June 2023

Issue

No. 628

CIRCULAR OF THE ENTOMOLOGICAL SOCIETY OF NEW SOUTH WALES Inc

This month there is no member profile. We still have plenty of members we would like to hear from, so please spare a little time.

The AGM of the society was held on 15 May 2023 via a zoom meeting. All current office bearers were re-elected. Further information will occur in upcoming editions of Tarsus.

This edition also includes a few entomological call-outs.

We continue providing hyperlinks to entomological stories and research that may be of interest to members. Thanks to Ross Rickard (DAFF) for some biosecurity-related news articles.

Kind Regards

tcheddle

Garry Webb Thomas Heddle

Circular editors

Project update - Searching for the Samurai wasp

Ian Dewar, Communication Advisor | CSIRO (Ian.Dewar@csiro.au)

Hello, I just wanted to give an update on our recent survey searching for the Samurai wasp! A potent weapon against the marmorated stink bug

Samurai Wasp

I understand the project team put a callout in Tarsus asking members to collect egg rafts of the Green Vegetable Bug (which can be difficult to find in the field).

Brown marmorated stink bug

We used vegetable bug eggs to conduct an egg sentinel survey for this tiny wasp at organic farms and market gardens across NSW, ACT, Queensland, Victoria and South Australia.

The Green Vegetable Bug, Nezara viridula, in green and brown forms

See our recent blog post for further info. And let me know if you'd like any further images for a Tarsus article,

There's also a post about this on our Facebook page:

https://www.facebook.com/CSIROnews/posts/pfbid036iWw19ZaQHPvQNWs8BkszgNyF8gr93oC5S9U5jhwPm73AmJbbtvCMUtCFBzwEGLtl?__cft__[0]=AZUY2ROMCavBoH4bbrckH6lt25WMh1xttN1FDkQ49WXTacxpvwMSpybSzSD8F-fPInyePKLgDxyat5dyinsP3MfdE1rYIlUJlAROEbV4GdxfWuzL-SFEC2CsCsMdELJbeoRN8-tna3lzsVOySgeU31oRDSINTBeqJwE07OEFc4gdpyn4Ic29-zjgHTKC7EhtNcH6-i21gI_FKM024g9aOwL5&__tn__=%2CO%2CP-R

A call-out from the GLiTRS project

Julie Carter, Cambridge University

I am writing to you on behalf of the Global Insect Threat-Response Synthesis (GLiTRS) project (https://glitrs.ceh.ac.uk/, a collaboration between the UK Centre for Ecology and Hydrology, the University of Cambridge, the Natural History Museum, University College London, Queen Mary University of London, and Stellenbosch University), to request your help in reaching out to the members of the Entomological Society of New South Wales, with two requests.

Request 1

The GLiTRS project is synthesising the available evidence for trends in insect populations globally, and the threats which are driving them. To fill in gaps for taxa and regions where field data does not exist, we will be running an online global expert elicitation process in the coming months, to gather expert opinions on how each group of insects responds to major global threats. We are therefore compiling a database of experts for each insect Order and would be pleased to hear from any of your colleagues/members if they would like to take part in the process.

We have created a short online form for entomologists to register their interest in participating. I was wondering whether you would be able to advertise this opportunity to your entomology colleagues/members via whatever communication you wish. This could be a dedicated email, an advert in a regular newsletter, a blog, or a post on closed social media groups. The form only takes a couple of minutes to complete, and further information will be sent out by email to everyone who has registered, before they are asked to commit to participating.

The form can be found here: https://forms.office.com/e/0HJRk0GAMw

Everyone who completes all three rounds of the expert elicitation process will be invited to provide comments on the resulting manuscript, and those who do will be invited to be co-authors on the publication.

We would also be grateful if you and your colleagues/members could share this link with entomology colleagues and contacts around the world. Please don't hesitate to get in touch with me (jc2454@cam.ac.uk) if you have any questions or require any further information about the expert elicitation.

Request 2

We are also collating data on insect trends, which includes a measure of abundance of insect species (or genera/families), at a given location, over a time period of 8-10 years or more. If your society, your members, or your wider entomological community have any suitable data that they would be willing to share with us, we would be delighted to hear from them.

In return for sharing their data, we are offering data providers authorship on an open-access paper that we will draft (and circulate for comments) describing and publicising the GLiTRS database of insect trends (similar to https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.1303).

The database we are creating with this data on insect trends will inform a key piece of research that we want to use within our global threat-response model used to understand drivers of invertebrate decline (see https://glitrs.ceh.ac.uk/data for further details).

We are happy to discuss data access with you or provide any clarification if needed. Please direct any questions regarding insect trend data to: glitrs.data@ceh.ac.uk.

New Entomological Research

(**Right Click** on the titles (or **CTRL Right Click**) to see the full articles)

Cute and horny: stink bug with tusks discovered in Western Australia

Entomologists from the University of New South Wales and Western Australian Museum have discovered a stink bug species believed to be new to science during a two-week expedition near Esperance in Western Australia. The bug, yet to be officially described and given a scientific name, is the size of a pea, has curved horns and bright yellow tusks and is remarkably well camouflaged on its host plant, a local hakea species.

Yellow crazy ant outbreaks in Whitsundays linked to construction of new home

With its tropical climate and picturesque beaches, the Whitsundays draw travellers from around the globe, but recently the area has been battling an unwelcome visitor. And now, as more people choose to call the North Queensland region home, there are fears the construction of new houses could open it up to more invasions of the devastating insect. A fifth infestation of yellow crazy ants has been confirmed this week at the coastal town of Mandalay. Infestations have occurred at four other locations over the past five years, including Shute Harbour, Funnel Bay, Hamilton Island and Woodwark. The ants have also infiltrated homes in the region, with reports of wire damage to at least one Woodwark property.

Red fire ants spread west of Great Dividing Range, nests detected in Toowoomba

The red fire ant has been detected on the western side of the Great Dividing Range for the first time and a biosecurity group says the "window of opportunity" to eradicate the exotic pest is closing. The South American species and was first detected in Australia at the Port of Brisbane in 2001. It has since spread into areas including Ipswich, Gold Coast, Scenic Rim, and Lockyer Valley areas and has now been detected in Toowoomba. Agriculture Minister Mark Furner said after the inspection of more than 180 properties two nests were found and destroyed in the suburb of Kleinton. "The program is methodically conducting treatment and surveillance of all properties in the area to ensure there aren't any more nests," Mr Furner said.

Diligent port surveillance traps alien stink bug in Sydney

Ongoing targeted seasonal surveillance of imported goods has not detected brown marmorated stink bug (*Halyomorpha halys*) in Sydney since early January 2023, following detections at Port Botany and nearby Matraville. Surveillance is continuing in the area, led by NSW Department of Primary Industries (DPI) with support from Greater Sydney Local Land Services and the Australian Department of Agriculture, Forestry and Fisheries (DAFF). NSW Chief Plant Protection Officer, Satendra Kumar, said brown marmorated stink bug is a serious threat to horticultural industries as it damages a wide range of plants, including vegetables, fruit crops and ornamental trees. "These exotic pests are not present and not wanted in Australia. NSW DPI analysis estimates the maximum potential damage of brown marmorated stink bug on NSW's fruit and vegetable industry could be up to $1.2 billion per year," Dr Kumar said. "Infrequent detections have been associated with imports and international travel, which are managed through diligent surveillance by DAFF and state biosecurity authorities.

Invasive stink bug detected in passenger's luggage by sniffer dog at Brisbane airport

A pest that could cause devastation to Australia's horticulture sector has been prevented from entering the country after biosecurity officers detected it at Brisbane airport. Detector dog Petal successfully sniffed out a live brown marmorated stink bug (BMSB) in a passenger's duffle bag, the second time the pe st has been discovered in the country. Deputy secretary of biosecurity Chris Locke said while BMSB does not pose a health risk to humans it is deemed a national priority plant pest as it can breed profusely to become a household nuisance and threaten the horticulture sector. "BMSB is exotic to Australia and would devastate our cropping industries if it were to establish here," Dr Locke said.

Australia is in a unique position to eliminate the bee-killing Varroa mite. Here's what happens if we don't

Varroa mites – notorious honey bee parasites – have recently reached Australian shores, detected at the Port of Newcastle in New South Wales last year. If they establish here, there would be significant implications for agricultural food security, as honey bees are heavily relied on for the pollination of many crops. However, while Australia is the last continent to be invaded by the mite, it has an opportunity to be the first to eradicate it.

Varroa destructor is a small mite that attaches to bees and eats their "fat body". The fat bodies of honey bees are the insect equivalent of a liver. Varroa weakens bees, reduces their lifespan and increases the spread of deadly viruses. Scientists need to be ready: this might be Australia's best chance to collect important data on the spread and evolution of this parasite. Our new paper published today in Biology Letters outlines what questions scientists need to ask and what data they need to collect if Varroa spreads in Australia.

Warning as Aussies return from Bali with mystery scars: 'Years to heal'

Australian tourists in Bali are being warned to protect themselves from an exotic insect that is toxic to humans. It comes as some travellers return home from the popular holiday destination suffering strange burn-like blisters on their bodies that are taking weeks to heal. Their painful liquid-filled blisters are being caused by a rove beetle, similar in size to an ant - known in Indonesia as tomcats. One Tomcat victim took to social media seeking help to heal a rash, which mysteriously appeared on her leg while she was staying in Sanur. "Would love to know other people's experience who have been burnt by a tomcat insect in Bali and if their burn mark completely healed?" the Australian woman posted to Facebook group Bali Bogans. The woman explained she was injured almost two weeks ago and has been using a doctor-prescribed cortisone cream on the blisters twice a day. "Even though the burn has mostly peeled, I'm still left with burnt looking skin underneath," she wrote.

NSW closes border to Victorian beehives following detection of braula fly in illegal hive movement

The New South Wales government has restricted the entry of all beehives from Victoria after the detection of braula fly in illegally moved hives. It follows detections of the exotic pest in Victoria last month during varroa mite surveillance and a further two detections over the weekend on two new properties. While the wingless fly is endemic in Tasmania, any detection or suspicion of the fly in other states must be reported to government authorities. Its presence in NSW was confirmed on Monday by the NSW Department of Primary Industries (DPI) through laboratory testing after a beekeeper reported it. Victoria already has a hard border in place with NSW to prevent the spread interstate of varroa mite, which is currently being controlled in NSW through an emergency response.

Fighting exotic mosquito menace

Sydney's warm and wet weather over the past year has kept Australia's frontline biosecurity officers busy in the fight against mosquito-borne diseases. More than half of all exotic mosquitoes detected through the Department of Agriculture, Fisheries and Forestry's national vector monitoring program in 2022 were associated with aircraft and cargo arrivals through Sydney's Kingsford Smith Airport. From January 2022 to January 2023, the department's vector monitoring officers and biosecurity officers detected 24 exotic mosquitoes across the country and 14 of those were found in Sydney. In the same period the previous year there were just three detections in Sydney and a national total of 18 detections. Deputy Secretary, Biosecurity and Compliance Group, Dr Chris Locke said the vector monitoring program plays a major role in intercepting mosquitoes, many of which can transmit serious diseases.

Panic at the Ant Hill: The Specialized Pheromone Response in Ant Brains

Ants have a specialized communication processing center that has not been found in other social insects. *A new study reveals that ants communicate danger through specific pheromones which activate a particular part of their brains, triggering complex responses like nest evacuation and offspring protection. The response varies depending on the colony size, and future research aims to delve into how different ant groups process the same signals.* Have you ever noticed an ant in your home, only to find that a week later the whole colony has moved in? The traps you set up catch only a few of these ants, but soon, the rest of the colony has mysteriously disappeared. Now, a study published in the journal *Cell* on June 14 explores how certain danger-signaling pheromones—the scent markers ants emit to communicate with each other—activate a specific part of the ants' brains and can change the behavior of an entire nest. "Humans aren't the only animals with complex societies and communication systems," says lead author Taylor Hart of The Rockefeller University. "Over the course of evolution, ants have evolved extremely complex olfactory systems compared to other insects, which allows them to communicate using many different types of pheromones that can mean different things."

Why red fire ants and yellow crazy ants have given themselves a green light to invade Australia

Two of the worst ant pests on the planet are invading Australia. Red imported fire ants have been detected for the first time on the western side of the Great Dividing Range in Toowoomba, Queensland. Yellow crazy ants recently reached the Whitsundays. The red imported fire ant is one of the world's most dangerous ants. The yellow crazy ant (*Anoplolepis gracilipes*) ranks among the world's 100 worst animal pests because of its impacts on agriculture and biodiversity. The red imported fire ant (*Solenopsis invicta*) poses similar threats, and is also one of the world's most dangerous ants. Its intensely painful stings, which give the ant its name, can kill people. The prospects of total eradication of these ants in Australia are poor. Both species are highly adaptable and colonies need to be detected and eradicated early to contain them. Eradication efforts face other several challenges, including:

- inadequate biosecurity resources for checking incoming cargo
- the need for the public to maintain constant vigilance
- spread from built-up urban areas into bushland that's much harder to monitor
- other pressing issues, such as the housing crisis, demand attention and resources, crowding out threats from insects.

A Major Agricultural Pest Hides the Key to Its Survival in Its Poop

Squash bugs are the deadbeat parents of the insect world. After they lay their eggs, they pretty much leave the larvae to fend for themselves. If the nymphs ever want to reach a new state of maturity, they need a special something: bacterial symbionts of the *Caballeronia* genus, which give the insects an immuno-boost and help provide the nutrients they need to survive. But without a parent to spoonfeed you bites of *Caballeronia,* what is a squash bug nymph to do? It turns out the little larvae evolved a clever workaround: Squash bugs find poop of members of their own species and eat it, ingesting the symbiont and giving themselves a chance to thrive.

Scientists Are Gene-Editing Flies to Fight Crop Damage

In 2008, a fruit fly known as the spotted-wing drosophila made its way from Southeast Asia to the continental US, likely hitching a ride on fruit shipments. First detected in California raspberry fields, the insect rapidly spread to other states. Unlike the common fruit fly, which is attracted to rotting food, spotted-wing drosophila prefers ripening, healthy fruit. Using a serrated, tubelike organ, the females slice through fruit skin and deposit their eggs inside. When the eggs hatch, the emerging larvae destroy the crop. The invasive pests cause hundreds of millions of dollars in damage each year. To control them, growers rely on pesticides that kill insects indiscriminately, including both pests and helpful bugs. But scientists are working on new solutions that could one day replace—or at least limit—the need for spraying chemicals.

Perfectly Preserved Testicle Found In 50-Million-Year-Old Katydid Fossil

Researchers have uncovered a unique 50-million-year-old specimen of an extinct katydid species with its muscles, digestive tract, glands, and even one testicle still intact. Marking a likely first-of-its-kind find, the detailed fossil has provided vital new information into the evolutionary history of katydids. Belonging to the genus *Arethaea*, also known as thread-legged katydids in reference to their grass-like limbs, the extinct species has been named *Arethaea solterae* after the lead author's colleague and retired insect pathologist Leellen Solter. "Katydids are very rare in the fossil record, so any new katydid fossil you find represents a new data point in the evolutionary history of katydids," Sam Heads, study lead and director of the Prairie Research Institute's Center for Paleontology, said in a statement. "Now we know that about 50 million years ago, this genus had already evolved and already had a morphology that mimics the grass in which it lives and hides from predators." While Heads describes finding gut traces in specimens from this area as "not so unusual", after further microscopic investigation, the team uncovered evidence of thoracic muscle fibers associated with the wings or flank muscles, tissue known as a "fat body", and even the inclusion of one testicle.

Flies like blue objects because they confuse colour for food

Biting flies are strongly attracted to blue objects because they mistake the colour for an animal they want to feast on, scientists have said. The finding may help the fight against diseases that are spread by flies, such as sleeping sickness, by making traps more effective. Dr Roger Santer, from Aberystwyth University's department of life sciences who led the work, said entomological field studies have long shown that flies are attracted to blue, which has led to traps across the world being made in that colour. "But why biting flies are especially attracted to blue traps has been a real puzzle for researchers," he said.

Gardener shares genius hack for fighting off aphids with something you probably have in your fridge: 'It really does work'

TikToker Kia Jade (@kia_urbangardener) shared a video with a gardening hack that could change the game for anybody battling aphids or powdery mildew in their garden. The hack is affordable, simple, and uses products you may very well already have at home. How it works: In the video, Jade shows how she uses full-fat milk, water, and a spray bottle to rid her plants of aphids and powdery mildew. The TikToker mixes equal parts milk and water, spraying it all over the plants, noting, "If you do it consecutively on aphids for a number of days, the aphids will actually suffocate from the fat in the milk."

Fire ants Australia: Looming invasion 'worse than cane toads'

Experts fear Australia is at risk of being overwhelmed by potentially lethal fire ants due to a lack of funding and political support for the ant eradication program. Scientists dread fire ants breaking out of their 20-year stronghold in and around Brisbane and potentially impacting human life, agriculture and native ecosystems across the country. "They just have a particularly potent venom and studies around the world show three per cent of all people will have severe allergic reactions and could need hospitalisation if bitten," said CSIRO invasive ant specialist Dr Ben Hoffman. "If you put that in perspective, three per cent of the population of the east coast is a few hundred thousand people that potentially would be at risk of hospitalisation and death. We've just been lucky in Australia so far that we haven't had any deaths, but deaths do occur in the US every year." There have been eight red fire ant incursions across Australia since 2001, all of which have been eradicated except for a large incursion in and around Brisbane that is now thought to extend to around 20 kilometres from the NSW border.

Buying bugs and beetles, or shopping for scorpions and snails? Australia's pet trade includes hundreds of spineless species

Shacking up with tarantulas, scorpions, and ants would be a nightmare for most people. But for others, these creepy-crawlies are welcome companions and collectables. Global demand for exotic pets is rising, fuelled by social media and a shift from traditional brick-and-mortar pet stores to online marketplaces. The pet trade now extends beyond well known species such as parrots, reptiles and fish to a wide variety of invertebrates (animals without backbones) – from both land and water. In our new research, we explored the rapidly growing trade in land-based invertebrates across 23 Australian online pet stores and one popular classifieds website. We found an astonishing 264 species traded online – from spiders and scorpions, to beetles and snails. The most commonly advertised species were stick insects, tarantulas and ants – we found a staggering 57 species of ant for sale. While most of the invertebrates were native to Australia, we also exposed trade in three highly invasive alien species. The white garden snail, the Asian tramp snail and the African big-headed ant all pose serious threats to Australia's biosecurity. They threaten agriculture, forestry and even public health.

Monarch Butterfly Migration: The Secret Power of White Spots

Monarch butterflies with larger white spots fly more efficiently, making long trips easier.
A new study examined nearly 400 wild monarch wings and discovered that successful migrant monarchs had about 3% less black and 3% more white on their wings. The researchers hypothesize that the butterflies' coloring is tied to the amount of solar radiation they receive during their migration, with the white spots improving their flight efficiency. However, with increasing temperatures and changes in solar radiation, these butterflies may have to adapt to maintain their migration success. If you've ever wondered how the monarch butterfly got its spots, University of Georgia researchers may have just found the answer. The new study suggests that the butterflies with more white spots are more successful at reaching their long-distance wintering destination. Although it's not yet clear how the spots aid the species' migration, it's possible that the spots change airflow patterns around their wings.

Evolutionary Fuel: How an Ancient Chromosomal Inversion Could Foster Survival

The complexity of evolutionary processes affecting an inversion in stick insects provides resilience against loss of genetic variation, and may foster long-term survival. Genetic variation is the ultimate fuel for evolution, says Utah State University evolutionary geneticist Zachariah Gompert. But, over centuries, that fuel reservoir gets depleted in the course of natural selection and random genetic drift. Whether, or how, genetic variation can persist over the long haul remains a big question for scientists. Gompert and colleagues from the University of Montpellier in France, the United Kingdom's John Innes Centre, the National Autonomous University of México, Querétaro; the University of Nevada, Reno; and the University of Notre Dame, published their investigation of this question in the June 13, 2023, online edition of the *Proceedings of the National Academy of Sciences*. The research was supported by a National Science Foundation CAREER Award Gompert received in 2019, along with funds from the European Research Council. "We examined how you maintain genetic variation in a species, and how such variation impacts adaptation," says Gompert, associate professor in USU's Department of Biology and the USU Ecology Center. For the study, the team investigated stick insects (genus *Timema*), which feed on a wide variety of plants.

"Jet-Lagging" – A New Way To Battle Malaria

The research could lead to the development of new anti-malarial drugs, which operate by inducing a "jet lag" effect on the parasites responsible for the disease. Health authorities have cautioned that the rise of drug resistance might reverse recent advancements in combating malaria, specifically in Africa and Southeast Asia. In the pursuit of alternate methods to combat the disease-inducing parasites transmitted by mosquitoes, researchers have now identified a potential new target: biological clocks. Almost all living creatures possess innate clocks that manage variations in everything from appetite and hormone concentrations to the timing of gene activity throughout the day. In a study published June 6 in the journal *Proceedings of the National Academy of Sciences*, researchers analyzed gene activity in patients who showed up at medical facilities along the Thailand-Cambodia border, showing signs of malaria infection in their blood. The team found that malaria parasites somehow sync their molecular rhythms with the internal 24-hour clocks of their hosts, their respective genes rising and falling in perfect lockstep with each other over the course of a day, like two pendulum clocks with synchronized swings.

Wolbachia in Cockroaches: A New Paradigm for Urban Pest Management?

Insects are fascinating! Yet, insects can also be a source of nuisance. For example, cockroach infestations in homes can be a source of allergen triggers, mechanical vectors of pathogens, and embarrassment to homeowners as cockroaches often move from filth to food in homes and are perceived as a sign of poor hygiene/sanitation. Cockroach management often relies heavily on the use of insecticides and sprays, which, due to evolving resistance among some

cockroach populations, no longer provide the anticipated level of control. However, there may be a new avenue for cockroach control using knowledge of cockroach endosymbionts like *Wolbachia*. *Wolbachia* is a type of bacteria found living within many insects. The bacterium is passed from a mother to its offspring. To ensure this, *Wolbachia* manipulates the reproductive biology of its insect host. For example, *Wolbachia* can kill all the males in an insect population. *Wolbachia* can modify sperm making it toxic to eggs. *Wolbachia* can turn biological males into females. Also, *Wolbachia* can promote host dependence by providing essential nutrients. The type of *Wolbachia*-mediated reproductive manipulation, however, depends on the strain found in an insect. In a new study published in May in the *Journal of Economic Entomology*, my colleagues at Auburn University and Aix Marseille Université and I explored the possibility of *Wolbachia* as a potential tool to control cockroaches.

Why the House Fly Should Join the Ranks of Agricultural Waste Recyclers

The sight of fly maggots noshing on manure has an undeniably high yuck quotient—but not for everyone. Some environmental scientists see it as a thing of beauty. The same buzzy pests that swarm over manure in livestock facilities can be economically sound agents for cleaning up poop while going on to feed the animals that produced it in the first place, suggests research published this month in the *Journal of Economic Entomology*. Specifically, house flies (*Musca domestica*) should be viewed as waste management agents, not just as noxious pests, says Chelsea D. Miranda, Ph.D., of Texas A&M University (TAMU), lead author on the study. The maggots—fly larvae—can recycle the manure into livestock feed, soil amendments, and even biodiesel fuel. Manure draws house flies like, well, flies to manure. They eat it and breed in it, making them abominable pests of barns, coops, and pens. However, if managed on an industrialized basis, house flies can be super waste recyclers, says TAMU's Jeffery K. Tomberlin, Ph.D., senior author on the study. A few countries, notably China, already recycle manure by feeding it to house fly larvae and then using the larvae as an ingredient of animal feed. Because they can spread pathogens, however, house flies have been avoided most everywhere else.

Help, bees have colonised the walls of my house! Why are they there and what should I do?

Have you spotted a swarm of flying insects emerging from a wall? Or noticed a buzzing noise coming from inside the house? If this sounds familiar, a colony of European honeybees (*Apis mellifera*) may be making their home in your walls. Why does this happen, and what should you do? First, work out who these house guests really are. Honeybees are often the culprits, but European wasps (*Vespula germanica*) also occasionally build their nests inside human-made structures. Their nests have a papery appearance and are made from chewed-up plant fibres. European wasps are a more dramatic yellow and black, and have narrower waists. Honeybees have less slender waists, appear furrier, and are a duller orange-brown colour. If they are inside homes or high-traffic areas, both honeybees and European wasps will usually need to be removed by a professional.

Depending on where you live, other social bees such as stingless bees and bumblebees may occasionally build colonies in human-built structures, but they rarely cause any serious problems. Solitary native bees such as carpenter bees, blue banded bees and teddy bear bees do not live in colonies. However, they sometimes build their individual nests close to one another. These insects are rarely aggressive and can often be left alone.

New Zealand needs to up its biosecurity game to protect the country from the next devastating pest threat

Climate change is increasing the risk of plant-destroying insects, diseases and invasive weeds entering Aotearoa New Zealand. Border security is not enough to protect us from the next biosecurity threat – it's time to be proactive in preventing the risks. As New Zealanders, our natural world is important for our wellbeing and our sense of identity. It is also important economically and for food production. With a total economic cost of pests estimated at NZ$9.2 billion in 2020 (2.9% of GDP), biosecurity is a major component of our annual budget. Most of New Zealand's biosecurity detection is concentrated at the border – monitoring ships and cargo coming into New Zealand. But this approach does not take into account pests that arrive by other ways.

More than 60 billion leaf litter invertebrates died in the Black Summer fires.

The Black Summer megafires engulfing south-eastern Australia in 2019–2020 were so intense they burned habitats rarely exposed to fire, such as southern warm temperate rainforest. These rainforests range from East Gippsland in Victoria up to just south of Sydney. Usually, they stay moist enough to prevent major fires. But in that unprecedented summer of fire, 80,000 hectares burned. Our new research estimates more than 60 billion invertebrates in the soil and leaf litter died too. While our hearts went out to the burned koalas and kangaroos, this was a silent tragedy. These tiny creatures are enormously important in ecosystems. They eat dead leaves, create rich soil, and provide a key food source for bandicoots and lyrebirds. Many species have very small ranges, putting them at real risk of decline or even extinction from fire. As renowned naturalist E. O. Wilson once said, invertebrates are the "the little things that run the world". But because they are small and out of sight, we still underestimate their significance in ecosystems and their contribution to Australia's biodiversity. They're all but forgotten when ecological disasters strike.

Trillions dead: Shocking new details emerge from Australian disaster

Squash, swat and buzz are just three of the words many Aussies think of when they hear the word insects. But no matter how annoying you find them, they are an essential food source for birds, reptiles and small mammals. They also turn over and mulch leaf litter, ensuring debris doesn't turn into bushfire material. With that in mind, you may want to brace yourself before you hear the astronomical figure of insects researchers found were killed in the 2019/2020 Black Summer bushfires. It's also possible it caused multiple extinctions. In 2020, it was revealed three billion animals were im pacted by the disaster, but at the time it

was not known how many insects were killed. So scientists from LaTrobe University used modelling to create an estimate. Looking only at insects wiped-out from rainforest forest floors in NSW and Victoria, they believe 60 billion invertebrates were lost, when compared to unburnt areas. When that modelling is roughly used to look at the entire bushfire zone, the number is staggering.

The world's first flowers were pollinated by insects

Plants existed on Earth for hundreds of millions of years before the first flowers bloomed. But when flowering plants did evolve, more than 140 million years ago, they were a huge evolutionary success. What pollinated these first flowering plants, the ancestor of all the flowers we see today? Was it insects carrying pollen between those early flowers, fertilising them in the process? Or perhaps other animals, or even wind or water? The question has been a tricky one to answer. However, in new research published in New Phytologist, we show the first pollinators wer e most likely insects. What's more, despite some evolutionary detours, around 86% of all flowering plant species throughout history have also relied on insects for pollination.

Rising Temps Put Foraging Bees at Risk of Overheating

With spring in full bloom, you might notice more bees buzzing outside and more pollen making you sneeze. Pollen makes big news as an aggravator of seasonal allergies, but, for bees and plants, pollen is essential for ensuring their reproductive success. Bees collect pollen as a source of protein to feed their larvae. During their foraging trips, they also move pollen from flower to flower, fertilizing the flowers and allowing plants to produce seeds and fruits. With pollination being such an essential part of both bee and plant life cycles, the recent declines in bees associated with climate change are especially worrisome. Bumble bees are just one of several groups of pollinators seeing dramatic declines in their populations and ranges. Bumble bees are remarkably cold tolerant and well known for their ability to generate and maintain body heat, but it's less clear how they will fare in the face of climate change or what factors might increase their risk of heat stress.

What's the world's biggest butterfly?

Did you know the largest butterfly in the world has a wingspan of 28cm and weighs 12g? The female Queen Alexandra's birdwing (*Ornithoptera alexandrae*), is the biggest butterfly in the world. It's so big that the first specimen was brought down with a shotgun. Found in the rainforests of Papua New Guinea, the female Queen Alexandra butterfly has a wingspan in excess of 28cm, while its body is 8cm long. It weighs approx 12g. The males are slightly smaller, with a wingspan of 27cm.

This spider scuttles like an ant to avoid trouble

This spider pretends to be an ant, but not well enough to avoid being eaten. Not all predators are so easily fooled. If Spiderman and Antman took their DNA and mixed it together in a petri dish, the result might be something like the spider species *Siler collingwoodi* (*S. collingwoodi*). This tiny, colorful, jumping spider found in China and Japan uses a combination of camouflage and some award-worthy mimicry to deter some hungry predators. In a stressful scenario, these spiders will imitate the way an ant walks to avoid being eaten. A study published May 17 in the journal *iScience* found that the combo of camouflage and ant mimicry works to evade spiders that eat other spiders, but not hungry praying mantises. It's advantageous to mimic an ant because they are typically not very tasty, and can have spiny defenses, chemical repellents, or venom. Not to mention, species of "exploding" ants like *Colobopsis saundersi* that are not afraid to fight and bite back. While scientists already knew that *S. collingwoodi* walked like an ant, the team on this study were curious how accurate the mimicry is, whether it imitates multiple species of ants, and how effective it is at discouraging predators.

ALARMING NEW SIDE EFFECT OF AIR POLLUTION: 'WE HAD NOT THOUGHT ABOUT THIS BEFORE'

Air pollution is having an unbelievable effect on flies, altering how they attract one another and mate. Insects typically find their mates by heavily relying on pheromones — chemicals that allow males and females to locate each other and mate. These pheromones are distinctive to males and females of a species, and in the case of flies, they are being disrupted and degraded by the pervasive increase of ozone in the air, which is a result of air pollution. Scientists at the Max Planck Institute for Chemical Ecology in Germany discovered these effects by developing an experiment that mimicked ozone levels similar to what is measured during the summertime in cities. Typically, male flies' pheromones attract females while simultaneously repelling other males. But increased ozone levels caused a decrease in pheromones, which caused females to be less attracted to males and led to courtship between male flies.

Examining puppeteer fungus' targeted takeover of zombie flies

In a new study published in *eLife*, lead author Carolyn Elya, postdoctoral researcher in the Department of Organismic and Evolutionary Biology at Harvard, reveals the molecular and cellular underpinnings behind the parasitic fungus, Entomophthora muscae's (E. muscae), ability to manipulate the behavior of fruit flies. Elya first described the manipulated behavior, called summiting, in a study published in *eLife* in 2018. Elya, who was studying microbes carried by fruit flies while a graduate student at University of California (UC) Berkeley, set out rotting fruit to capture wild fruit flies. When she later checked to see is she had captured any, she found instead zombie flies, with a banding pattern on their abdomen, that had died striking an interesting pose. Through extraction and sequencing of DNA Elya confirmed the suspected cause, E. muscae. Summiting occurs at sunset when the infected flies climb to an elevated location and extend their proboscises to the surface. A sticky droplet that emerges from the proboscis adheres the fly to the surface right before the wings raise up and away from the body and the flies die.

A botanical detective story: shedding light on the journey out of Africa for one of Australia's worst weeds

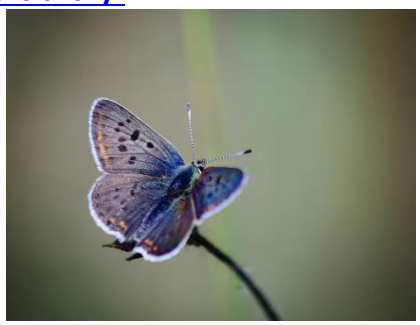
The scrubby harbour-side hills of a South African city recently revealed details of an historical event that transformed Australian coastlines. That event led to the arrival in Australia of a native South African shrub, bitou bush. The invader went on to become one of Australia's worst weeds, smothering coastal dune vegetation. While bitou bush has been widespread along Australia's east coast for decades, the weed arrived in Western Australia relatively recently. The species (*Chrysanthemoides monilifera* subspecies *rotundata*) was discovered in 2012 at Kwinana, a port and industrial area south of Perth. This new invasion required urgent attention. Bitou bush (*Chrysanthemoides monilifera* subspecies *rotundata*) is a weed targeted for eradication in Western Australia. The flowers are bright yellow daisies. Knowing where a weed has come from is fundamental to managing it well. Understanding how plants are introduced to new regions can enable effective biosecurity measures to be put in place. Establishing a weed's origin also reveals where to look for its natural enemies, such as insects or fungi, that can be used as classical biological control agents. Our research set out to decipher how bitou bush originally entered Australia and then spread from east to west. We reveal how the chance of new bitou bush arrivals in Australia is low and better biological control is possible.

Bees can do so much more than you think – from dancing to being little art critics

Bees are among the most important insects on Earth – vital pollinators of our crops and significant contributors to human societies for thousands of years. While visiting various plants, bees need to figure out the best flowers so they can be the most efficient foragers possible, and communicate this to their hive. But there's much more these insects' tiny brains are capable of. Bees have a great memory and can learn a lot

Bees can visit hundreds of flowers a day across multiple locations, and are great at learning which floral colours, shapes and locations are best for finding food. These flower memories can last for days, allowing for individual workers to return to the best flowers. Bees are capable of learning in complex ways. They can use "cross-modal" learning, recognising an object they've experienced with one sense when it's presented in another sense. In one study, bumblebees were trained to tell cubes and spheres apart using only touch, but could still distinguish them visually if they were unable to touch the shapes – and vice versa.

Climate change destroys habitats. Relocation of the animals is tricky.



Nine years ago, a team of scientists studying a violet-blue, thumb-sized butterfly found only two remaining in a rolling landscape of dunes along southern Lake Michigan. The pair, the last two Karner blue butterflies ever seen in the area, had emerged two years after an unusually hot spring wiped out most of their ancestors. The warmth caused the caterpillars to hatch from their eggs early, before the lupine plant they eat had emerged from the soil. And, just like that, the southernmost population of the endangered butterfly was gone.

Because of climate ch ange, the remaining populations of the Karner blue could face the same fate — unless state and federal wildlife officials move the butterfly farther north. But the U.S. Fish and Wildlife Service, which oversees plants and animals listed under the Endangered Species Act, prohibits the relocation of endangered species outside their historic range.

Bee vs wasp: what's the difference?

Bees and wasps aren't really all that different says the charity Buglife, and we should treasure and protect both. Wasps often get bad press, the villain of the insect world, while the bee is the hero, lo ved and protected. Yet the truth is they are not too dissimilar, and both play hugely important roles in the ecosystem**.** Bees and wasps are members of the order *Hymenoptera*, and as such share many characteristics and features. Visually they can look very similar and are easy to get confused; wasps can look like bees and bees can look like wasps. Both bees and wasps can be classified as social or solitary, additionally many solitary species are also described as cuckoos (they use other species to complete their lifecycles, particularly in terms of caring for/raising young and pirating food), i.e. the gypsy cuckoo bumblebee (*Bombus bohemicus*) and the cuckoo wasp (*Vespula austriaca*). Social bee societies are generally better researched and understood than social wasps, but both consist of a queen (the only sexually developed female), workers (sexually under developed females who do all the "heavy lifting") and drones

(males, whose sole purpose is to fertilise the queen's eggs). For wasps the mated queen will hibernate during the winter months and she is the only wasp that will survive more than a year as a result.

How butterflies conquered the world: a new 'family tree' traces their 100-million-year journey across the globe

How old are butterflies, and where did they evolve? And perhaps more importantly, how and when did they reach the isolated continent of Australia?. Answers to these simple questions have baffled scientists for decades. Until recently we had very little idea when butterflies evolved, and hypotheses concerning their place of origin were largely educated guesses. In recent years, however, several studies have indicated butterflies most likely arose sometime during the Cretaceous period, when dinosaurs dominated the Earth. Now, an international collaboration (of which I am a member) has placed the time of origin much more precisely: 101.4 million years ago, give or take 1.2 million years. These early butterflies were different from nocturnal moths, t heir ancestors. They flew during the day, rather than at night, and were attracted to brightly coloured flowers for their rich nectar.

What defines a species?

A frog that looks like it's made of tempered chocolate. A rainbow-colored fish that dwells in the ocean's "twilight zone." A hairy sloth with a coconut-shaped head. These are just a few of the hundreds of newfound species that scientists described in 2022. The animals join a growing list of more than 1.25 million species that have been scientifically described and cataloged since the 18th century. But what defines an organism as a species that's new to science? And what exactly is a species, for that matter? Biologists have wrestled with the concept for about as long as the field of biology has existed. Renowned naturalist Charles Darwin wrote in 1859: "No one definition has as yet satisfied all naturalists; yet every naturalist knows vaguely what he means when he speaks of a species." Fast-forward to the present, and the debate hasn't changed much. "There are many definitions, and none of them applies broadly to all life on the planet," said Bruno de Medeiros, assistant curator of insects at the Field Museum in Chicago. And yet, recognizing and distinguishing between species is vital — and not only for biologists. It's also necessary for cultivating the food we eat, treating diseases caused by different pathogens, and conserving endangered animals, plants and habitats.

Microworlds: Bugs—Adapting to Life as a Bug

Adaptations are where biology meets innovation. And over millions of years, bugs have evolved some of the strangest adaptations anywhere on Earth. Meet a few of our coastal favorites. Hey, teachers! Here's a cheat sheet of what's included in this episode of Microworlds: - What are adaptations? Different types of adaptations - Water strider legs and how they walk on water - Roles bugs play in an ecosystem - Life cycles - Mating - Water strider, sheep moth, caterpillar, ironclad beetle This episode is part of our series

Microworlds: Bugs, where we shrink down and discover the wonderful lives of the tiny, the miniature, the microworlds.

Why Are There So Few Insects in the Ocean? Japanese Scientists May Have Solved the Mystery

New hypothesis says it's to do with how they harden their shells. Scientists propose that the unique enzyme MCO2, which helps insects harden their shells, is the reason for their rarity in marine environments but success on land. Scientists from Tokyo Metropolitan University have proposed a hypothesis for why insects are so rare in marine environments. They previously showed that insects evolved a unique chemical mechanism to harden their shells which uses molecular oxygen and an enzyme called multicopper oxidase-2 (MCO2). Now, they argue that this gives them a disadvantage in the sea, while it confers advantages that help them on land, placing MCO2 at the heart of insect eco-evolution.

Are you a mosquito magnet? Help may be at hand

From repellants to app-based mosquito monitoring and a new malaria vaccine, researchers are making important breakthroughs in the fight against the biting insects. The earliest signs of summer herald my annual metamorphosis – from woman to lifesize pincushion. Whether at home or abroad, when mosquitoes begin their hunt for blood I am reminded, via a blanket of red blotches that have more than once swelled to the size of a golf ball, that mine is a godlike nectar. On a single day last December, a tropical Christmas trip quickly became a less-than-festive scratchathon after a glut of bites arrived, following which I was stung by jellyfish, then wasps. At this point, I can only assume the mosquitoes are giving other species ideas. But there are signs that a solution for the 20% of the population who receive above-average numbers of bites may soon be at hand. Earlier this month, researchers at the Hebrew University of Jerusalem (HUJI) developed a new repellant capable of reducing the number of mosquitoes feeding by 80%. Applying a thin coating made from naturally occurring cellulose nanocrystals (CNC), a renewable raw material found in the likes of cotton and wood, and indole, an organic compound with an unpleasant odour, to skin served as "chemical camouflage", said the study published in *PNAS Nexus*.

Scientists Discover Bug That Uses Tool

There's an assassin on the loose in Australia — but not the kind you might be thinking. As detailed in a recent study published in the journal *Biology Letters*, scientists have discovered a new type of tool-wielding insect, nicknamed the "assassin bug" for a creative — and deadly — hunting technique in which it meticulously coats itself in a sticky resin as a means of more effectively catching prey. Per the study, the assassin bug uses a specific resin from a native Australian grass called spinifex grass. "Tool use in animals is a complex and rare phenomenon, particularly in insects," reads the scientists' research. "Tool use in assassin bugs has been suggested as several species apply adhesive plant resins to their body, which has been hypothesized to function in enhancing prey capture." Deadly glue arms? Check. Watch out, flies.

Curious About Edible Insects? There's a Free Online Course for That

In recent years, insects as a regular food item have moved from a relatively fringe passion among some entomologists and adventurous eaters to a common and even controversial topic of discussion—and an increasingly large bite of the food and feed market. Whether out of curiosity or disgust or entrepreneurism, ever more people worldwide are craving answers about what role insects could or should have in their food futures. Politicians, celebrities, chefs, anthropologists, climate activists, businessmen, farmers, and so forth have joined the conversation, though each with a narrow view of the whole story and their own biases.

To help meet this demand for comprehensive information about edible insects, my colleagues and I at National Taiwan University have developed the world's first-ever massive open online course, or MOOC, on edible insects, available free to the entire world. The course, simply titled "Edible Insects," is one of only two MOOCs about insects on Coursera, a premier learning platform hosting MOOCs—the other being "Bugs 101: Insect-Human Interactions," by entomologists at the University of Alberta—and the first on any platform about insects as food or feed. (For more on the Bugs 101 course, see past articles in *American Entomologist* and here on *Entomology Today*.)

New butterfly genus named after villain Sauron

The piercing and malevolent gaze of Sauron, the powerful villain *The Lord of the Rings*, is being honored in a way that may even make Gandalf's heroic eagles envious. A new genus of butterflies has been named Saurona in honor of one of fiction's greatest villains. With their fiery orange hindwings and piercingly dark eyespots, *Saurona triangula* and *Saurona aurigera* are the first two species described in this new genus, described in a study published April 10 in the journal *Systematic Entomology*. Scientists believe that there are more species within this genus waiting to be described.

Kangaroo Island ants 'play dead' to avoid predators

They're well known for their industrious work, but now a species of ant on Kangaroo Island is also showing that it is skilled at 'playing dead', a behavior that researchers believe is a recorded world first. Accidentally discovered as researchers were checking pygmy-possum and bat nest boxes on Kangaroo Island, a colony of *Polyrhachis femorata* ants appeared to be dead… until one moved. Researchers believe the ants were 'playing dead' as a defensive strategy to avoid potential danger. Published by CSIRO, this is the first time that a whole colony of ants has been recorded feigning death, and the first record of the *Polyrhachis femorata* ant species for South Australia. Wildlife ecologist, UniSA's Associate Professor S. 'Topa' Petit, says she was surprised to discover a colony of what appeared to be dead ants in one of the nest boxes. "The mimicry was perfect," Assoc

Professor Petit says. "When we opened the box, we saw all these dead ants…and then one moved slightly. "This sort of defensive immobility is known among only a few ant species -- in individuals or specific casts -- but we don't know of other instances when it's been observed for entire colonies.

Corporate Sponsor

AUSTRALIAN ENTOMOLOGICAL SUPPLIES PTY LTD

Australian Entomological Supplies Pty Ltd
Unit 3, 173 Lundberg Drive South Murwillumbah NSW 2484
02 6684 7650 | f: 02 6684 7188
accounts@entosupplies.com.au | sales@entosupplies.com.au
www.entosupplies.com.au

SOCIETY POSTAL ADDRESS	MEMBERSHIP FEES 2022	
C/- ENTOMOLOGY DEPARTMENT	ORDINARY MEMBERS	$50 ($45 if paid by next AGM)
THE AUSTRALIAN MUSEUM	COMPANY ASSOCIATES	$60
1 WILLIAM STREET	STUDENT MEMBERS	$25 ($20 if paid by next AGM)
SYDNEY NSW 2010	CORPORATE MEMBERS	$150

OFFICERS (elected AGM 2023)

HON PRESIDENT	Mr Bob Ryan
HON VICE PRESIDENT	Professor Nigel Andrew
HON SECRETARY	Mr Khalid Ahmad
HON TREASURER	Mr Robin Parsons
HON EDITOR	Dr Robin Gunning
HON BUSINESS MANAGER	Ms Gitte Strid-Nwulaekwe
HON CIRCULAR EDITOR(s)	Mr Garry Webb/Mr Thomas Heddle
COUNCILLORS	Dr Bernie Dominiak
	Mr Stephen Fellenberg
	Mrs Barbara May
	Mr Thomas Heddle

Non-council positions

AUSTRALIAN ENTOMOLOGICAL SOCIETY CORRESPONDENT	Dr Dinah Hales
PUBLIC OFFICER	Mr Robin Parsons
WEB PAGE MANAGER	Dr Graeme Smith

GENERAL and APPLIED ENTOMOLOGY (G&AE)

Page charges are not levied on contributions to the Journal where at least one author is a member of the Society
Preprints of all papers will be made available to members on the website ahead of the printed version
(at the moment excluding taxonomic papers)

Please send any manuscripts to Robin Gunning (rgunning@bigpond.com) as soon as possible

Articles, from volumes 23 & 27 to 48 are freely available from the Society's website. Members can access new preprint articles from Volume 49.

(www.entsocnsw.org.au)

All articles from volumes 10 to 48 as well as the most recent complete issue (Volume 49) can also be purchased on-line from Informit for just a few dollars each at

https://search.informit.com.au

Hard copy issues of G&AE may be purchased (if available): Volumes 1-27 (1964-96) at $10 each, Volumes 28 on-wards (1997 to vols > 5 years old) at $15 each **plus** postage. Volumes **under** 5yrs old, $45 each or $50 via agents, including postage within Australia; if overseas $60 each including postage, transmission charges for individuals or agents.