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Editorial

Robert Whyte and Helen Smith

One particularly sad incident for our scientific community since the last Australasian Arachnology was the untimely passing of Norm Platnick in April 2020 at the tender age of 68.

Norm leaves a huge legacy of work relevant to our region and contributed over 500 taxonomic names of Australian genera and species.

His death was announced in the NY Times with the article [link](https://www.nytimes.com/2020/04/17/science/earth/norman-platnick-the-real-spider-man-is-dead-at-68.html). The American Natural History Museum ran the official obituary, stating “it is with much sadness that we mourn the passing of Dr. Norman I. Platnick, Curator Emeritus.”

With more sadness and yet celebration of a life well lived we include a Tribute to Dr Barbara York Main: arachnologist and nature writer by Leanda Mason and Patricia L. Kennedy (see page 50).

We are heartened to see a jam-packed newsletter with a huge range of topics, locations and authors. We hope to enthuse our members to submit even more features and news items for future editions. Until next time, we wish our members all the best for success in science.

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“An Australian botanist took me to Springbrook National Park, where he showed me the contrast between the lowlands with sub-tropical Asian and Gondwanic elements and the cool temperate Gondwanic dominated forest at highlands. While the other visitors were amazed with the view for “Best of All lookout”, I could not stop looking at the Antarctic Beech (Nothofagus moorei). The impression this forest had on me was strong enough to rival that view and its bold name, which is, by the way, very well deserved.”

— Darko Cotoras

News

Mark Harvey has passed on a newly published paper on mygalomorph phylogeny using genomic data. The study results in several family-level taxonomic changes to the classification of the Australian fauna, including: Stanwellia: from Nesimidae to Pycnothelidae. Namea, Chenistonia, Hesperonatalius, Kwonkan, Namea, Proshermacha, Teyloides: from Nesimidae to Anamidae. Cethegus, Australothele and relatives: from Dipluridae to Eugnidae. Ixamatus, Xamiatus and Kianna: to Microstigmataidae. Some other changes have been made in earlier papers, including: Atrax & relatives: to Atracidae and Conothele: from Ctenidae to Halonoprotidae.

Heteropoda records sought for Sydney Region see page 41 Ventral view of Sydney’s native Huntsman Heteropoda longipes. Have you seen one? Tell Helen.
One day I was working at the Museo Nacional de Historia Natural in Santiago, Chile. I was having a hard time identifying some strange beetles. At some point, I asked the curator for some guidance. He looked at me and said: “I will bring you the Bible”. He quickly walked away and came back with a large green book titled *The Insects of Australia*. I realized that he was joking about the Bible and probably I did not mention that the samples were from Chile. After indicating the origin of the specimens, the curator insisted and said: “Yes, they are from Chile, but at a high taxonomic level this book is, perhaps, one of the best resources for Chilean insects as well as Australian ones.”

An ancient connection across the Pacific

Nothofagus forests. Left Antarctic Beech (*Nothofagus moorei*) at Springbrook National Park, Queensland, Australia. Right Coigüe de Magallanes (*Nothofagus betuloides*) and Lenga (*Nothofagus pumilio*) forest at Cerro Bandera, Isla Navarino, Chile.

Darko D. Cotoras
California Academy of Sciences
I knew about the Gondwanic connections between South America and Australia. However, the incident with the book made me think about how much this biological connection is present in our collective unconscious. I am saying this because the second after the curator started his explanation my rational mind kicked in and I understood the reason.

I am sure if he had brought a book about insects of Latin America, I would have not been confused. But this book would have devoted many pages to where the bulk of the diversity is from. In the case of South America, the Amazon. Biogeographically, the Amazon has very few affinities with the temperate rainforests of southern Chile. Despite being in the same continent, geographic conditions such as the Arid Diagonal and the Andes have isolated the forests of the Pacific coast of southern South America from the rest of the continent.

It is true that there are many connections between the forests in Chile and the rest of the Neotropics, such as the Podocarpus conifers, which are also present in the Yungas of Perú, Bolivia and Argentina, or the Drymis trees with a disjoint distribution with the Mata Atlântica from Brazil.

But, there is also a large number of taxa shared with Australia and New Zealand: Nothofagus, Eucryphia, Araucariaceae and Berberidopsidales trees, Peripatopsidae velvet worms, Parastacidae fresh water crayfish, Galaxia fish, Ratite birds, Australidelphia marsupials, among many others.

Of course, the spiders are not the exception and there are remarkable examples such as the family Austrochilidae with two genera in Chile and Argentina (Austrochilus and Thaida) and one in Tasmania (Hickmania). The family Malkaridae with 12 known genera between Australia and New Zealand and one in Chile and Argentina (Chilenodes). The subfamily Micropholcommatinae within Anapidae has species in Chile, Brazil, Australia and New Zealand. The superfamily Archaeoidea includes several families all of them with Gondwanic distribution. In particular, Mecysmaucheniiidae with species in New Zealand, Chile and Argentina. Finally, the mygalomorph genus Missulena (Actinopodidae) has one species in Chile and 17 in Australia. In general, most of these groups correspond to old lineages, which existed before the split of Gondwana and have limited dispersal abilities.

I knew about this by the books, but it was not until I had the fortune to go to Australia that it really “hit” me. An Australian botanist took me to Springbrook National Park, where he showed me the contrast between the lowlands with sub-tropical Asian and Gondwanic elements and the cool temperate Gondwanic dominated forest at highlands. The lowlands looked foreign and exotic, yet when we ascended I found a strangely familiar vegetation. While the other visitors were amazed with the view for “Best of All lookout”, I could not stop looking at the Antarctic Beech (Nothofagus moorei). The impression this forest had on me was strong enough to rival with that view and its bold name, which is, by the way, very well deserved.

This distant connection has been the focus of a large amount of research, but probably has not yet permeated into our collective unconscious of the biological identity of where we live. This ancient connection will greatly illustrate important concepts of deep time, geologic processes and evolution. Giving us a notion of how the austral continents from the Pacific were once connected and today more than hundreds of million years after, witnesses of that time are still living in our forests.

Acknowledgements

I am very grateful to Mario Elgueta and Lui Weber for sharing their knowledge about these ancient connections. I would like to also express my gratitude to Robert Whyte and Anne Jones for their welcoming and generous sharing of knowledge about Australian spiders and many other topics. My research in Australia was funded by the 2019 Lizard Island Reef Research Foundation Fellowship.
Walking sideways

Some Crab Spiders (Thomisidae) of the Wet Tropics, reported by Jim Hackett from Cairns, far north Queensland.

*Mastira adusta*. This crab spider’s range stretches from Papua New Guinea out to the Solomon Islands and down to Sydney NSW with its concentration in Far North Queensland from the tip of the Cape southwards to about Rockhampton.

Stephanopis sp. Female far left and male left. This genus has been revised by Machado, Teixeira and Milledge 2019, making it possible to diagnose species more easily, though many require the aid of a stereo microscope. This species resembles *Stephanopis armata*.

Above left, a hard to identify crab spider not uncommon in Far North Queensland, somewhat like a *Tharpyra* but with a wrongly shaped cephalothorax for that genus. It may be *Misumena* or a relative of that genus. The male, middle left, with only five legs remaining, was photographed by Iain Macaulay. The remaining legs show a distinctive spination and colour. These spines and colours are shared by the female.

Above right is the widespread *Stephanopis altifrons* which was redescribed by Machado, Teixeira and Milledge in 2019. *S. aspera*, *S. depressa*, *S. monticola*, *S. elongata* and *S. scabra* are now considered its junior synonyms.

Below left, a Running Crab Spider. This is a philodromid, thus not a crab spider at all. There are only a few species known from Australia but more will be found. For identification, the second leg is longer than the first. This is one of the characters of this family. White hairs around the back of the abdomen and on femora 4 and 3 may help with ID. Interestingly, this spider is guarding its egg-sac during the day.

**Acknowledgements**. Thanks to Rob Whyte and Greg Anderson, authors of *A Field Guide to Spiders of Australia* CSIRO Publishing 2017, for their help.

For more Crab Spiders, see Steve Woodman’s article on Thomisids of Wingham on page 28.
Interview from 2012: Norman Platnick on the history of the World Spider Catalog

Robert Raven We are talking about your Catalog – the Catalog of Spiders of the World. It began when?

Norman Platnick I started working in 1986. We did scan Brignoli's catalog. We acquired that. The OCR [optical character recognition] worked pretty well. When it came to do the big job which was Roewer's Catalog, we tried several different OCR systems. None of them produced acceptable results so we took the old-fashioned way. We got a volunteer and over the next couple of years that volunteer typed. One of our division secretaries Beat Brewer who's an excellent typist did some of the work as well, on those rare occasions when she didn't have anything else to do. In a sense the decision had been made for me by Brignoli because when Brignoli decided to do his first update to the Catalog he adopted Roewer's style. It's obvious why he did that. He was a working taxonomist. As a working taxonomist Roewer gives you quick access to exactly what you want to know. That seemed to be the way to go. When I first started work on the Catalog in 1986 we had just acquired XyWrite which is in my view still the best word processing program that's been invented. Unfortunately it works only in DOS [disk operating system]. There is a sort of third cousin twice removed that's available for the Windows world called Nota Bene. It's been customized for use in the humanities and so I use it on occasion and in a pinch. When it came to exactly what you want to know. That seemed to be the way to go. When I first started work on the Catalog in 1986 we had just acquired XyWrite which is in my view still the best word processing program that's been invented. Unfortunately it works only in DOS [disk operating system]. There is a sort of third cousin twice removed that's available for the Windows world called Nota Bene. It's been customized for use in the humanities and so I use it on occasion and in a pinch. When it came to the Catalog using tools like Microsoft Word. It's not possible.

RR It's not one Catalog, it's like 26 files plus the bibliography.

NP Yeah, I'd say about 40 or 50 files all together.

RR And the order of the families is roughly phylogenetic, is that right?

NP Yes. And it changes periodically as you learn something more about the relationships of particular groups. Obviously there is no way to translate phylogeny directly into a single linear unambiguous listing but it does roughly follow the relationships.

RR You're a very busy man. How do you get all this stuff done? When do you do the Catalog?

NP Well the Catalog is done basically in off hours. It's not something in the city or in the office to do. In fact the only thing I do here in the office is to check original old literature. I can't do it any other way than physically looking at the things. Everything else is done either at home or on the train.

RR How do you know about the literature? You don't rely on people just sending it to you.

NP Well it is important that people send things to me because I often find out about things first that way. But these days electronic notifications work pretty well. I routinely check things like Zootaxa and Zookeys, where lots of stuff is published. In the old days you had to wait a year to get an issue of Zoological Record to see what they had found that you hadn't. Now the Zoological Record online is updated once a month. So once a month I check those listings.

RR So Zoo Record but not just Zoo Record?

NP But not just Zoo Record. I use the news feed from TOL [Tree of Life]. It sends me lists of everything they see that's published on spiders. The problem is that it's done by a computer so it's very dumb. Because we have a spider named Arachnea and so are half the microbes in the world I get all those microbial papers of which I have only tangential interest but I do occasionally find things.

RR It's a sifting process?

NP Same is true with Zoological Record which includes lots of titles which aren't relevant to the Catalog.

RR You've followed Roewer and Brignoli in a number of the specific aspects. For example, that you're carrying the sexes but the qualifying reason for something to appear in the Catalog is?

NP Well there has to be a taxonomic novelty in the description of the species obviously, a transfer, a synonymy or a description that's important for working taxonomists and importance that translates pretty directly into illustrations of genitalia because that's what we use. That's our stock in trade.

RR The significant thing here is that the sexes are leading the line so that we know what's important. The other thing that people ask a lot about is the distribution and unlike some catalogs you don't carry the distribution against each entry.

NP That's correct. We don't have a huge matrix with 42,000 species on one side and 165 nations on the other. If someone wants to do that work then all power to them but not me.

RR Am I correct in understanding that the order of a distribution is usually from west to east and north to south. Is that correct?

NP Yes. Definitely north to south and usually yes west to east.

RR The maintenance, for example, of Australian states is part of the historical thing or is it because of area?

NP It's primarily a matter of area. Australia by itself is too large. The states in Australia are pretty much perfect for use in the Catalog. In the U.S. we don't do that, you know, because states are too small.

RR The purpose of the Catalog is not to try to track every momentary change in distribution.

NP Correct. We can't possibly do that because I don't even cite all the relevant literature. There are often times papers are published that might have 200 records. I don't check those records to see if this is a new record for you, know, Lower Slavia.

RR And the thing is should anybody in the future decide to go back to dissect them it would be a massive task.

NP You would have to go back to the original literature and way more literature than is in my bibliography. And the question becomes how valuable is the information? Identities that are published in faunistic studies that aren't revisionary studies are wrong as often as they're right. So taking all that information at face value you will get nowhere.

RR There are a number of places in the Catalog where you make an ex-cathedra decision. In some places, species disappear, they're still born in the Catalog. These are decisions because they're in your group – a group that you know and understand – and that's the reason that you make those decisions.

NP There are very few examples of that actually. By and large I catalog the literature as a literature cataloger not as my opinions about the literature but there are some cases that are so obvious and so flagrant it would be silly to follow them.

RR One of the reasons I'm interviewing you is because you're the cataloger and it's your fine understanding of The Code and of the final outputs and how they interact that's important. In the final analysis everything is subjective. For example, there are over 5,000 linyphiids. I think, out there.

NP I'd have to check. It's close. There are over 5,000 linyphiids. Probably not quite that many linyphiids. There's no doubt that certainly in that particular family there is incredible minutia. There have no statistically effective generic level classification therefore everything is largely random. They have dozens and dozens and dozens of monotypic genera all of which are in essence statements of total ignorance about the relationships of the other taxa.

RR What I'm thinking about is we're seeing now single species papers.

NP As a reviewer I personally now decline to even look at manuscripts that involve only isolated descriptions in groups that haven't been recently supervised. I don't believe it's a worthwhile activity.

RR And likewise with monotypic genera – if they're out of context?

NP If they're out of context. Exactly. The fact is you cannot publish a legitimate argument for establishing a monotypic genus looking only at that genus. You can't. It's not possible by definition. You have to show that the relationships are such that it is not a subgroup of any currently named taxon and of course many people don't follow that very obvious principle.


For a personal tribute by Tracey Churchill, see page 52.

Norman IRA Platnick (1951–2020)

It is with much sadness that we mourn the passing of our friend and colleague Norman Platnick after a tragic accident. Norman is survived by his son Will Platnick and daughter-in-law Rebecca Ehrlich.

For the video from which this transcript was drawn see www.youtube.com/ watch?v=Myc_-T6ELDU

For a personal tribute by Tracey Churchill, see page 52.
mites are tiny. Most are so small we can ignore their existence, except when we encounter one of the few species able to impinge on our lives. It might be when a greenhouse is attacked by spider mites, capsicums destroyed by broad mites, when we are bitten by fowl mites, a case of scabies, or a beloved moggie with ear-mites — all annoying but usually transitory. Mites then fade into the background again.

mites are everywhere all the time. Multitudes of mites are in soils, in freshwater, in oceans, seething masses on plants, on fur and feathers. In unspeakable places, nasal passages, lungs, eyeballs, cloacas, even burrowing in our hair follicles and skin!

mites are often found in association with insects, where they are far more diverse and no less extraordinary than those on vertebrates.

mites, a big story about small things

mites are the tiniest of all arachnids and the tiniest animals with legs. This allows their exploitation of many unusual habitats. They’re remarkably diverse in species and body form, so much so that we generally treat them as a subclass of the Arachnida, relegating the other arachnid groups to miserable little orders. Yet despite being united in a subclass, few acarologists now consider the group monophyletic.

the enormous Superorder Acariformes (42,000 species) has a fossil history extending to the Devonian, back with all the other ancient groups of arachnids, while the less diverse Parasitiformes (14,000 species) may well be among the most recent of all arachnid groups, with fossils barely being known from the Jurassic and only hitting their stride in the Eocene.

groups

within the Acariformes, mite-insect associations are common in two major groups, the Astigmatina and the Prostigmata.

both of these groups also have many species that do not live with insects. Prostigmata are the live-everywhere-do-anything mites and has the most significant plant parasites.

within the Parasitiformes Mesostigmata is by far the most diverse group (though ticks deserve a mention). Many of these mites form relationships with insects.

What are these relationships? Parasitism
is one of the most obvious, and the scourge of *Varroa* parasitising honey bees is but one example of what impact mites can have on insects. Many other parasitic relationships are more benign, with mites taking all the sustenance they need without obvious effects on their host.

The weirdest of all mites are often parasites, especially those that spend their entire lives on the host, where unusual or reductive morphologies result in animals that sometimes barely look like mites at all.

Some parasites are parasitic in just one life stage. The most common of these are the Parasitengoninina. These mites are parasitic only in the larval stage, often seen on their hosts as red, orange or creamy blobs. Usually they are tiny while their hosts are large. These have little impact. Those that attack tiny bugs, such as aphids, can act like parasitoids. After their parasitic life stage, these mites drop off and become free-living predators, for example red-velvet mites or — if their host was an adult aquatic insect — the water mites.

Kleptoparasitism is also likely for some adult mites that live with their hosts, where they join in the fun when their host kills a large prey item and makes a slobbering mess of it.

Mutualism is also present, but proving mutualistic relationships is tricky and requires detailed study. Typically, mutualists are closely associated with their host in all life stages, and their services are confined to eating on fungi or nematodes that are pathogenic to their host.

Commensalistic relationships are those where mites gain advantage from their association but have no impact on their host. Within this realm is phoresy: a relationship where a small animal uses a larger animal for transport. Mites, being tiny and wingless, are nature’s expert hitch-hikers. They exploit the carrier’s superior mobility to take them from one habitat to another, habitats that are patchy in time and space but resource-rich, for example, dung, carrion, fungi, decomposing plants and rotting logs. Usually, only one life stage utilises phoresy, typically a deutonymph or an adult. These mites must cling on to their hosts. Some seem to do...
so with little more than sucker-like feet, such as the mites found on Panesthia cockroaches or the ameroeud mites on honeybees. Others use their chelicerae to clasp onto setae or bite into the soft cuticle of their host. But others have more extraordinary adaptations: modified claws for grasping onto setae, great suckers for hunckering down on their hosts, or, rather revoltingly, secreting stalks of hard-setting glue from their anus in the case of many Uropodina.

A phoretic relationship can be purely phoretic: the mite attaches to its host, ceases feeding, and obligingly disembarks once they reach their destination. But nature isn’t always so orderly. Sometimes, they might puncture the cuticle and feed, even though they revert to predation in their preferred habitat. For some, their phoretic association is more sinister — a way of staying close to their host so that they can become predators or parasitoids of their host’s eggs and early-instar larvae. Sometimes, mites seem to spend their adult lives with a host without ever feeding on them. For example, the enormous Megisthanus found on passalid beetles are predators and scavengers of small arthropods, yet seem to spend all but the first few days of their adult life in close association with their host, which becomes a place to find a mate and perhaps a safe place to scrounge food. This also facilitates potential transport to a new log, should the beetle experience the urge to migrate.

The other other 99%
Several decades ago, some cheeky entomologists termed the invertebrate world the other 99%, a gleeful jibe at the immense funding put into the 1% of animal life, the vertebrates. And to be honest, as entomologists we were really just thinking about insects, and perhaps arachnids, and turned a wilful blind-eye to the frightening groups of truly tiny animals, such as protists and nematodes.

But could one of these megadiverse groups also be the mites? A paper published a few years ago (Larsen et al. 2017) thinks so. As well as advocating for a vast underestimate of protists and nematodes, they suggest mites could rival or even exceed the diversity of insects. The scientific literature supports them: mites are known from almost every order of insects (only the smallest orders have no records) and most surveys of mites on insects return more species of mites than insects. However, I had some reason to doubt. Some time ago, I surveyed about 1,500 Mesostigmata-invertebrate associations and found a strong bias for host relationships with Coleoptera and Hymenoptera. Not only were they biased at the ordinal level, but also for families within those orders: scarabaeids, passalids and scolytines made up about three-quarters of all beetle-Mesostigmata records, and ants and apid bees made up 90% of all Hymenoptera records.

So, with some scepticism of the results of...
Larsen et al. (2017), I applied for a small ABRS grant to test their ideas while also working on one of my favourite groups of mites, the Podapolipidae. These bizarre Prostigmata are found on several groups of insects but are particularly fond of beetles. They are almost all regarded as sexually-transmitted parasites and, due to this method of transmission, highly host-specific. I reasoned that if there were going to be millions of species of mites on insects, then beetles — as the most diverse group of insects — needed to pull their weight and that the Podapolipidae would have to play an important role. They are not a huge family (ca. 250 described species), but as host-specific subequal parasites known from many families of beetles, perhaps they were underappreciated.

What I did was this: I randomly selected 200 species from the Queensland Museum Insect Collection: 30 species from each of four highly diverse groups of beetles — the Carabidae, Chrysomelidae, Scarabaeidae, and Tenebrionidae. For each species, I examined 10 specimens — externally at first, but then they were soaked in warm water, their elytra gently lifted and then jetted with ethanol to remove any mites hidden there. It’s a slow process, but also a lot of fun for an acarologist, as examining each specimen felt like being a kid opening presents at Christmas. Was it going to be something you were wishing for, or yet another pair of lurid underpants?

And did I smash those ideas of a 1:1 or even 1:4 ratio for mites on insects? Not even close. My survey found over 200 species of mites, and even when I removed collection contaminants (very old specimens were often attacked by mites, and their century-old mite mummies remained) and tourists (free-living mites entangled on insects by accident), there was still 195 species. Close enough to a 1:1 ratio.

Carabidae were very popular with mites (79 spp.) and Chrysomelidae not so much (29 spp.), with Scarabaeidae (47 spp.) and Tenebrionidae (59 spp.) intermediate. No mite species were found across all four families, but four species were on three and nine species were on two, so “tramps” that associate loosely with beetles were present but not a huge part of mite diversity.

However, one of the first indicators that the 1:1 ratio might not be true was the number of described species. This was just 21, but that represents about 10%, which is similar to more restrained predictions that 5-10% of mite species are described (making ca. half to one million mite species globally — see Walter & Proctor 2013). About half those species were from dung beetles, where Bruce Halliday and Michael Costa had worked on their Mesostigmata. In contrast, the most diverse group were the Astigmatina families Acaridae (50 spp.) and Histiostomatidae (22 spp.). These are enormous, daunting families that have never been worked on in any serious way in Australia. Considering Australia’s pathetic investment in taxonomic acarology, it will likely remain this way.

What about the Podapolipidae? Are beetles the source of a huge, hidden diversity of these mites? Not really. Yes, the Carabidae were a rich source, with 15 species, but there were none on Scarabaeidae, just two on Tenebrionidae, and a reasonable seven on Chrysomelidae. Nevertheless, I estimate that if 30% of Australian Carabidae have their own species of Podapolipidae, then we can expect 750 species in Australia alone and 12,000 world-wide. Which is pretty impressive for one family of mites on one family of beetles currently known to host a bit over 100 described podapolipid species.

What determines if a beetle species is going to have mites? The best indicator seems to be size. Mites like big insects. For example, I sampled 17 species of Carabidae with body lengths < 4.3 mm and found just one tramp mite from those 170 specimens. Overall, for beetles < 5 mm in body length, the probability of finding a mite on that beetle species was 16% — compared to 49% for beetles 5-10 mm, 78% for 10-20 mm and 90% for beetles > 20 mm.

Phylogeny also plays a role. Some mites seem to prefer some groups more than others. In the Carabidae the Pterostichini had many more mites compared with all other groups, even when corrected for the larger size of pterostichines. In Scarabaeidae, mites were found equally on dung beetles and non-dung beetles, but once corrected for size, dung beetles are clearly (and expectedly) much more mite-infested than equal-sized non-dung beetles.

I was also interested in how the life habit of mite species affects host specifi city, as this is an important part of making species diversity estimates. As expected, parasites that spent their entire lives on their host were more host-specific (1.4 insect host species per mite species), as were the mite species that associated phoretically but not just for transport (1.5 insect host species per mite species). The species parasitic in one life stage were less specific (2.3) while those that were purely phoretic were usually found on several species (4).

Given the above information, I felt that I could — and should — have a stab at my own species estimate for mites on insects. I stress that
my work didn’t come close to debunking the 1:4 ratio for mites on insects of Larsen et al. (2017) and could even support ideas of a 1:1 ratio (which is what I found!). However, there seemed to be more to it, especially considering the different ratios of mite species to insect species present not only within Coleoptera, but surely other insect groups too.

**Preliminary model**

First, I used my own data or surveys of others (e.g., 3.5 mite species per one ant species, 1 mite species per 50 Plecoptera species) to get a ratio of mite species: insect species in a group (either orders or, within orders, families with > 3,000 species). When there was no survey data — and there often isn’t — I estimated it. First, I estimated a rough size distribution for each order or family of insects (% of species in size classes 0-5 mm, 5-10 mm, 10-20 mm, > 20 mm), and applied to all insect species my probability of finding a mite species on a beetle species according to their size (16/49/78/90%). I then thought about the kinds of mites we knew from these insects. Were most of them parasites in all life stages (1:1.5), parasitic in one life stage (1:2.3) or mostly phoretic (1:3.8)? Or were they a mixed bunch? (1:2.5). This decreased the estimate by the appropriate amount.

However, this alone isn’t good enough. Consider even a small group, like fleas (2000 spp.) - this model would still predict 84 species of mites from fleas which, considering how well-studied they are, is ridiculous considering that mites rarely, if ever, form relationships with them. Diverse groups of bigger insects, such as erebid moths, are even more of a problem: despite just a handful of mite-erebid records, the above estimate suggests there would about 8,000 mite species associated with them. So, to help correct for this, I reduced the estimate by 100% minus 1% for each mite-insect record for that group. Unsatisfactory, but something had to be done!

With this approach, I still find very close to a 1:4 ratio (1:3.4), again supporting the 1:4 ratio of Larsen et al. (2017) but further from a 1:1 ratio. That gives us an estimate of ca. 305,000 mite species that should be associated with the 1.02 million insect species currently described. And it’s the “champion” groups that contribute to this estimate — insects that are large, live close to the ground, live socially or use patchy resources. Mites love these insects more than others.

What’s also important are the types of insects that remain to be described, and how many of them there are. First, the 40.8 million non-mite

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arthropods of Larsen et al. (2017) is on the high side: a more realistic estimate is the 5.5 million of Stork (2018), for example.

No matter how many remain to be described, they’re mostly small, and are in groups that have very few known relationships with mites: microhymenoptera, tiny beetles and flies, small-medium moths, small Hemiptera — all very unlikely to have more than a scattering of mite-insect relationships (albeit likely to be interesting ones, but is there any other sort?!).

Thus, my estimate of 305,000 mite species in mite-insect relationships may not increase too much. Once we add a more likely 1:1 ratio of mites to vascular plants (391,000) and add the very significant contribution of soil mites — perhaps the biggest mystery of all — then hypotheses just pipping the million species mark (= 5% of mites already described) seem more palatable. That’s still an immense number of species. Not quite in the realm of insects, but up there with their most diverse groups, and to describe them is a supremely challenging journey or dark chasm of despair, depending on your outlook!

Acknowledgements
This talk was first prepared for the AES/ASA/SSAB conference last year, and I am very grateful for the support of the Australasian Arachnological Society, for whom I was their nominated plenary speaker. I’d also especially like to thank Susan Wright and Karin Koch, the entomology collection managers at QM, who were very patient with me as I scoured the collection for mites. I’d also like to thank Christine Lambkin and Chris Burwell for their permission to do so; also Geoff Monteith, who collected > 50% of all beetles sampled, indicative of his enormous contribution to the QM collection, and Helen Nahrung, for her kind and helpful comments on an early draft. Numerous people contributed photos to my talk and, in this article, I thank Dave Walter, Jeff Wright and Geoff Monteith. This project was funded by an ABRS research grant and the Queensland Museum. This article previously appeared in the Entomological Society of Queensland NEWS BULLETIN.

References

Colour and movement
Receiving Caitlan Henderson’s images of Cosmophasis darwini from the Northern Territory (see below) brought home to me something I have often contemplated. Colour and movement are key factors in the popularity of spiders.

Peacock spiders, Maratus and Saratus are winning the popularity race, daylight second, with their male dance routines captivating an audience not generally fond of spiders.

Yet there are more colourful species than just Peacock Spiders and in some tropical and subtropical species the females have brilliant colours, sometimes outshining the males.

Peacock Spiders, on the other hand, have drab females, often almost impossible to determine to species without their males and being able to observe a successful mating sequence.

The Peacock Spider males, like peacocks themselves, are incorrigible show-offs, displaying their colourful fan to attract the interest of the female and, more recently, countless macro-photographers.

Once you begin to look into the closeup world you begin to see colour everywhere, in crab spiders, uloborids, orb weavers, arkyids, zodariids, redbacks and relatives, just to name a few. With more videos coming online for diagnostic as well as entertainment purposes, the popularity of spiders will continue to rise.

Cosmophasis micaroides, the female of this species has stunning colours. IAIN MACAULAY

Robert Whyte on the secrets to popular success
I joined the Australasian Arachnological Society because of my interest in creating paintings of spiders.

I am very much an amateur when it comes to knowledge of spiders, their names, habitats and locations, but I am learning every time I paint a new one.

I am fortunate to know Jürgen Otto who has given me permission to use his peacock spider photos as reference material for my paintings—definitely a favourite subject. I have a few other resources who allow me to use their photos too, and of course, I paint spiders that I find and photograph myself. I am also making many new spider friends every day and I love how there’s a community out there who enjoy sharing their knowledge and news about these remarkable creatures.

As a “spider artist” I have a bit of a dilemma because I’ve chosen a subject that the general public would not consider buying and hanging on their wall. This means I’ve limited my market. My paintings are more creative rather than scientifically correct so may not appeal to arachnologists.

So who is my market? I have decided to leave that up to the spider fans of the big wide world. I do have a few loyal fans who continue to buy my art and for that I am eternally grateful.

My mission is to create spider art that shows the beauty in spiders and their homes, and to teach people that spiders are not as scary as the Hollywood movies portray them.

As I continue to paint them, I know I will continue to learn more and more. I am enjoying this journey! You can follow my journey on Facebook (Renata Wright Art), Instagram (Renata Wright Art), or my website - www.renatawrightart.net. Kind regards Renata Wright 0450 524 229.
Comparing Argiope picta with Argiope keyserlingi from a ventral viewpoint. Text and images by Graham Winterflood

Dorsal abdominal markings of female Argiope picta and Argiope keyserlingi vary sufficiently to present no difficulty with identification. From below, however, the markings on female Argiope picta and Argiope keyserlingi look almost identical.

They both have two longitudinal yellow stripes running from beside the epigyne to the posterior of the spinnerets and they both have six white spots between the yellow stripes. Nevertheless, there are subtle differences in the abdominal markings of these species which, taken together, have enabled identification from a ventral perspective alone.

Yellow Stripes
The yellow stripes can be thought of as having two segments. The anterior segment is roughly 60 per cent of the total length and the posterior segment is 40 per cent.

There is a whitish bulge at the join of the two segments, and the posterior segment narrows markedly as it approaches the spinnerets. The yellow stripes on A. picta are generally wider than on A. keyserlingi and flow continuously from the epigyne through the bulge to the posterior of the spinnerets. The yellow stripes on A. keyserlingi are generally thinner from the epigyne to the bulge followed by a noticeable narrowing or even a gap between the bulge and the posterior segment of the stripe. Additionally on A. keyserlingi the rear segment of each stripe is displaced laterally inwards forming a zig-zag join at the bulge.

White Spots
On A. picta the middle two of six spots are noticeably smaller than the outer four, may be circular in form, and occasionally one may be absent. On A. keyserlingi the middle two spots are barely smaller than the outer four and are ovate.

Abdominal Shape
On A. picta the abdomen is longer but narrower than a similarly sized A. keyserlingi.

Supplementary observations
Adult Argiope picta have been observed on webs with stabilimenta composed of just two radials aligned nearly vertically, whereas the similar looking Argiope keyserlingi build web decorations in the shape of an “X” (or parts thereof) of up to four components. On A. picta the leg bands tend to contrast more in colour and be more numerous than on A. keyserlingi. These characteristics may aid with identification in the field.
Thomisids of Wingham

Steve Woodman was intrigued and enthused when he discovered new species of Crab Spiders in his garden. The result was a book on crab spiders with a second one in the pipeline. Here is a taste of his work.

The family Thomisidae, commonly known as Crab Spiders, is rich in form and colour. True to their common name they have a decidedly crab-like appearance. The front two pairs of legs generally are much longer and more robust than the rear pairs. With a distinctive cephalothorax and an inclination to hide in plain sight, they are excellent photographic subjects.

Thomisids are cryptic spiders, mostly around 5 mm in body length, so well camouflaged they are seldom noticed. A dedicated search will be richly rewarded.

Known as a sit-and-wait predators, Crab Spiders do not use webs to catch prey, nor do they actively hunt like Salticidae (Jumping Spiders). They wait on a flower, leaf, grass stem or twig. In a blink of an eye they snatch any unwary insect that strays within the compass of their outstretched front legs. They are able to bring down prey many times their size.

Taxonomy

The taxonomy of Thomisidae is in a state of flux, as are many other Australian spider families, with redescriptions of genera and species regularly appearing in the literature as their relationships with each other are sorted out. This process is complemented by the plethora of undescribed species that are being photographed by amateurs and brought to the attention of taxonomists.

A multitude of forms

Thomisidae come in all shapes and sizes. From the tiny Bomis to the bulky Stephanopis, the long bodied Runcinia, the round Boomerangia, to the trapezoidal Sidymella. In colour they range from the green Cetratus and Hedana to yellow and white Tharrhalea and the smiley-face markings of Zygometis, not to mention the bandit mask of Tharpyna.

Worldwide there are currently 175 named genera and over 2,100 described species of Thomisidae. Of the 23 genera found in Australia, many of which are endemic to this continent, I’ve been fortunate enough to photograph 15 in my local neighbourhood.

Above left a Zygometis sp. From my garden, and on the right a Sidymella sp. From Wingham Brush Nature Reserve. STEVE WOODMAN

Wingham NSW

Wingham is a small rural town situated near the picturesque Manning River in the Mid North Coast of NSW. It boasts a number of nearby national parks, and has several natural areas within its precincts, the jewel in the crown being Wingham Brush Nature Reserve, a small area of sub-tropical rainforest close to

This species, nicknamed ‘Leopard’ is possibly Australomisidia kangarooblaszaki. STEVE WOODMAN
the riverbank preserved and cared for by local volunteers. Here, and in nearby Chrissy Gollan Park, I have found some gorgeous specimens.

When on a photographic excursion I approach each leaf and twig with the anticipation of a gold prospector, and experience the same jolt of excitement as they do on seeing a flash of colour in the pan. Finding and recording Thomisids is a richly rewarding endeavour, and there are truly nuggets to be found in Wingham.

**Edina and Edgar**

My favourite Thomisid is the one which kickstarted my obsession with Crab Spiders. Robert Whyte nicknamed it ‘Edina’ (female) and ‘Edgar’ (male). It comes in a variety of shades from white to hot pink and then onto grape. One of these appears in Robert Whyte
Spiders in general are a joy to photograph, and there are many avid photographers posting exciting new finds on Facebook, Flickr, Instagram and Twitter. Many of us have our favourite family, genus and species, and whatever yours may be, I encourage you to be on the lookout for crab spiders next time you’re turning over a leaf — you won’t be disappointed.

Text and images by Steve Woodman


While the authors noted specimens are strangely rare in museum collections, I think these will represent just the tip of the iceberg, in terms of range of Jotus which are likely to be described over time. I find them to be quite common in the wild and have many photographs of undescribed species.
David and Fleur Knowles of Spineless Wonders were employed by the Bungendore Park Environmental Group to carry out a macroinvertebrate sampling regime.

The first stage was a desktop survey. The second stage involved sampling macrofauna to produce new records.

The sampling regime focused on three day-night samples of two dominant tree species, Yarri in January and Marri in full flower later in summer and the third day-night in the botanically-diverse Cooliabberra Spring area in late spring.

Unexpected biodiversity sampling boons came in October 2016, September 2017 and August 2018 when members of the WA Insect Study Society spent time in the park in prime collecting conditions.

**Background**

Bungendore Park was gazetted as a reserve in 1897 for timber extraction. About five kilometres from Armadale city centre, along the Albany Highway, this 498 ha reserve is a fine example of remnant Jarrah forest, with Jarrah-Marri, Wandoo and Yarri associations. It is of great value environmentally and as an amenity. In 1908 the reserve was reclassified as an 'A' class reserve and the vesting purposes changed to Parkland.

Situated on the western edge of the Darling Scarp, the park includes a wide range of soils, topography and vegetation types, resulting in a rich and diverse flora and associated fauna. It provides habitat for all three species of the black cockatoos unique to Western Australia.

The park was officially named Bungendore Park in 1973. A management committee was established in June 1981. It has always had a member of the Armadale Branch of the Wildflower Society of Western Australia on the committee. It is virtually weed free.

Research over the years has focused on birds of Bungendore Park and other vertebrates, including a PhD study on bats. These have been well documented in publications.

With the rich diversity of the flora, the management group decided that the macroinvertebrates of the park needed to be studied, not just as a record for Bungendore Park, but also as key example for use in bush management locally.

**Interested to know more?**

If you would like to follow up on the survey referred to here, write to David and Fleur Knowles info@spinelesswonders.com.au

Up until February 2015, the fauna list for Bungendore Park was only known for a small number of amphibians, reptiles, birds and mammals.
A new Australian subfamily of garden orb-weavers

Australian Biological Resources Study is funding the taxonomy and systematic of the ‘backobourkiine’ spiders. Story by Pedro Castanheira & Volker W. Framenau, Harry Butler Institute, Murdoch University WA.

In Australia, a total of 207 species elevate the Araneidae to one of the most diverse spider families based on the number of described taxa, only trailing the jumping spiders (Salticidae — 466 species) and the ant-eating spiders (Zodariidae — 257 species). For all these, real diversity is likely to be higher by a factor of between 3 or 4.

For many, justified or not, the large orb-weaving spiders in the family Araneidae hanging upside down in an orbicular orb-web epitomise what a spider is.

Members of the Araneidae have been the subject of considerable ecological, phylogenetic and evolutionary research. These studies investigated some classical evolutionary problems, e.g. the evolution of web forms (including the form and function of web stabilimenta), but also addressed spider mating behaviour (e.g. sperm competition and sexual size dimorphism) and foraging tactics. Araneid spiders have also been the focus of considerable applied research investigations, e.g. in pest control, pharmacology, venom research and the mechanical properties of silk (see references in Scharff et al. 2020).

Scharff et al.’s (2020) world-wide molecular systematic study on the Araneidae has, for the first time, established testable hypotheses at the subfamily level for the Araneidae and therefore provided the systematic framework to tackle the taxonomy of this diverse group of spiders in manageable clades of related species. The study showed a highly paraphyletic ‘Araneinae’ (a subfamily based on the genus they were historically described in — Epeira — today a junior synonym of Araneus) and the Australian fauna split into at least two large clades representing new regional subfamilies of orb-weaving spiders, termed the ‘Backobourkines’ and the ‘Zealaraneines’ in addition to some species currently misplaced due to lack of phylogenetic support.

The Australasian ‘backobourkiine’ clade includes some of the largest and most conspicuous orb-weaving spiders in Australia, including many of the colloquially termed and ubiquitous ‘garden orb-weavers’. The objectives of our ABRS funded project are to molecularly and morphologically characterise and establish a new subfamily of orb-weaving spiders for the ‘Backobourkines’ (currently mainly known from Australia) and develop a taxonomic and systematic framework for all genera of the subfamily. It will revise ca. 50 described species, many currently misplaced in the Holartic or Nearctic genera Araneus and Eriophora, and describe an estimated 80 new species in a total of 15 genera. Currently valid genera that belong to the ‘backobourkiines’, some reviewed or revised, include Backobourkia, Plebs, Lariophora, Acroaspis, Carepalxis, Novakiella and Singa (Scharff et al. 2020).

The project will be spearheaded by Pedro Castanheira and Volker Framenau based at the Harry Butler Institute, Murdoch University, but represents an international collaboration with Ass. Prof. Abha Chopra (Institute for Immunology and Infectious Diseases, Murdoch University where the molecular analyses will be conducted), Prof. Nikolaj Scharff (University of Copenhagen), Ass. Prof. Dimitar Dimitrov (University of Bergen) and Dr Renner Baptista (Federal University of Rio de Janeiro).

The significance of the project reaches beyond its main geographic scope. It will also provide the baseline for other taxonomic revisions of Araneidae from neighbouring countries as backobourkines are known from the Pacific region, South-east Asia and China. Similarly, the revision of the garden orb-weaving genus Plebs documented the distribution of the genus to reach into Asia and also identified species on the Indian subcontinent providing testable hypotheses (dispersal vs vicariance) of far-reaching biogeographic relevance (Joseph & Framenau 2012). Additionally, solving the phylogenetic relationships of the backobourkines, including an interpretation of morphological characters and their evolution, will greatly inform evolutionary patterns beyond the subfamily level.

The project will commence in January 2021 and run over three years, currently delayed by six months due to COVID-19 related travel restriction for Pedro Castanheira to relocate to Australia. It will benefit greatly from a previous ABRS-funded research grant during which Volker Framenau and Nikolaj Scharff have already examined and in many cases illustrated species of Australian backobourkines. Please drop us an email if you have any questions or specimens for examination for this exciting project! Email: pedrocastanheira.bio@gmail.com

References


The genus Carepalxis belongs to the ‘backobourkiine’ clade that is the focus of a taxonomic and systematic revision at the Harry Butler Institute, Murdoch University (2021–2023). Males of the genus are diagnosed by genitalic characters of the complex pedipalps, a strong spine on the tibia of the second leg and the shape of the cephalic area.
In May 2019, I had the good fortune to be invited to accompany two botanists to Queensland to work on Cycas. What?! Plants? Well, I’ll never pass up a trip to uncharted (or even charted) selenopid territory. I must fulfill my dream of visiting every pile of rocks in Australia.

The botanists were Manuel Luján, at my institution (California Academy of Sciences), and Patrick Griffith from the Montgomery Botanical Center in Florida. I was the general factotum, guide and troubleshooter on the trip, getting the opportunity to search for my beloved Karaops whenever I could.

With Karaops it can be either feast or famine. Every place I’m sure they will be, I can’t find them. Every place I’m doubtful they will be found, they are swarming all over the place. Rarely do the stars align, at least in Queensland.

Around Coen I was able to collect several specimens of Karaops monteithi, including the undescribed male. There had been some sightings of Karaops near Cobbold Gorge, and looking around in that area produced members of a new species.

Granite Gorge is nearby and looks like it would be full of selenopids – but there were only vicious rock wallabies to be found.

They aren’t difficult to rear... but it does take a lot of patience and focus since they take a while to mature. As of this writing, more than a year later, there are some that are still not adults.

At Mt. Inkerman Lookout, which is especially interesting because it is an isolated hill surrounded by flat farmland, I found more...

Growing them on

Arachnologists determine species by looking at spider genitalia. Subadult spiders, however, do not have genitalia. In some locations I only had sub-adults. It would be such a shame to find new species and verifying them with DNA, yet to be unable to describe them.

Luckily, one of Robert Whyte’s colleagues, Liam Bromley, took on the task of rearing a significantly large number of specimens. As a result many new species will have full, valid descriptions from multiple specimens.

They aren’t difficult to rear... but it does take a lot of patience and focus since they take a while to mature. As of this writing, more than a year later, there are some that are still not adults.

When I returned to California, I received a loan from the Queensland Museum, with a number of selenopids Robert Raven had fossicked out of the collection. They were from areas near where some species had been found previously, so I assumed they would be those species. Guess what... They weren’t. And they were new.

I was actually supposed to have done another trip with Manuel this year – it was going to be great!

But then coronavirus came along. The good thing, though, is that it has provided me with plenty of time to get the new species described. This means things are looking good for being able to submit a paper this year, and with the new material continuously arriving, for years ahead.

Images: Opposite page Mt. Surprise Station, above Dinosaur Stampede NP, bottom left Karaops sp. n., O’Brien’s Creek, bottom right Karaops sp. n., Boodjamulla.
Huntsman subdued and carried off

Here, a Huntsman spider subdued and carried away by a pompilid wasp.

Brian Jenkins has witnessed this several times in recent years in the backyard of his home in Safety Bay, Western Australia. The wasp’s nest is usually located in the roof of the house. The spider is dragged up the brickwork after being immobilised.

Photos 1-5 by Brian Jenkins. Photo bottom right, some sphecid wasps also provision their nests with spiders. These mud dauber nests contain multiple smaller spiders, unlike the pompilids that use one large prey item. HELEN SMITH

Call for *Heteropoda* photos and specimens from the Sydney area

If you see a *Heteropoda* sp. in the Sydney area please take a photo, jot down date, time and location and notify Helen.smith@austmus.gov.au. Experienced spider handlers will be invited to collect specimens.

I am investigating the distribution of *Heteropoda* species in the wider Sydney area. The species *H. longipes* was the only Australian *Heteropoda* species recorded from Sydney by Davies (1994), although a specimen of *H. venatoria* was also noted.

However, since that time, *H. jugulans* has established and is now common in some areas, possibly another species is present too. To help inform correct identification on platforms such as iNaturalist, where any Sydney *Heteropoda* photo seems to get automatically identified as *H. longipes*, I am hoping to publish some information on the distribution of the species and provide some pointers to aid identification from photographs only.

I am interested in specimens alive or dead, and clear photos. Medium to large juveniles may be of use in addition to adults.

My main region of interest is from Newcastle to the Illawarra and Blue Mountains. Clear photos of whole spiders and closeups are both good, and ventral shots are extremely useful. If you catch a spider alive then need to kill it before I can take it, please take photos first because parts of the abdominal pattern may change in alcohol.

Date and suburb or area are essential information.

Old photos scanned from slides would also be very useful. If you think *Heteropoda* have recently appeared or disappeared in your area, that is useful information too.

If you can help, please contact me via my Australian Museum email address, or send photos via a file transfer or Dropbox system. Thanks everyone!

Contact: Helen.smith@austmus.gov.au

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*Heteropoda longipes,* female, April 2020, photographed in a clear CD case to show relevant dorsal features.
Two stunning Bellawongarah spiders

In early 2018, I was fortunate enough to stumble across one of the most striking spiders I have ever seen. This spider, which appears to belong to the genus *Arkys* [see editors’ note below], I came across during a night walk in a small gully in Bellawongarah, NSW. The gully was full of arum lillies, which seem to provide habitat for a wide variety of spiders which sit out on the leaves in the dark.

This *Arkys* sp. was found sitting just on the edge of one of these leaves. Its body length (excluding legs) was approximately 10mm.

Just a couple of months later I came across another stunning spider in the same area. This time belonging to the family Sparassidae. With its legs outstretched, the sparassid spider had a leg span of about 50 mm in diameter.

I was amazed by its orange leg segments, green cephalothorax and its white abdomen with prominent dark-orange dots. Many sparassids are quite dull in colour by comparison, often only shades of brown and grey. If this one is immature, which seems a possibility, there’s a chance that these colours might not reflect what the adult form looks like. I haven’t been able to track down any info regarding this species so far. Hopefully I can find these spiders again so that they can be studied in greater detail.

Editors’ note. This story ran as a supplement to issue 88. Since then we have discovered the spider below looks like *Arkys enigma*, described from Tasmania in 2019. Editor Helen Smith has a nagging feeling the Huntsman is a ‘known unknown’ but hasn’t been able to find the reference in her files.

Below, a beautiful *Arkys* sp. possibly *Arkys enigma* and opposite, a stunning sparassid. LINCOLN MACGREGOR
Searching for and finding Periegops

For an Australian travelling across the ditch to New Zealand, a search for Periegops is a must. It’s the only practical way of seeing this genus, which although it has been reported from Queensland, Australia, no specimens have been found in the sunshine state since the early 1980s.

An opportunity to locate and look at this genus came when arachnologists gathered in New Zealand for the recent arachnological congress reported in the previous issue, Australasian Arachnology 88.

Periegops is a genus of spiders with six eyes, rather than the more common eight. It is the only genus in its family Periegopidae, considered to be in Segestriidae until Raymond Forster elevated it to family level in 1995.

The genus Periegops was first described in 1893 by Eugene Simon from a specimen he named P. hirsutus (a synonym of P. suterii named by Urquhart in genus Segestria).

Periegops occur in forest habitat featuring fallen logs, deep leaf litter layers and well drained soil.

No Periegops species has been observed creating webs for prey capture, instead they use silk to create drag lines and silk retreats. Periegops are likely all fast moving, nocturnal hunters.

In P. suterii, females have been found with two to three males with them, which may imply that the female has a way of attracting males.

Hinewai Reserve was initially a 109 ha block of farmland bought by the Maurice White Native Forest Trust in September 1987 and is now 1230 ha of gorse and regenerating native bush.

News

Polish arachnologists studying Australian Jumping Spiders — continuing the tradition

Hi, I’m Łukasz Trębicki, a biologist focused on arachnology. Currently I’m working at the University of Lodz in Poland.

My research is focused on Australian jumping spiders since I’ve started my PhD project at the University of Natural Science and Humanities in Siedlce, Poland under the supervision of Professor Marek Zabka.

In my thesis I sought to solve a number of taxonomical problems with Cytaea, an enigmatic, ‘puzzling’ jumping spider genus.

Applying an integrative approach, I established monophyly of the genus, the distribution range and the location of diversity hotspots. I found that the number of Cytaea species is highly underestimated and the genus itself is an interesting model for future studies, for example, on the impact of sexual selection on species and genus evolution. At the moment I’m completing data for publications where redescriptions and taxonomic changes to Cytaea species will be included. Many representatives were described in the 19th century and their identification to the species level is problematic. This kind of basic research will allow for complete revision of the genus and proper new species descriptions.

In the last months I’ve been working abroad, starting new projects. November 2019, I participated in an expedition to the Philippines and in January/February 2020 in Thailand with zoologists and botanists from University of Lodz. One of the important goals of the University of Lodz is supporting and developing research on biodiversity of tropical regions, mostly in the Philippines, Thailand and Colombia. During the expeditions I’ve been focused on collecting jumping spiders and information about them to enrich the knowledge about the diversity of their taxa in tropical regions and also about the history of evolution and distribution of genera.

In December 2019 I visited Australia participating in the Australian Entomological Society Conference in Brisbane.

After the conference I met Robert Whyte, we did some fieldwork and lab studies on jumping spiders. In following weeks I made research visit at the Department of Jobs, Precincts and Regions, Agriculture Victoria Research, of AgriBio, Centre for AgriBioscience, Horsham, Victoria. In Australia I’ve been focused on enriching knowledge about Salticidae and their habitats. I’ve been collecting spiders, data as well as photographing living specimens. This was a very fruitful time.
Distribution of specimen records of 11 new species of New Zealand Malkaridae. We also treat the phylogenetic relationships of Malkaridae and use the results of our previous work on the molecular phylogeny of Araneoidea as the bases for the classification of the family. We further hypothesise and discuss the morphological synapomorphies of Malkaridae, Tingotinginae, subfam. nov. and the two new genera.

Tawhai, gen. nov., Harlanethis, gen. nov., and Iamarra, gen. nov.
We also synonymise Nediphyx Marusik and Omelko, 2017, and the monotypic genus Erycinthola Strand, 1912, with Nanometa, bringing the total number of species in the genus from one to 14.

Nanometinae and its constituent genera Nanometa and Pinkfloydia are reciprocally monophyletic. Harlanethis belongs to Leucauginae.

The malkariid spiders of New Zealand, Hormiga, G. & Scharff, N. 2020
Malkarids are small araneid spiders that live primarily in the leaf litter and mosses of temperate and tropical wet forests in Australia and New Zealand, with the exception of a single species in southern South America and another in New Caledonia. We treat the New Zealand species of Malkaridae that are not members of the subfamily Pararchaeinae, a monophyletic group of 11 new species that we classify in 2 new genera (Tingotingo, gen. nov. and Whakamoke, gen. nov.) and a new subfamily (Tingotinginae, subfam. nov.). We describe, diagnose, illustrate and map the distribution of specimen records of 11 new species of New Zealand Malkaridae. We also treat the phylogenetic relationships of Malkaridae and use the results of our previous work on the molecular phylogeny of Araneoidea as the bases for the classification of the family. We further hypothesise and discuss the morphological synapomorphies of Malkaridae, Tingotinginae, subfam. nov. and the two new genera.

Unfinished web of Iamarra multitheca at the base of a tree from Crater Lakes National Park, Queensland, Australia. Several turns of the nonsticky temporary spiral remain in the web. GUSTAVO HORMIGA

QuestaGame and Innovative Technology
What’s your favourite Star Wars creature? The slimy dianogas with their single bulbous eye? That big-eared, crystal-furred vulptex in The Last Jedi? Or is it the spiny orb-weaver with its wide, bright yellow abdomen covered in spikes? This last one, of course, was never in Star Wars. But it could have been. As could so many spiders and other flora and fauna people are discovering every day while playing the popular QuestaGame mobile app in their backyards, neighbourhoods and parks.

“Spiders and moths are the ones people get most excited about when they make new discoveries,” says Mallika Robinson, co-founder and board member of the Cairns-based Earth Guardians, the company that develops QuestaGame.

Discovery is what Earth Guardians is all about. The company builds digital technologies designed to awaken people to the miraculous creatures all around them.

With sponsorships from CSIRO, Google and the Ministry of Industry, Science and Technology, QuestaGame launched the Bushfire Recovery BioQuest (https://questagame.com/recovery). Since March, QuestaGame players have submitted over 20,000 observations, over 45,000 identifications, and mapped nearly 2000 unique species in the bushfire zones.

Then came COVID-19. Parents and teachers were suddenly working from home, looking for STEM activities.

“So we decided to launch our Science at Home program, which saw 150 schools from around the world sign up in less than a week,” says Robinson. “They formed teams and competed in our Schools BioQuest (https://questagame.com/schools).

While Earth Guardians is most well-known for QuestaGame, the company is working on other groundbreaking projects, including the BioExpertise Engine (BioExpertise.org), an Indigi-Quest project for indigenous knowledge, two brand new games for younger audiences, and an app called QuestaPro designed for researchers, ecologists and those interested in running a citizen science project to map specific taxon groups.

These can be seen at https://launchpad.earthguardians.life (password = liftoff).

In August, during National Science Week, QuestaGame will run its annual GreatAussieBioQuest.com), the largest bioblitz in Australia — part of a federally funded program with Inspire Australia and round two of QuestaGame’s World BioQuest.

Given recent partnerships with the Ministry of Education in India and SciStarter in the US, the company expects a larger contingent from South Asia and the US this year. Recently Australia Post honoured QuestaGame with a “citizen science” postage stamp. If the tribute is any indication, perhaps Robinson’s message is starting to be heard.”We’re busy pioneering technology to accelerate the mapping and conservation of life on Earth. It’s a perfect time for Australia to step up and declare itself the world leader in biodiversity technology.”

Story by Mallika Robinson QuestaGame images compiled by Andrew Robinson
News

Let’s be social spiders!
Increasing online engagement in arachnology across Australasia

In light of many working from home and living more isolated lives, we’d like to ramp up our community engagement. Being physically isolated doesn’t have to mean being socially isolated!

With so many activities now online it’s easier than ever to share our love of arachnology across Australia.

Dr Lizzy Lowe from Macquarie University will be coordinating a range of events for the society including a seminar series, online identification workshops and the sharing of recent published work in the area of arachnology. So keep an eye out! If you have additional ideas for activities or ways you’d like to get involved please send Lizzy an email lizzy.lowe@mq.edu.au

We’re also keen to encourage arachnology discourse online, so if you haven’t already, please join our facebook group https://www.facebook.com/groups/988885801306639/ and follow us on Twitter!

Below Dr Lizzy Lowe with promotional poster and puppet.

Awareness skills through education
Increased heart rate, heavy breathing, the compulsion to run away or reach for the rolled up newspaper are well-known reactions many people experience when they see spiders.

The team at Critterpedia wants to change these negative mindsets with their interactive immersive educational platform.

Critterpedia will allow a user to take a photo of a spider (or snake) with a smart device. Its trained AI algorithm will attempt to identify the photo to family, genus or species level.

Successful in securing CSIRO Kick-Start funding for this part of the project and, in collaboration with CSIRO’s Data61, Critterpedia is building a machine learning engine for automated spider and snake identification.

To realise their goal, Critterpedia has developed positive business relationships with CSIRO, Ignite Alliance, SingularityU, Josephmark and Advance Queensland, just to name a few.

With the help of advisors including Robert Whyte and a further 29 of Australia’s top spider and snake experts, Critterpedia has been able to jam-pack their platform with all kinds of awareness, safety and educational tools.

The founders Nic and Murray Scarce have seen their journey continue to morph and pivot the further into this adventure they get. What started solely as an identification app is developing into a more rewarding social enterprise that aims to eventually join forces with similar organisations to tackle biodiversity issues.

“Critterpedia will be partnering with other organisations to contribute our strengths with the ultimate aim of safeguarding and restoring our environment,” said Murray Scarce, Co-founder and CEO.

“It is obvious that the human element is the constant factor with regard to damage to our environment. Our team believe changing peoples’ mindsets and reversing their phobias can be one of the keys to positive environmental change. Changing mindsets starts with education. That is where our focus needs to be. We felt we had a responsibility to extend ourselves beyond business into social enterprise.”

From fear to fascination
“Spider enthusiasts especially are an incredibly welcoming, generous and tight knit community. We really want to give back to them, the herpetology community, and science, particularly citizen science, in any way we can. We strongly believe acknowledging these experts, including our citizen scientists, is critical. They make a lot of discoveries and put an incredible amount of work into the field, work often overlooked or under-rated. By incorporating education with really cool technology, we’re hoping to bring people closer to nature, allowing us all to happily coexist,” said Murray.

www.critterpedia.com
www.facebook.com/critterpediaapp
hello@critterpedia.com

Below Maratus volans, the ‘Flying’ Peacock spider, is shown displaying in courtship. Peacock spiders, winning hearts and minds all over the world for their colourful dancing, are only found in Australia, and are very small, adults from about 2 mm to the largest at around 7 mm. As far as we know, they are of no medical importance for humans. Illustration by KDS444 cc-by-sa-3.0
Tribute to Dr Barbara York Main

Leanda Mason and Patricia Kennedy have given their permission to reproduce an edited version of their tribute here to honour the life of the late Adjunct Professor Barbara York Main. The full piece was published by CSIRO in Pacific Conservation Biology.

Barbara York Main was a Renaissance woman, one of those rare individuals who succeeded in multiple vocations. Her passion for south-western Australia was evident in her essays and books on nature that focused primarily on her birthplace in the Central Wheatbelt. She conducted many of her scientific investigations and enjoyed camping adventures with her family in this region.

Her talent brought to life the natural beauty of the Wheatbelt, as well as the social and ecological history describing how Wheatbelt settlement had separated this landscape from its ancient ecological patterns (Main 1967, 1971, 1993).

Barbara was born in 1929 on a small farm in Tambarin, in the Central Wheatbelt. She had four brothers. Her family farm had approximately 8ha of ‘nice bush around the homestead’ with abundant native biota. She loved exploring, and insects particularly intrigued her.

Barbara started high school with correspondence courses up to her junior year then was awarded a scholarship that supported her boarding costs at Northam High School, where she matriculated.

She knew that if she wanted to pursue entomology and nature writing she would have to go to university. In this she followed her mother who had been one of the first female students to attend the University of Western Australia (UWA).

She completed her Honours degree in Zoology at UWA in 1950 where she met Bert Main, ‘friend, colleague, and beloved husband’. He was also a Zoology undergraduate. They married in 1952. They both were awarded doctorates from UWA in 1956; Barbara was the first woman to earn a Ph.D. in Zoology from UWA.

Her doctoral dissertation concerning the evolution of trapdoor spiders synthesised the emergent paradigm of ecology with the older and well established biological disciplines of natural history, evolution and biogeography.

Barbara wrote four books and over 90 scientific papers and book chapters. ‘Between Wodjil and Tor’ (1967) and ‘Twice Trodden Ground’ (1971) are classic accounts of the environmental costs of clearing native vegetation for the development of broadscale agriculture in the Wheatbelt. She was recognised nationally and internationally for her prolific work on the natural history, biogeography and taxonomy of mygalomorph spiders.

She studied the oldest known spider, which she named ‘Number 16’ from its birth in 1974 in North Bungulla Nature Reserve to its death in 2016. In 1981, the BBC and ABC produced a film about her work, ‘Lady of the Spiders’.

Barbara and Bert had three children, Rebecca, Gilbert and Monica. According to Monica, Barbara was a ‘very loving and supportive mother, with a playful sense of humour’ who ‘enjoyed reading children’s books aloud, just as much as [her children] enjoyed listening’.

She died on 14 May 2019. A loving family, and a community and scientific legacy remains.

Poem for Barbara York Main

by Dr Leanda Mason

Over time and career we learn and we teach
Share knowledge and wisdom with those we can reach
From formal instruction in methods and fact
To personal doctrines that shape how we act
Sometimes we’re lucky and we will be blessed
With a capable mentor who inspires our best
Respected and learned in their field or skill
We follow direction, a vessel to fill
Barbara York Main was a lady I followed
Down paths she has cleared, into niches she’s hollowed
In hindsight it’s taken me years just to process
The foresight that Barbara invoked towards progress
A woman of science, a pioneer true
Earned on her own merit and helped herself through
Hostile environments inside and out,
Endured for pure research, not standing or clout
Though humble, reclusive and hidden from sight
Her books and her papers would shed quite a light
On my personal interest to study her spider
I soon had a goal and sat down beside her
Her patience, wisdom, and determined resilience
Earned on her own merit and helped herself through
A woman of science, a pioneer true
The foresight that Barbara invoked towards progress
In hindsight it’s taken me years just to process
Without any kudos or gain from this part
Longitudinal work in its slow onward grindings
Bestow on the next generation deep findings
And then there’s the story of #16
The oldest of spiders the world had yet seen
A trapdoor whom Barbara discovered and tagged
Went virally famous when dead it was flagged
Though honoured to speak on behalf of the study
It pains me that Barbara’s thoughts then got muddy
Too late moments of praise, recognition of worth,
Efforts and great contributions to earth
So much achieved, so much more to contribute
A lifetime of lessons passed on to distribute
Through publishing, teaching or close demonstration
Humanity learns only from collaboration

Barbara York Main

Surveying North Bungulla Reserve in 2015. Grant Wardell-Johnson.

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I am really pleased to be able to write this article as it gives me a chance explain some early thinking behind starting this enterprise; ‘Ecoconnections’.

I am also particularly excited to follow Darko Cotoras’ article on ‘An ancient connection across the Pacific’ and his comment on permeating “our collective unconscious of the biological identity of where we live”. This comment goes to the core of the fun, joy, interest and impact of what an ECOCONNECTION aims to contribute.

Put simply the goal of Ecoconnections is to connect every species to a person. It costs US$100 per species. The reason behind the cost is to raise funds for taxonomy research.

I first came to arachnology working with Integrated Pest Management (IPM) in Tasmanian Apples. Not only are arachnids colourful, interesting and fun; some are doing a great job in crop protection. Thyphlodromas pyri for example is an amazingly effective predator of the Two Spotted Spider Mite (Tetranychus urticae), the European Red Mite (Panonychus ulmi) and probably other Eriophyid mite pests too. Moving apple leaves around orchards and vineyards allowed establishment of this predator, essentially eliminating the need for chemical control of these pests.

My role was in extension and industry development. Extension is about getting information out of research papers and into practice. This means thinking through adult learning and how farmers engage with scientific information.

**Integrated Pest Management involves**

1. Understanding pest and disease lifecycles and ecologies.
2. Monitoring seasonal populations and conditions.
3. Applying biological, chemical and cultural control in response to economic damage thresholds.

**Integrated Pest Management can deliver benefits in**

1) Better pest and disease control
2) Fewer and/or more targeted chemical applications
3) More enlightened and enjoyable farming

To engage people, we needed to make it fun. This was not hard. From pointy-nosed mites sucking the guts out of grazing pests to earwigs chomping aphids and lacewing larvae disguising themselves with a coat of corpses. Looking down a microscope is like watching Ridley Scott ‘Alien’ movies. The dynamics of orchard and vineyard ecology in Tasmania is fun! There are also lots of unknowns.

In writing this article I am pleased to again connect with Owen Seeman. Owen was working as an entomologist with the Tasmanian Newtown Research Laboratories insect collection upstairs from me when I worked in IPM. You can see from Owen’s article how this workplace stoked a fire of interest in the ecology, behaviour and taxonomy of arachnids. Owen speaks here with expert clarity about the different types of relationships between species. What one species means to another is defined in these relationships. Clear thinking people like Owen, and you all, can promote interest in arachnology and biology. Observation and friendly discussions, like mine with Owen, can help uncover these meanings for a broader understanding.

I am particularly interested in the relationship between one species, us, and all others. We have relationships like food, exploitation, pets, pathogens. IPBES recognise that indigenous peoples tend to manage landscapes with less species losses. One common approach in indigenous cultures are totems. An ecoconnection is a bit like a science-age totem, though not the same. A farmer watches biological dynamics with an eye for optimising yield. Just as a farmer can get a richer understanding of his system so perhaps could everyone gain this window on the meanings in the relationships of life, without the pressure of a financial bottom line.

Naming a species gives us an ability to build a more specific understanding of a species. It is a first step. There are so many unknowns, how can we best chip away at them? Sometimes there are practical and urgent crop protection and biosecurity reasons to uncover these relationships. Mostly not. So many species… but even more people. It is a delegation challenge! Once you have a name, at some stage, your mind might turn to ‘how is it doing?’ This is where an ecoconnection can help make life more enlightened and enjoyable. Once you tell someone about your species, the knowledge lives. This is why we have structured ecoconnections as a gift. It builds in some personal encouragement. Understanding relationships with other species is fun. It is also potentially useful for their sake and ours.

**Spiders in Agriculture**

Given a history in IPM I was excited to develop an ecoconnections funded project that could potentially be useful in agriculture. Such a project would benefit farming communities in helping them understand their own systems. It could also benefit consumers in that there could be options discovered to enhance spider populations for pesticide reduction. This is where I started talking to the ever-enthusiastic Robert Whyte.

‘QuestaGame’, currently renaming to ‘Earth Guardians’, are a first partner with ecoconnect. Funds raised from ecoconnections are provided to QuestaGame to fund the ‘Pays to Know’ bioexpertise engine. This system pays identifiers (to their preferred conservation partner) for identifications submitted to the system. QuestaGame also has a capacity to assist farmers in understanding what species of spiders they have in their systems. Andrew Robinson from QuestaGame said I should speak with Robert and we got moving.

So, there are two ‘calls to action’ in this article.

1) **Engage with ecoconnections**
   a. Get ecoconnected and encourage others to do the same.
   b. Encourage consumers and everyone to ecoconnect.
   c. Encourage farmers and farmer groups to ecoconnect.
   d. Large donors can ecoconnect many people for free and focus on specific projects. This will help us fund projects.

2) **Encourage farmers and farmer groups to play QuestaGame (for free) and look for spiders**.

This will give data in specific systems. We could establish specific industry ‘spider-blitzes’ if there is interest in a more detailed understanding of a particular agroecology.

Ecoconnections has produced short video explainers of different aspects of the enterprise. These are some stills from these video explainers. https://www.ecoconnect.me
Remembering Norm – Dr Norman Platnick

In April 2020, the arachnological community lost a professional icon. I was privileged to have known Norm and benefited from his incredible knowledge of, and enthusiasm for, our wonderful Aussie arachnids.

I first met Norm in 1987 when I was surveying coastal heathland spiders for the Queen Victoria Museum in Launceston, Tasmania. I was delighted to have arachnophilic company when Robert Raven from Queensland Museum guided Norm to the Apple Isle to extract new secrets from the unique temperate rainforests. As Curator at the American Museum of Natural History, Norm had funds to revise anapids, micropholcommatids and sister taxa in the Southern Hemisphere. In seeking these tiny litter and moss-dwelling cuties, my ability to quickly spot specks of dirt with eight legs in litter trays soon gave me cred. Even then, Norm wore very thick glasses.

In the expedition around Tasmania, we discovered new species that filled the pages of Norm and Ray Forster’s 1989 monograph and other papers, and I was rapidly educated about the Gondwanan ancestry of these fascinating taxa.

One particular discovery was most memorable. As the more agile members of the team, Rob and I had to scramble into a cave down a ravine to seek the valuable prize of tiny orange specks on centimetre-wide webs on the limestone walls. We were relieved to find some and dutifully aspirated them into the sample vials, only to find that they did not make the journey. After a few of these failures, we shared our mutual conundrum and then realised the scary truth: the gauze mesh of the pooter was too large! With our professionalism clearly at risk, we quickly rebuilt the pooters with doubled over mesh and with great relief, presented our precious consignment to Norm. It was only after some delicious Australian red wine over a hearty meal that we confessed to Norm that we had, in fact, already eaten!

After working on barychelids with Rob Raven at the Queensland Museum, I went to the Northern Territory to tackle the arachnological frontier of the tropical savannas. Another decade and another inspirational visit from Norm. He was touring Australia alongside Vladimir Ovtsharenko and Kefyn Catley with a particular focus on gnaphosoids and their relatives.

Norm thought it was a prank when I asked him to identify one particular spider that I had found in my kitchen sink at Humpty Doo. Upon investigating the specimen he declared in a very surprised and unusually loud voice, “Oh my, you’ve got a cithaeronid.” The first record of the family Cithaeronidae for Australia!

I later spent a week in New York with Norm at the AMNH where he generously tutored me in the unique morphological attributes of many species, especially gnaphosids and prodidomids.

Norm was a kind and patient man with a good sense of humour. I am truly sad that I will not again have the privilege of surprising and delighting Norman Platnick with a new spider discovery. I treasure the memories.