are all trying to encourage. That is how the process works, right?

The impact of fire on tussock grassland invertebrates

Barbara Barratt [*1], Colin Ferguson [1], Diane Barton [1], Peter Johnstone [1]

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The impacts of burning on two tussock grassland invertebrate communities in the southern South Island of New Zealand were investigated between 1998 and 2006. At each site three replicate 1-ha plots of either unburned (control), spring- or late summer-burns were quantitatively sampled. Pre- and post-burn sampling compared invertebrate densities and trophic group structure in inter-tussock and tussock samples, and recovery after treatment. Most invertebrate groups were initially reduced in density immediately after the fires. The herbivore groups Thysanoptera (thrips) and Hemiptera (true bugs) ‘rebounded’ and reached higher population densities than before the fires in the 1–2 year period after the burns took place. The litter-dwelling detritivores such as the Myriopoda (particularly millipedes) exhibited a delayed response and took 2-3 years to recover to pre-burn densities at one site, and had not recovered at the other site 3 years after the fire. Amphipoda (bush hoppers) were the most severely affected group, failing to recover to pre-burn densities at either site three years after the fire. When Amphipoda were re-sampled in 2009, eight years after burning, recovery had still not occurred at one of the sites. In general, herbivore population density recovered over a 2–3 year period, and litter-dwelling invertebrate population densities were most negatively impacted. Season of treatment had no major impact on invertebrate responses in general, but fire intensity was a more important factor.

Rearing insects: Some personal insights

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In the past 30 years Lepidoptera, Chrysomelids, Curculionids, Psyllids, Tephritids, Acarina, Coleoptera, Thrips, Tingids and Hymenoptera insects have been successfully reared as part of the biological control of weeds. Here are some lessons learnt along the way. Moisture is always important, pairing of adults can influence oviposition and fecundity, cage size, lighting and heating regimes and food supplies can all influence the success or failure of rearing insects. The paper gives some general criteria that may help those involved in rearing insects.

How clasper morphology relates to genetic and behavioural isolation in the New Zealand Stick Insect genus Clitarchus

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A hybrid zone is the geographic area where two species meet and form offspring. It is common for the offspring of hybridising species to have reduced fitness. The theory of reinforcement predicts that prezygotic barriers will evolve between hybridising groups and there will be selection against hybridisation. In the Far North of New Zealand, the widely-distributed stick insect species C. hookeri is replaced by an ecologically similar and undescribed species of Clitarchus. These species are differentiated on the basis of male terminalia (specifically the claspers), egg morphology and mitochondrial DNA. Populations sampled between the two species show intermediate morphology. The aim of this research project is to describe the level of isolation between species of Clitarchus using interdisplinary techniques including behavioural studies, genetics and morphology. Genetic divergence and gene flow is being measured using SNP data obtained from 454 genomic reduction sequencing. Three dimensional morphometrics accurately describes differences in intra and inter-specific clasper shape. These quantitative approaches are being combined with mating experiments to provide a basis for addressing the following questions: does variation in morphology correspond to differences in mating behaviour and does morphological variation correlate with reproductive isolation?

What bugs are knocking on New Zealand’s doors? An analysis of ten years of border interception data

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Thousands of organisms are intercepted at New Zealand’s borders every year. To have a full picture of these interceptions we analysed MAF’s Laboratory Information Management System (LIMS) databases from 1 Jan 2001 through 31 Dec 2011. Of more than 36,500 organisms intercepted, 94.4% were from the following top ten taxa categories: mites (Acari, 24.9%), insects (Hemiptera, 21.1%; Diptera 16.0%; Coleoptera, 7.4%; Hymenoptera, 6.8%; Lepidoptera, 6.5%; Thysanoptera, 4.6%; and Neuroptera, 1.4%), spiders (Araneae, 3.9%) and snails and slugs (Gastropoda, 1.8 %). They were found mainly (in decreasing order) on taro (Colocasia esculenta), banana (Musa spp.), orange (Citrus sinensis), rockmelon (Cucumis melo), lime (Citrus aurantiifolia & latifolia), yam (Dioscorea atata), pineapple (Ananas comosus), ginger (Zingiber officinale), capsicum (Capsicum annuum) and asparagus (Asparagus officinalis) imported from Australia, Fiji, USA, Phillipines, Ecuador, Tonga, Samoa, Japan, Chile and Canada. The relationship between the ten taxa categories, their origins and hosts was consistent with a few minor variations between years. This analysis may provide insight into the prediction of interceptions for border quarantine management.

Genetic variation in Moroccan specimens of Microctonus aethiopoides, a widespread weevil parasitoid

Cor Vink [*1], Barbara Barratt [1], Craig Phillips [1], Diane Barton [1]

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Microctonus aethiopoides Loan (Hymenoptera: Braconidae) was introduced from Morocco to Australia and New Zealand for biological control of the lucerne pest, Sitona discoideus. Previous research has indicated that M. aethiopoides intraspecific genetic variation is more strongly associated with weevil host species than geographic origin. Cytochrome c oxidase subunit 1 (COI) sequences from parasitoids dissected from weevils collected during a survey of lucerne-growing areas in Morocco allowed us to further test this hypothesis. As found previously, there were two strong clades in M. aethiopoides with no geographical basis to this structure. Earlier research suggested that intraspecific variability within M. aethiopoides was related to weevil host genus (Sitona vs. Hypera), and the analysis confirmed that one of the clades corresponded strongly with the host Sitona discoideus. The other clade, however, previously characterised by parasitoids from Hypera postica also included parasitoids dissected from Charagmus spp., which is a sister genus to Sitona. It is suggested that food plant associations of the host weevils might have had an influence on the evolutionary history of the parasitoid.

Cryptotermes brevis (Isoptera: Kalotermitidae): – dealings with an illegal immigrant in New Zealand

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Cryptotermes brevis, the West Indian Drywood Termite, was detected in New Zealand at a residential property in 2011. Originally a native of South America it now occurs throughout the world and is considered one of the world's most destructive drywood termites. The detection of this species resulted in MAF undertaking response actions to eradicate C. brevis from New Zealand. This presentation will outline the potential impact of C. brevis establishing in New Zealand, response actions taken and the challenges faced by MAF in dealing with this incursion.

The role of olfactory and visual cues in host finding by pine bark beetles and wood borers

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The pine bark beetles Hylastes ater and Hylurgus ligniperda and the longhorn beetle Arhopalus ferus are economically important, invasive forest and timber insect pests of coniferous tree species. Accidentally introduced from Europe to New Zealand, these insects are abundant within plantation forests, making them good experimental systems for testing theory about insect host location. We conducted a large-scale trapping trial near Nelson to examine the extent such beetles use olfactory cues (e.g. monoterpenes emitted by conifers) and visual cues (e.g. the colour and silhouette of trees) to find host material. Our aim was to provide new information on attractant and repellent stimuli to improve the understanding of host selection in such insects, refine monitoring methods, and to devise new tools for the management of wood borers and bark beetles. The results of the trial indicated significant effects of both visual and olfactory cues for all three species. The highest trap catch was to black (host mimicking) and red panel flight-intercept traps, containing attractant (α-pinene and ethanol) and the lowest in clear or white traps without visual host stimuli or attractants. Candidate repellent, green leaf volatiles, when present on traps with attractant, significantly reduced catches of H. ater and H. ligniperda, but had no significant effect on A. ferus. Non-host volatiles occurring in natural landscapes could have the potential to act as repellents, lowering pest outbreaks in more diverse vegetation compared to monocultures. Future research should explore the use of repellents from natural vegetation resources that could influence host finding in wood borers and bark beetles.

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The effect of density on alternative mating tactics in the New Zealand giraffe weevil

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Many animal species have evolved weaponry as a means to resolve conflict between conspecifics in the acquisition of mates. In those species with high size variation, it is common for there to be alternative mating tactics (ARTs), where dominant individuals behave differently to subordinate males during mate searching and copulation. Despite these ARTs, subordinate males are usually thought to have a lower mating success than dominant males, and are simply making the best of a bad situation. Males of the giraffe weevil (Lasiorhynchus barbicornis) possess greatly elongated rostrums used as weapons during contests with other males for access to females. However, adult males are also highly size variable such that there is a 6-fold difference between the smallest and largest equivalent-aged individuals. This has led to the evolution of ARTs, where small males, in addition to using their rostrum to fight, will also use sneaking tactics to copulate with females while larger males stand guard. We previously found that at high densities there was no difference in relative mating success between males of different sizes, despite the expectation that large males would have the competitive advantage. We suggest that at high densities defence-based competition breaks down to scramble competition. To investigate the influence of both seasonal and local density on the relative mating success of different sized individuals, we conducted an extensive series of field-based observations between November 2011 and March 2012. These observations will lead us to further understand mating behaviour in the context of ARTs and weapon use.

Responding to Coptotermes acinaciformis detections in New Zealand

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n the past six years the Ministry of Agriculture and Forestry has responded to several detections of the Australian subterranean termite Coptotermes acinaciformis (Isoptera: Rhinotermitidae) in New Zealand. The Ministry’s work against this exotic pest will be presented, as will details of a passive surveillance initiative currently underway to detect further subterranean termite activity in New Zealand.KeywordsCoptotermes acinaciformis, Termites, passive surveillance

Enhancement of Biosecurity and Quarantine Services in Pacific Island Countries

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Enhancement of Biosecurity and Quarantine Services in Pacific Island Countries. Lalith Kumarasinghe, Disna Gunawardana and Sherly George Plant Health & Environment Laboratory, Ministry of Agriculture and Forestry, PO Box 2095, Auckland, 1140. E-mail: lalith.kumarasinghe@maf.govt.nz KeywordsBiosecurity, quarantine, diagnostics, Pacific Island Countries, Ministry of Agriculture and Forestry, New Zealand AID AbstractIn August 2010 MAF, along with Landcare Research, secured three years of funding from the Ministry of Foreign Affairs and Trade's New Zealand AID programme. The funding supported a project to fortify the Biosecurity and Quarantine services in six Pacific Island Countries (PICs). The project focus is to build diagnostic capability to efficiently tackle biosecurity threats associated with production and export of key commercial agricultural crops. During 2011 basic taxonomic training was imparted to 41 biosecurity officers from different agencies in Samoa, Tonga and the Solomon Islands. The next set of training in 2012/13 will focus on biosecurity officers in Vanuatu, Fiji and Tuvalu. Development of a New Zealand Biosecurity section on the Pest and Disease Image Library (PaDIL: http://www.padil.gov.au/maf-border/Search?queryType=all) website was also accomplished under this project. The training programme and tools developed by MAF in this area of capability development will be discussed and presented.

Two Orthopteran species recently established in Northland, New Zealand: Austrosalomona falcata (Tettigoniidae) and Pterapotrechus sp. (Gryllacrididae).

Olwyn R. Green [*1]

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This paper reports the establishment of the Australian species Austrosalomona falcata (Redtenbacher, 1891) (Orthoptera: Tettigoniidae) an addition to the New Zealand fauna in Northland. The Australian katydid has been collected from two Northland locations on three occasions - 2007, 2008 and 2011, confirming its survival in New Zealand.Additional distribution records of another Australian, a species of Pterapotrechus (Orthoptera; Gryllacrididae) now includes one sighting at Langs Beach, Northland in 2008. This 'winged weta' has previously been reported from Pukekohe since 1990 and Whangapoua on the Coromandel Peninsula in 1997.

A STRATEGY FOR REVEALING CRYPTIC BEASTIES: SOME THOUGHTS ON THE VALUE OF EMERGENCE CAGES.

George Gibbs [*1]

[1] Victoria University

An emergence cage refers to any tent-like device that can intercept flying insects emerging from a natural substrate (e.g pond or stream, pasture, forest floor etc.) or, in my case, for revealing very difficult-to-find adults of an insect where the larva is easier to find than the adult. A quest for fresh specimens of two ‘intractable’ new species of the jaw-moth Sabatinca (Micropterigidae) over the past 12 months led me to gather bulk samples of larval habitat (periphyton: the moss and liverwort carpet over rocks, logs, tree trunks etc) at the most appropriate time of year from the known larval site; place it in emergence cages, and await emergences. Early detective work to ascertain foodplants, locality and season are an essential part of the strategy. Conclusion: there is still a place for natural history investigations in modern biology.

Fooling flies with dung mimicry: New Zealand & Tasmanian Splachnaceae mosses

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Bryophytes and are not well known for their dynamic interactions with animals but microarthropods and insects can be important vectors for dispersing moss sperm and spores. Splachnaceae mosses provide no rewards for their insect visitors, and instead appear to actively attract and exploit insects with deceptive mimicry. Splachnaceae mosses uniquely grow only on decaying carcasses, bone, or dung. This scarce and patchily distributed habitat may be difficult for most mosses to colonise given their reliance on passive dispersal by water. To achieve dispersal, apparently primitive Splachnaceae appear to have sophisticated adaptations that attract and exploit flies, much like Asia's famous carrion-mimicking Rafflesia flowers. We tested for dung and carrion mimicry and insect exploitation by NZ and Tasmanian Splachnaceae mosses. We used gas chromatography–mass spectrometry to compare the appalling rotting odours of the moss spores and sporophytes with odours produced by gametophytes, underlying rotten substrates, fresh carnivore and herbivore dung, and synthetic compounds typically associated with carrion-mimicry by other plants. In the field, insects visiting moss, carrion, and fresh herbivore and carnivore dung, were trapped with hand nets, bottle traps and pitfall traps. These investigations revealed the importance of New Zealand's native fly and dung beetle fauna in interactions with bryophytes.

FOSTERING THE FRENCH CONNECTION: ZEALANDIAN JAW-MOTH BIOGEOGRAPHY

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Micropterigids are a world-wide family, known from New Zealand since 1863 and with 19 species now recorded. By 1985 three species had been recorded from New Caledonia but today the total is nearer 65 species, still with only five described. Almost all these Zealandian jaw-moths are in the genus Sabatinca and represent a prolific radiation on the 93% submerged continent of Zealandia. Molecular phylogenetic analysis of this fauna, with substantial fossil calibration, indicates that these tiny archaeic moths are close to ideal organisms for historical biogeographic study. Their story offers not only clues to the history of these modern Zealandian islands from the opening of the Tasman Sea, to the possibility of land between New Zealand and New Caledonia, but also to the drowning myths concerning both modern islands and currently receiving much media attention... as well as some tempting French indulgence. This progress report summarises the contribution micro-jaw-moths can make to the historic biogeography of this region.

New insights from re-examining labels and old specimens of the New Zealand black fly, Austrosimulium australense (Schiner) (Diptera: Simuliidae)

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Re-examination of labels with important, old specimens of the New Zealand black fly, Austrosimulium australense (Schiner, 1868), held in Vienna (NHMW), Berlin (ZMHU), London (BMNH), and Auckland (NZAC) has revealed new information surrounding the taxonomic and collecting events associated with these specimens.The species australense was the first simuliid described in the Australasian Region when described as part of the “Novara” expedition publication by Schiner (NHMW). Tonnoir, based in Nelson, examined a specimen from Vienna for his 1925 revision of Australasian species, and placed it in his new genus Austrosimulium as the type-species for the genus: his placement has been accepted by nearly all subsequent researchers. An exception was Enderlein in Berlin, and we now know his 1930 assignment to the European genus Wilhelmia Enderlein was based on his examination of the same specimens in Vienna, but using alternative characters he favoured for defining genera.Literature suggests that a single simuliid specimen was collected from the Bay of Islands in the early 1840s and deposited in BMNH, and has been referred to by the nomen nudum ‘caecutiens Walker’. An unexpected discovery was this record, rather than referring to a single specimen, was in fact a pillbox containing about 450 specimens, all now confirmed as australense. We believe these specimens were collected by Colonial Secretary Sinclair near Waimate North about September 1844, when he was there with Governor FitzRoy for a peace conference resulting from Hone Heke’s cutting down of the flagstaff on Maiki Hill, Kororareka on 8 July 1844.crosbyt@landcareresearch.co.nzdcraig@ualberta.ca

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Dragonfly (Anisoptera:Odonata) diversity from the northern Meta region of Colombia.

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The Dragonflies (Odonata: Anisoptera) are highly diverse in the tropics, representing a major predatory component of ecosystems at both the larval and adult stages. We assessed diversity of dragonflies (Anisoptera : Odonata), for 14 sampling sites in the north of Meta region of Colombia, South America. Sampling took place biannually during May and November for 2003-2011. All the collected material was preserved in acetone immersion for 12 hours and identified to species. We collected 946 individuals from 86 species representing three families: Libellulidae, Aeshnidae and Gomphidae. These ranged from the highly abundant Uracis imbuta (Libellulidae) representing 237 collected specimens with a large distribution in the localities, through to species where only a single individual was collected. We compared the previous study lists made in the country and we report for the first time 17 new reports for the country and 15 new reports for Meta region.

Sexual conflict among the lichen tuft moths.

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Insect species display extraordinary variation in male genital morphology therefore; genital evolution is rapid and divergent. Previous assumptions for diversification in genital morphology were based on species isolation and pleiotropy, but subsequent comparative research has failed to support these hypotheses. Recent comparative and experimental research has proposed sexual selection to be the most likely driver of rapid and divergent evolution of genitalia, either via sperm competition, cryptic female choice, or sexual conflict. Sexual conflict may drive genital evolution through opposing selection of male and female reproductive strategies as genital adaptations that allow males a competitive advantage may consequently reduce female fitness leading to an evolutionary arms race via sexually antagonistic co-evolution (SAC). Lichen tuft moths of the genus Izatha (Lepidoptera: Oecophoridae) are excellent candidates for exploring the potential for sexual conflict to drive genital evolution, as some males have detachable spines (deciduous cornuti) which are ejected into the female reproductive tract during their first mating, apparently causing damage. Some species lack deciduous cornuti, but have permanently attached sclerotised teeth on the phallus, whilst others lack these structures all together. Here I present a molecular and morphological phylogenetic analysis of the genus that provides insight into the evolution of these complex genitalic adaptations. Genital complexity appears to have evolved along multiple paths, via the modification of different genital structures. Izatha therefore may represent an ideal model for the study of genital evolution.

A novel fluorescence-based multiplex real-time PCR assay for rapid and simultaneous detection of leafminers

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Liriomyza spp. are leafminer pests associated with imported fresh produce, plants and other commodities. Rapid and precise identification of juvenile individuals of Liriomyza spp. is of crucial importance to enable appropriate biosecurity decisions to be made at the border or post-border. We have developed a multiplex TaqMan real-time PCR assay that can simultaneously detect Liriomyza huidobrensis, L. sativae and L. trifolii in a single test. Species-specific primers and probes were designed against existing genomic sequences within the mitochondrial cytochrome oxidase I gene. The real-time assay was specific for L. trifolii, L. huidobrensis or L. sativae, both in simplex and multiplex formats. Serial dilution results showed reliable amplification at a 10^{-4} dilution (1 pg of DNA) and generally even at 10^{-5} dilutions (0.1 pg), which allows the possibility of using only a small amount of tissue for DNA extraction.

Scramble competition and sperm competition in a sexually cannibalistic praying mantis

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In species where males do not actively fight for access to females, competition between males largely consists of a race to locate their mates (scramble competition) and to fertilise their eggs (sperm competition). Scramble competition polygyny is perhaps the most common mating system in insects, and yet the factors influencing its evolution are largely unstudied. The sexually cannibalistic praying mantis, Pseudomantis albofimbriata exhibits a polygynous mating system, and females are highly cannibalistic, consuming approximately 40% of males encountered. In this species, both scramble competition and sperm competition therefore interact with the cannibalistic nature of females to determine the optimal mating strategy for males. Here, I will describe some recent research on P. albofimbriata demonstrating (a) last-male sperm precedence and (b) greater attraction to unmated females. I also show that when males are kept under conditions of high perceived risk of competition, they (b) develop to maturity more slowly, and (d) transfer larger ejaculates. Together, these results show that different components of male competition can interact in intriguing ways to determine the strategies that males use to maximize reproductive success.

The tick fauna of the New Zealand subregion: Recent additions, misidentifications and associated gaps in our knowledge.

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The New Zealand tick fauna (Acarina: Ixodidae, Argasidae) is currently in a state of flux through additions and a misidentification. Two recent findings of Ixodes amersoni Kohls, 1966 and description of a Carios sp. (Argasidae) from the New Zealand lesser short-tailed bat (Mystacina tuberculata Grey, 1843) brings the number of tick species in the New Zealand subregion to eleven. Ixodes amersoni is represented by two females collected from the Kermadec Island group. Little is known about the biology of this tick and all other life stages are yet to be described. Similarly little is known about the biology of a newly described soft tick, Carios sp. with formal publication of the description due later this year. This tick has been collected in the North Island on only two occasions. The scarcity of knowledge of the behaviour and biology of both I. amersoni and the new bat tick is not surprising given the isolation of the former and difficulty in accessing and relative rarity of hosts for the latter. Another member of the fauna, I. jacksoni Hoogstraal, 1967, previously considered rare may actually be more common than was once thought. Specimens have previously been misidentified as I. uriae, a very similar species. Further collecting and our enhanced ability to recognize I. jacksoni confirms its only known host to be the spotted cormorant (Stictocarbo punctatus punctatus Sparrman, 1786) which furthermore has a widespread distribution. Filling these knowledge gaps is important to our understanding of the biodiversity of the New Zealand fauna.

Dispersal behaviour of the parasitic wasp Cotesia urabae Austin and Allen (Hymenoptera: Braconidae): a recently introduced biocontrol agent to fight the gumleaf skeletoniser Uraba lugens Walker (Lepidoptera: Nolidae) in New Zealand

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Biological control programs provide a great opportunity to study the ecology of the introduced agent in its new environment. Since the species being introduced is not present in the new ecosystem, one of the most interesting aspects to study is its rate of dispersal. Estimates of the dispersal rate of the biocontrol agent in its new environment are vital to understanding its relative searching capacity, and to foresee the maximum area that could be covered in a parasitoids' release event. The objective of this experiment is to study the dispersal behaviour of one generation of the recently introduced biocontrol agent Cotesia urabae, to fight the gumleaf skeletoniser Uraba lugens in New Zealand. It was found that C. urabae dispersed up to 20 m away from the release point and was most successful parasitizing hosts located no more than 5 m from the release point. A high level of parasitism was observed at the epicentre itself (81.5%) which suggests that most of the females released stayed in the release tree. According to the dispersal model adjusted from the data collected, Cotesia would be able to disperse up to 53 m in one release event. Additionally, statistically significant differences ($P < 0.001$) were found between the different directions tested for dispersal. These results suggest that wind has a direct effect on the dispersal behaviour of C. urabae in the field, showing a clear downwind dispersal, in this case to NE and E directions.

New Zealand cave weta biodiversity (Rhaphidophoridae)

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New Zealand cave weta are a diverse group, falling into 16 genera and approximately 55 species. The exact number of species is difficult to assess as many are yet to be discovered and described. Our research focuses on developing morphological tools to diagnose genera and species, using large samples that encompass the full variation within populations and species. Characters that will distinguish genera and species are best if they can be applied to juveniles and adults of either sex. Using DNA sequencing, we will be able to ensure that the morphological traits we focus on are effective in identifying and distinguishing species. Here we present an example of cave weta sampled from the Far North where we see how combining sub-genital plate shape and spine counts can reliably differentiate species in all individuals except early instar stages.

The challenges in demonstrating cause and effect in weed biocontrol: St. John's wort as a case study

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To biocontrol practitioners and land managers, who have reaped the benefits already, biocontrol is a no-brainer. But many others will remain sceptical about biocontrol, until more proof can be provided that biocontrol really can slow or reverse plant invasions. We identified the successful biocontrol programme against St. John's wort (Hypericum perforatum) in NZ as a suitable system to demonstrate a direct cause and effect relationship between the activity of biocontrol agents and population growth (or decline) of the host weed. We found a remnant population of the weed, hosting well established populations of the biocontrol agents (lesser and greater St. John's wort beetles, Chrysolina hyperici and C. quadrigemina) and, over the past two years, treated parts of the population with insecticide to exclude the biocontrol agents. The experiment is on-going (into its third season now), and preliminary results will be presented.

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Effects of mate choice and mate density on mating success in Diaeretiella rapae (Hymenoptera: Aphidiidae)

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Intrasexual competition and intersexual selection are important drivers in the evolution of mating system in parasitoids, in which only female offspring are produced from fertile eggs. Effects of mate age, mating status, body size, density and sex ratio on mating success were investigated in aphid parasitoid Diaeretiella rape by giving mate choices. Females were found more selective than males. Virgin female D. rapae preferred to mate with virgin males, while males were rejected by mated females. In terms of mate body size, large males did not discriminate the females on their body size when offered a large and a small female, and more than 40% them mated with both females. More matings were observed between larger females and larger males despite the higher courtship display by smaller males. In mate-age choice, younger males mated with younger females. However, older males and females did not show age preference in choosing mates. Increase in male density caused mating interferences, and decreased the mating probabilities of D. rapae. Furthermore, multiple mating in males changes female-biased population sex ratio to male-biased operational sex ratio which increases male-male competition, and eventually causes mating delay and decreases mating success. In the female-biased sex ratio, females became less selective and accepted males mating attempts. Male-male courtship in D. rapae was observed in the absence of females. This study supports the intrasexual competition among males where D. rapae males eliminate other males from competition by mounting on them, which reduces the other male’s courting and future mating probabilities.

Tokoriro taxonomy - web tool

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New Zealand cave weta (Tokoriro) (Orthoptera: Rhaphidophoridae) are a diverse but poorly studied group. Because cave weta are common in all New Zealand forests and contain a great deal of species diversity they offer an excellent resource for conservation, phylogeography and restoration ecology. However difficulty identifying cave weta genera and species is hampering research. A web based taxonomic tool for cave weta, powered with genetic, morphological and ecological data, will be developed to serve as an informative, simple yet robust online utility. Contemporary software tools considered for designing the website will be discussed. An active engagement with our end-user community is contemplated during the process. The cave weta web tool would enhance public awareness and contribute to species biodiversity informatics while also serving as the primary taxonomic resource for students, researchers and conservation managers working on this group.

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Verdict of the Ultimate Poo Critics: Food Selection and Preference in Native New Zealand Dung Beetles

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Worldwide, dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae) are one of the most extensively researched groups of insects. Unique and diverse feeding habits have been documented in dung beetle taxa across an array of ecosystems and this is recurrently linked to a number of important ecological processes. Conversely, New Zealand's endemic dung beetle fauna is poorly understood, even though these beetles habitually fill entomologists' pitfall traps. The feeding ecology of New Zealand dung beetles is intriguing given the near absence of land mammals in New Zealand's evolutionary history and the importance of mammal dung for most dung beetles elsewhere. It has been hypothesised that New Zealand species use a range of non-mammalian dung resources, and default to saprophagy, although this remains unproven. My research is focused on the feeding ecology of three North Island dung beetle species and seeks to determine their food preference, feeding rate and trophic position. To date I have found that endemic dung beetles vary substantially in food preference across different taxa. One species displays a generalist response to different dung types while the other two species are either highly specific or do not remove dung at all. Further research will expand on our current understanding of feeding behaviour and will investigate factors involved in food selection processes.

Hopping madness: taxonomic troubles with terrestrial Talitridae of Tai Tokerau

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Landhoppers (Crustacea: Amphipoda: Talitridae) are a widespread and diverse presence in New Zealand and other southern lands that once made up Gondwana. However, New Zealand talitrids are not all identified and their biology is poorly studied. Pitfall trapping was conducted in native forest, pine forestry, and shrubland habitats across the Te Paki Ecological District, to study the species composition and ecology of the talitrid fauna. Four species were found to be widespread and abundant in native forest; Waematau kaitaia, W. reinga, W. cf. unuwhao, and an undescribed Puhuruhuru sp. Waematau kaitaia and W. cf. unuwhao were also present at pine forestry and shrubland sites, while W. reinga was absent from these two habitats. Puhuruhuru sp. was found at one shrubland site but not from pine forest sites. Close examination of the landhoppers in this study has made us re-evaluate some aspects of the taxonomy and biology of the species encountered. For example, the species we are calling W. cf. unuwhao is very similar to the described species W. unuwhao, but differs slightly in telson spination. Also, W. unuwhao was considered extremely rare and possibly extinct, whereas W. cf. unuwhao is widespread and fairly common. Similar uncertainties apply to W. reinga. Further morphological study may resolve these uncertainties, but a re-evaluation of some of the characters used to identify New Zealand's talitrids may also be required. In addition, molecular analysis might play an important part in interpreting this apparent variation.

Observations on spider diversity in Tai Tokerau

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Collection of spiders during the 1960's and their subsequent description, chiefly by the late Ray Forster, reveals a rich and distinctive spider fauna in Tai Tokerau. During the last decade we have undertaken surveys in various parts of Tai Tokerau by pitfall trapping and collecting by hand. Comparing results of pitfall trapping and hand collecting at Bream Head showed that the two methods sampled different segments of the spider fauna. Not surprisingly, pitfall trapping tended to catch ground-dwelling species, many with limited geographic ranges, while hand-collecting took species that live above ground, and are widely distributed throughout New Zealand (e.g. araneids and clubionids). Many of the genera of ground-dwelling spiders are predominantly northern in distribution (northern half of the North Island). These include Reinga (Amphinectidae), Artoria (Lycosidae) and Pahoroides (Synotaxidae). Several genera, including Pahoroides, Paramamoea (Amphinectidae), Hapona (Desidae), Uliodon (Zoropsidae) and Hypodrassodes (Gnaphosidae), are notably speciose in Tai Tokerau. At Te Paki representatives of several genera of Hahniidae were much more common than in pitfall collections in other parts of the country. Comparisons in species composition between Bream Head and Te Paki using pitfall traps reveal both similarities (e.g. habitat use by identical or similar species) and differences (e.g. habitat use by Stanwellia spp., and rarity of mysmenids and hahniids at Bream Head) in the two areas. Further study will help us understand more about the fascinating spider diversity of Tai Tokerau.

Impact of native and exotic millipedes on decomposition, nutrient cycling and puriri (Vitex lucens) growth rates in laboratory microcosms

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Litter decomposition and nutrient cycling are key ecosystem functions affecting soil nutrient levels and ecosystem productivity. The decomposer community, comprising micro-organisms and soil invertebrates exerts an important influence on decomposition. However an increasingly important issue in the context of native forest ecosystems is the effect of exotic invertebrates on litter decomposition and nutrient cycling. Exotic invertebrates may compete with native fauna for litter resources but may also alter nutrient cycling in native forests which may affect plant growth. Invertebrate sampling in reserves in North Auckland found that introduced millipedes were abundant in native broadleaf tree litter where they co-existed with native millipedes. This study used a native millipede (Spirobolellus antipodarus) and an exotic species (Oxidus gracilis) alone and in combination to investigate their individual and combined effects on decomposition rates and nutrient cycling in a microcosm experiment. Puriri (Vitex lucens) seedlings were grown in microcosms containing: (1) the native millipede (S. antipodarus); (2) the non-native (O. gracilis); (3) low and (4) high density treatments of both species; and finally, controls without millipedes. The performance of the two millipede species in different treatments was compared as were decomposition rates, soil and foliar nutrient levels, and growth of the puriri seedlings. Both millipede species reproduced during the course of the study and co-existed at high densities without apparent adverse effects. Treatments containing the exotic millipede O. gracilis showed significant differences in decomposition rates and soil nutrient levels compared to treatments without this species.

Nematodes in the native bush ant Prolasius advenus.

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We have observed the native bush ant, Prolasius advenus, to be infected by three different species of nematodes. All three nematodes appear new to science. They appear to have a widespread distribution through the New Zealand range of bush ants. A high proportion of ant colonies are infected, and within some colonies ant infection rates of up to 37% have been observed. In laboratory trials we have managed to infect other ants with these nematodes. The nematodes may thus be present in a range of different ants. In this talk I will discuss this ant-nematode relationship and its potential influence on ant populations.

Has the ecological importance of scale insects been neglected as a restoration strategy in New Zealand forest ecosystems?

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The ecological importance of scale insects as keystone species has been widely documented both in New Zealand and worldwide. Although numerous studies have already examined key interactions within New Zealand honeydew forest ecosystems, large knowledge gaps still remain surrounding the trophic interactions of endemic scale insect Coelostomidia zealandica (Coelostomidiidae) with organisms, especially endemic herpetofauna. Anthropogenic changes have caused significant reductions in range and abundance of this endemic scale insect species and its associated fauna. The study site on Korapuki Island, east of Coromandel peninsula is now one of the sole remaining sites in New Zealand where C. zealandica and honeydew exploiters, such as insects and herpetofauna, survive in densities that are likely to be representative of pre-human conditions. This system provides an ideal opportunity to evaluate whether the sugar resource is partitioned between invertebrates and vertebrates. We recorded the abundance and diversity of faunal visitors to available sugar resources three times daily along a fixed transect. Large numbers of two species of endemic gecko were recorded nocturnally feeding on honeydew. Reintroduced endemic darkling beetles (Mimopeus opaculus) were seen regularly feeding on honeydew, indicating this sugar resource is likely to be important in restoring the native fauna. This research will assist in the development and evaluation of future restoration and management plans for these ecologically important endemic species. Such research will also benefit the global entomological community by filling current global knowledge gaps regarding the strength of trophic interactions; particularly with insects and herpetofauna; thus creating a more holistic view of honeydew ecosystems worldwide.

Effects of phytosanitary measures to reduce borer infestations of wood packaging materials and trends in interception rates of organisms associated with wooden items

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Concerns about the impacts of invasive bark beetles and wood borers have prompted the development of phytosanitary regulations designed to reduce infestations of wood packaging materials (WPM) traded internationally. The International Standards for Phytosanitary Measures, No. 15, Guidelines for Regulating Wood Packaging Material in International Trade (hereafter “ISPM 15”), requires the use of heat treatment or fumigation, to certain specifications, to achieve compliance of WPM used in international trade. ISPM 15 was first implemented in NZ in 2003 and in the United States between 2005 and 2006. While the treatments described above are known to be effective, reports of occasional interceptions of live borers in various countries indicate that measures to manage pathway risks are not (yet) completely effective. As part of a wider project to assess the benefits and costs of phytosanitary measures, we examined interception rates recorded in the United States and other countries, before and after the implementation of ISPM 15, to investigate the effectiveness of the policy. We queried the USDA AQIM data base which is designed to provide more accurate information on actual interception rates than regular, less systematically collected interception data. The analysis indicated that interception rates declined after the introduction of ISPM 15 but a persistence of some WPM infestations was noted. A review of recent interceptions of borers and other organisms of concern that were detected on WPM and other wooden imports will also be given.

New Zealand’s endemic dung beetles (Coleoptera: Canthonini): what have we got?

Shaun Forgie [*1]

[1] Landcare Reserarch

New Zealand’s endemic dung beetle fauna is poor as was the taxonomic condition of its members. But what we do have is truly magnificent to a dung beetle enthusiast. All species are flightless and possess a ball-rolling morphological template. They predominately occupy native forests throughout NZ with very rare forays into fringe and open habitats by a few individuals daring for adventure. Until recently, nothing was known of their biology, yet they are often recovered from many forest biodiversity and ecological surveys and general collecting mainly with pitfall traps and sifting litter. New Zealand canthonines belong to the genera, Saphobius Sharp 1873, Saphobiamorpha Brooks 1944 and a new genus with 15 species recognised in a current revision. One new genus and species together with a new species of Saphobiamorpha and three new members of Saphobius have been described. Saphobius brouni Paulian 1935, S. curvipes Broun 1893, S. nitidulus 1890, S. tibialis Broun1895, and S. fuscus Broun 1893 are recognised as synonyms. The single specimen of Saphobius arrowi Paulian1935 isn't a Saphobius, but it is a member of the morphologically similar South African endemic genus Epirinus Reiche 1841. The remaining valid species are re-described. This talk presents an overview of the taxa in the revision with some science facts and some pure speculation on the ecology of some of its members.

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The Larger Moths of New Zealand image gallery and online guide

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[1] Landcare Research

The mission of this three-year TFBIS-funded project was to photograph a male and female of all the 'larger' moth species of New Zealand, and make the images available online. In practice, both sexes of most species belonging to Hepialidae, Zygaenidae, Sesiidae, Saturniidae, Sphingidae, Geometridae, Erebidae, Nolidae and Noctuidae have been imaged, along with a female of the legendary Titanomis sisyrota (family unknown). The result is an online guide to identification of larger moths, and a celebration of their biodiversity and of Birgit Rhode's photography. Use of the guide will be demonstrated, its limitations discussed and some species to look out for highlighted. Pyraloidea are next.

Developing simplified identification guides for border control throughout the Pacific.

Franz-Rudolf Schnitzler [*1], James Haw [1], Lalith Kumarasinghe [1], Sherly George [1]

[1] Plant Health & Environment Laboratory, Ministry of Agriculture and Forestry

Developing a simplified Lepidoptera larvae and Coleoptera identification manual is part of the project “Enhancement of Biosecurity and Quarantine Services in the Pacific Countries”, funded by the New Zealand Aid Programme. The manuals are prepared using invertebrate interception data collected from fresh produce imported into New Zealand. Imports into New Zealand cover a wide range of fresh produce from all over the world and those commodities are essentially the same as those imported into Pacific Island Countries. The manuals provide information on the recognition of common interceptions as well as economically significant pests associated with frequently imported and exported fresh produce from Pacific Island Countries. Moreover, the scope was expanded to include some potential interceptions, NZ natives, and other taxa of importance. The identification manual to lepidopteran larvae contains keys to larvae of 22 families, and covers 70 genera and 71 species. The coleopteran manual contains keys to adults of 33 families, covering approx. 151 genera and 192 species. The keys are simplified using basic terms where possible and contain multiple photographic and diagrammatic illustrations. Thus the manual as an identification tool is expected to assist biosecurity officers throughout the Pacific in informed decision making.

Invertebrates of geothermally influenced aquatic and terrestrial ecosystems: longitudinal and lateral linkages.

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New Zealand has a range of geothermally-influenced ecosystems with distinctive ecological features and biotic communities. In geothermally-influenced streams, distinctions in aquatic flora and fauna occur longitudinally downstream from the source of thermal springs and also laterally within the aquatic-terrestrial ecostone. Despite the significance of geothermal areas within New Zealand, studies of the ecology of these extreme environments have been sporadic. However, recent studies of geothermal ecosystems in New Zealand have determined the diversity and characteristics of aquatic geothermal ecosystems and within the aquatic-terrestrial ecotone. Amongst the more prominent features of aquatic geothermal ecosystems are members of the dipteran family, particularly Ephydridae and Chironomidae. In this paper the invertebrate communities of several geothermal ecosystems are described, and some of the environmental factors influencing their distribution are examined.

Sexual conflict in New Zealand seaweed flies (Coelopidae).

Dhobasheni Newman [*1], Greg Holwell [1]

[1] University of Auckland

Sexual conflict occurs due to the differing reproductive interests of males and females and there has been a surge of interest in how this can influence the evolution of mating systems. Previous studies on a small number of species of seaweed flies (Coelopidae) from the northern hemisphere have revealed that mating interactions in this family involve premating struggles whereby the female physically resists copulation attempts by males. Australasia has recently been identified as the centre of diversity for members of the family Coelopidae. However, very little work has been done to investigate mating behaviour and sexual conflict in the seaweed flies in this region. There are 7 species of Coelopidae found in New Zealand and its Subantarctic islands, 5 of which are endemic and their behaviour is yet to be studied. Previous comparative work, looking at northern hemisphere species, has identified that females of different species exhibit different strategies to resist males resulting in selection for males with traits to overcome resistance, usually resulting in selection for large male body size. Here I present preliminary results on mating behaviour and sexual conflict in the New Zealand Coelopid Chaetocoelopa littoralis and compare these with the behaviours observed in other members of Coelopidae.

Kanapa Karaaroa (Aupouriella pohei) — New Zealand's rarest mayfly

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In late 2008 an unusual mayfly (Ephemeroptera) nymph was collected from a stony stream in the northernmost part of Northland, New Zealand. Additional nymphal, subimaginal and adult material resulted in the description by one of us (MJW) of a new species of Leptophlebiidae and a new genus, Aupouriella, erected to contain it. Aupouriella pohei, given the common name kanapa Karaaroa by the landowner of the type locality, is unique among New Zealand Ephemeroptera, in that eyes of adult males are not divided into upper and lower portions, and that nymphs, subimagos and adults all have very slender legs. Little is known of the biology, ecology or distribution of this mayfly other than aspects of the physical environment of the sole stream in which the species was found, and the species of co-occurring stream invertebrates. The Department of Conservation Threat Classification System for aquatic invertebrates is currently being revised and A. pohei has been placed as Nationally Critical.

The distribution, phylogeography and morphology of the New Zealand ground weta, Hemiandrus maculifrons.

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New Zealand has around 40 species of ground weta, most of which have restricted ranges and are found on either North Island or South Island. Hemiandrus maculifrons, however, is found throughout most of New Zealand, making it the most widespread Anostostomatid in the country. The objective of this research was to understand why this species is so widespread. The presence of H. maculifrons on both North and South Islands might be the result of recent extensive range expansion, or the maintenance of high population size and gene flow across a wide geographic range. Alternatively, H. maculifrons could in fact be a cryptic species complex consisting of more than one taxon. To assess this I measured and described morphological characters and analysed mitochondrial cytochrome oxidase I DNA sequences from specimens across the distributional range of H. maculifrons. MtDNA showed that H. maculifrons consists of two clades with high genetic distances between clades (14.3% to 20.4%) as well as within clades. Morphological analysis revealed a concordance between mtDNA lineage and the shape of male terminalia and weta size. Furthermore, there was genetic evidence of isolation by distance within clades but not between clades, and these two putative entities exist in sympatry in part of their range. This is evidence that H. maculifrons is at least two taxa. More recently I have employed geometric morphometrics to further investigate differences between the two species.

Auckland Museum Natural History Collections Online

John Early, Curator Entomology [*1], Wilma Blom, Curator Marine [1]

[1] Auckland Museum

Auckland Museum has been steadily databasing its biological collections since 1989 and now has almost 430,000 specimen records across the collecting areas of Entomology (81,500), Botany (240,500), Marine (89,000) and Land Vertebrates (18,800). Of these ca 2,300 are primary types. It's a work in progress. New automontage images of specimens and labels are being added to types and a link to their original description is provided. Circa 50,000 records are currently available on http://muse.aucklandmuseum.com/collections/naturalhistory/BasicSearch.aspx but this number will soon be greatly expanded as records across all groups of plants and animals are progressively verified and released for public access. Presently there are ca 24,000 entomology records comprising all primary types, Plecoptera, Hemiptera and Lepidoptera. Coleoptera: Caraboidea, Hydrophiloidea and Staphylinoidea will be added soon. Users can search the online database and download records to a spreadsheet file for manipulation and inclusion in publications.

Insect Visitation to the Native New Zealand Orchid, Corybas cheesemanii

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Flowers often attract their pollinators by advertising rewards. These interactions are not always mutually beneficial because some plants have evolved mechanisms to cheat them. Deception is primarily found in the Orchidaceae, which can be food deceptive, sexually deceptive, or, less commonly, brood-site deceptive. The New Zealand endemic orchid, Corybas cheesemanii has been hypothesized to be brood-site deceptive. It is thought to mimic mushrooms and get pollinated by female fungus gnats seeking an oviposition site. I surveyed insects visiting C. cheesemannii orchids and leaves and co-occurring mushrooms every few days before, during and after the orchid's entire flowering season. Several fungus gnat species do indeed visit these flowers and mushrooms, however, there was also a number of other fly families especially Lauxaniidae, Anisopodidae, and Tipulidae, which are typically associated with fungi and rotting vegetation. This suggests C. cheesemanii possesses a more generalist strategy of insect attraction than previously thought. Although female fungus gnats were previously predicted to be the major visitor to these orchids, male fungus gnats were found more frequently, suggesting C. cheesemanii attracts and possibly uses both sexes as pollinators by mimicking a mating or 'rendezvous' site, rather than just an oviposition site.

Ground-dwelling invertebrates from Bream Head Scenic Reserve

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Ground-dwelling invertebrates were assessed at the Bream Head Scenic Reserve near Whangarei, Tai Tokerau, to examine habitat differences and to monitor the progress of the restoration programme there. Pitfall trapping was conducted at three sites within the reserve encompassing three habitat types: kanuka-dominant regenerating scrub, regenerating forest with some kanuka and canopy trees, and mature coastal broadleaf forest. Taxa were identified to species or genus, or to a recognizable taxonomic unit. The highest numbers of individuals (5676 individuals) and identifiable invertebrate taxa (145 taxa) were recorded at the mature forest site. The lowest number of taxa was recorded at the regenerating forest site (114 taxa), while the lowest number of individuals was recorded from the regenerating scrub site (1056 individuals). Examination of key indicator groups or species may be useful in evaluating habitat differences and the success of the restoration programme. With the exception of the Hemiptera, the “abundances” of every major taxon were highest in mature forest. Much of the increase in mature forest was due to disproportionate contributions from a small number of taxa, mainly within the Collembola, Amphipoda, Isopoda and Acari. The ground beetles (Carabidae), Diptera (Howickia sp), Hemiptera, Amphipoda, Isopoda, Acari and Aranaea appear to be emerging as potentially useful indicator taxa. Twice yearly pitfall trapping will continue and will likely further elucidate many of the interactions between species, habitat-type, and ecological restoration.

Kauri Fine Woody Debris: Invertebrate decomposers

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Globally, research has shown that saproxylic invertebrates play an important role in decomposing woody debris (WD), and thus nutrient cycling. However, there has been minimal research on invertebrate communities associated with WD in New Zealand. Due to the high level of endemism in New Zealand, findings from overseas may not be representative for New Zealand. Therefore this study aims to identify the invertebrates associated with kauri (Agathis australis) fine woody debris (FWD). Invertebrates were sampled in a kauri dominated native forest (Huapai) via the collection of dead fallen branches (<5 cm diameter, <1.5 m in length). The invertebrates were extracted using Tullgren funnels. Initial results indicated that there is considerable diversity in the invertebrate families present at each stage of decomposition. Further studies will examine species level invertebrate associations of intermediately decomposed wood (Stage 2). This research provides important information on the invertebrate community associated with kauri FWD decomposition. This is of particular interest since the volume of kauri WD is likely to increase substantially with the increasing spread of Kauri die-back (Phytophthora taxon Agathis).