Over-invasion – a useful concept in Biological Invasions?

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Invasive species are becoming ever more common in the ecosystems we research and manage. There is now a strong body of literature demonstrating how these species interact directly and indirectly with one another, and how this affects native species in the communities. With so many invasive species it is not surprising that in many locations very similar invasive species will be present. From a broader community impact perspective the subtleties among impacts of similar invasive species may be negligible, but interactions among very functionally similar invasive species could nonetheless have important outcomes.

Through my own work on three invasive rat species over the past ten years I became interested in what may cause the checkerboard pattern of these rat species on islands across the Pacific, and what the outcomes of this may be for island biodiversity. Although the difference in impacts between cats and rats on islands is clear (Towns et al., 2011), the difference in impacts of black rats from brown rats is also important (Jones et al., 2008). The results of the exercise revealed two forms of over-invasion. A propagule pressure effect occurs when two invasive species are simultaneously colonising, but one finally dominates, even if it is less competitively superior, though a numerical advantage. An incumbent advantage effect occurs when one invasive species resists invasion by another, even if the incoming one is competitively superior. The concepts of propagule pressure and incumbent advantage (aka priority effects) are not new to Invasion Biology or Community Ecology, but their application to the interactions among multiple invasive species and their management is an interesting one.

I also used a natural experiment on Tetiaroa atoll in French Polynesia to investigate the precise mechanisms and more subtle outcomes of over-invasion by black rats on Pacific rats. Here I could compare Pacific rat population structure and niche on one island where black rats never arrived, to another where black rats arrived 50 years earlier. The over-invasion of black rats reduced the density and downgraded the morphology of Pacific rats, and altered their catchability during an eradication campaign, through interference competition.

The Black Rat
(Photo: James Russell)
From the President

Greg Baxter

Welcome to the first AWMS newsletter of 2015. Its delivery is tempered by the unexpected and sad news that long-time AWMS member and stalwart, David Choquenot died suddenly in January this year. He will be missed by the wildlife management community.

There is a moving obituary to David in this Newsletter.

The book, published by CSIRO, on reintroduction science that arose from the 2013 conference in Palmerston North has now been published. AWMS was a sponsor of its production and AWMS members are entitled to a discounted purchase. Look out for notification of its availability either in subsequent newsletters or on the AWMS web site.

The final accounts for the 2014 conference have been settled and they show a slight monetary loss, though attendees all expressed satisfaction with the content. This result highlights two important points for AWMS. Firstly we want and need the 2015 conference to be a financial success. Secondly, that can only realistically be achieved by all members, not just the executive committee, working hard to publicise and promote the conference through their networks.

The various awards for students, practitioners and the Caughley Travelling Fellowship will all be awarded again this year. Please do promote them and make the judges’ lives difficult.

I noted at the 2014 AGM in Brisbane that we had found a model for a process to accept bequests. That model has now been vetted by a solicitor and it all seems to be in order. That protocol will soon appear on our web site. We do not yet have tax deductible status as an approved environmental organisation. But we are closer. Of course donations and bequests can be made now, but they are not as yet tax deductible and that will be important in some circumstances.

There were a number of changes to the executive at the 2014 AGM. We have a new Vice President, Ben Allen from Biosecurity Queensland. Our new Secretary is Karen Rusten. This newsletter is the first to be produced in its entirety by our new newsletter editor Jess Baumann. I am sure you will join me in welcoming them to the executive. Contact details for us all are on the AWMS web site, and we are truly interested in hearing from you about issues pertinent to the society.

I hope you enjoy this issue and I look forward to a productive 2015 for AWMS.

Graeme Caughley Travelling Fellowship of the Australian Academy of Science

is now open for applications.

The Fellowship commemorates the work of Dr Graeme Caughley FAA in ecology and wildlife management. Dr Caughley was a chief research scientist with the CSIRO Wildlife and Ecology until his death in February 1994. The Fellowship is financed through the generosity of his friends and colleagues.

The inaugural Fellowship was in 1996. The Fellowship is offered every two years. Up to $7,000 is offered (exempt of GST). The purpose of the Fellowship is to enable ecologists resident in Australia or New Zealand to share their expertise by visiting scientific centres and giving lectures in countries outside of the Fellow’s own country.

The Fellow will be an ecologist resident in Australia or New Zealand. Preference will be given to an applicant who indicates an interest in population ecology of wildlife and its scientific management.

For further details see the Australian Academy of Science (www.science.org.au/awards). The closing date for applications is June 15, 2015.

Previous fellows:

- 2014 R. van der Ree
- 2012 A. Byrom
- 2010 D. Bowman
- 2008 D. Armstrong
- 2006 D. Forsyth
- 2004 R. Shine
- 2002 J. Parkes
- 2000 P. Rismiller
- 1998 J. Hone
- 1996 D. Choquenot

Professor Jim Hone from the Institute for Applied Ecology, University of Canberra is happy to speak with any prospective applicants.

He can be contacted at Jim.Hone@canberra.edu.au.
Over-invasion – a useful concept in Biological Invasions?

Continued from Page 1

This result has important consequences for eradication campaigns targeting both species simultaneously. However, the arrival of black rats did not have noticeable impacts on the trophic niche of Pacific rats, but potentially impacted other components of the ecosystem such as crabs and ants.

Over-invasion is surprisingly common across biomes and invasive taxa, and although numerical (i.e. abundance) effects are the most easily determined (e.g. complete exclusion of one invasive species), many other subtle effects could occur, such as changes in behaviour, niche or morphology of one or both invasive species. Through my own field work I am continuing to investigate some of these other outcomes in the population dynamics of invasive rat populations on islands. I think research in this area for other invasive species could be fruitful and provide a novel perspective on considering the outcomes of biological invasions. The modelling study is just published in Ecology (Russell et al., 2014a) and the natural experiment in Biological Conservation (Russell et al., 2014b).

Literature cited:

Entries for The Australian Museum Eureka Prizes are now open

Presented annually by the Australian Museum, the Australian Museum Eureka Prizes reward excellence in the fields of research & innovation, leadership, science communication & journalism and school science. Established in 1990 to reward outstanding achievements in Australian science and science communication, the Eureka Prizes are Australia's most comprehensive national science awards.

Entries are now open and will close 1 May 2015.

For more information visit the Australian Museum website (http://australianmuseum.net.au/eureka).
Obituary. David Choquenot
Born 24/11/1959, Died 2/1/2015

Professor David Choquenot died suddenly on January 2, 2015. David was the Director of the Institute for Applied Ecology at the University of Canberra. His family, his colleagues and science in general lost a great spirit. Dave was a great champion for science-informed management of the environment, an exceptional manager and a larger-than-life character in the natural resource management sector in New Zealand, Australia and beyond.

David was born in Penrith, NSW and grew up in Greensborough, Vic, with his parents Maxine and Paul, brothers Mark, Peter, Matthew and sister, Lisa. He attended schools at Watsonia Heights Primary School, Watsonia High School and Preston Institute of Technology where he commenced a degree in Human Movement.

After exploring several areas of education David graduated from Macquarie University with a Bachelor of Science. In 1989 he completed a Master of Applied Science from the then Canberra College of Advanced Education (now University of Canberra), supervised by Dr Jim Hone. His research addressed control of feral donkeys in northern Australia. The applied topic was a theme he was to pursue throughout his scientific career, and his close liaison with state agencies also became a feature of how David did his research. Subsequently he completed a PhD at the University of Sydney, this time studying the population dynamics of feral pigs in eastern Australia, supervised by Prof. Chris Dickman and Dr Glen Saunders. David initiated an informal competition with other students to see who could write the shortest PhD thesis, such was his spirit and interest in getting straight to the point.

David's research focused on population dynamics and management, often of feral animals in Australia and New Zealand, and including mammals, birds and reptiles. His particular outstanding contribution was to test in field studies, current and classical hypotheses about why wildlife numbers went up and down and how they did, or could, respond to human actions. His research was heavily influenced by that of Dr Graeme Caughley, formerly of the University of Sydney and then CSIRO. His contributions were recognized internationally, including an invitation to contribute to a Royal Society of London meeting on population dynamics in 2002. His work influenced that of other scientists, locally, nationally and internationally, especially with his demonstrated capacity to publish high quality applied ecological research. David was an engaging collaborator with his enthusiastic efforts to get the work done and publish it on time. During such collaborations, and as a research leader, he was a great listener while having the willingness to call a spade a spade when he thought it appropriate.

He demonstrated a willingness to describe his research results even when they were contrary to conventional wisdom. As his career advanced he shared that attitude through supervision of a number of post-graduate students including in Australia, New Zealand and Mexico.

His career spanned many parts of the world, including Australia, New Zealand, Canada and Mexico, and his collaborators came from almost every part of the world. David was passionate about making sure research had an impact on the ground, and as a result built profound working relationships with numerous state agencies, federal government departments and universities. In collaboration with Dr John McIlroy and Terry Korn, he published a book, Managing Vertebrate Pests: Feral Pigs, in 1996 summarizing scientific knowledge on managing feral pig damage. At a personal level it symbolised his preference for the science of the topic, rather than ranting and raving about guns, bullets and shooting of feral pigs.

David slowly moved into research administration in the middle part of his career. He ran the Fauna Ecology Research Group for the Victorian Department of Sustainability and Environment before moving to New Zealand in early 2002. There he rose to be General Manager of Science and Policy for Manaaki Whenua - Landcare Research, and Professor of Ecology in the Centre for Biodiversity and Biosecurity at the University of Auckland. David's passion for New Zealand systems, landscapes and rugby lasted until his death.

In 2012 David returned to the University of Canberra as Director of the Institute for Applied Ecology (IAE). As Director he provided outstanding leadership to the IAE and the University. His leadership skills were recognised by being acting Deputy Vice Chancellor (Research) for several months in 2014. David was responsible for a program of reinvigoration that saw IAE attract a number of high profile new recruits and generate a real sense of excitement about the future.

David was active in the wildlife profession being a long-term member of the Australasian Wildlife Management Society (AWMS). He presented a paper at the inaugural annual AWMS conference which was held in Canberra in 1988, and he participated in many such conferences. He actively encouraged the bid by Manaaki Whenua - Landcare Research to host the 3rd International Wildlife Management Congress (IWMC) which occurred successfully in Christchurch in 2003 with about 1000 participants from around the world. The IWMC incorporated the annual AWMS conference. In 1996 he was the recipient of the Graeme Caughley Travelling Fellowship of the Australian Academy of Science, and used the award to travel to southern Africa for discussions with wildlife colleagues.

Continued on page 5
Obituary. David Choquenot
Born 24/11/1959, Died 2/1/2015

Continued from page 4
David enjoyed many activities outside of work, especially music, playing in the Hip Replacements band which included Stephen Parker (the Vice Chancellor), and Stephen Sarre. He was a keen rugby union supporter. His belief that Christchurch was the centre of world rugby, thanks to the Canterbury Crusaders, was dominant for years. David was passionate about great food and wine, particularly when entertaining his many international visitors and friends. He was an adoring father, and it is fitting that he passed away while enjoying holiday time with his wife Dianne, and children Kirra and Kelly.
Submitted ... Jim Hone, Ross Thompson & Arthur Georges

2014 AWMS Conference in Brisbane enjoyed by all!

The big storms in Brisbane prior to delegates arriving, did nothing to deter 100+ members and non members from enjoying every minute of their time at the Conference.

A group of around 25 delegates attended the pre-conference field trip to Stradbroke Island on the Monday, returning in time for the Icebreaker function that evening, where they joined other colleagues in nibbles and drinks.

The conference sessions on Tuesday, Wednesday and Thursday again provided an excellent forum for sharing knowledge, learning, debating and discussing everything in the wildlife management environment and more. The Book of Abstracts from the Conference can be found on the AWMS website for those interested in overviewing the program presentations.

The conference also hosted trade displays from a number of reputable companies. Please check out their logos as printed in the Book of Abstracts. AWMS members are encouraged to support these companies who continue to support our conferences each year and help keep our registration fees down to a minimum.


Photos from AWMS Conference 2014
Iconic wildlife or invasive vermin? Are we really still that confused?
Keith Bradby, Gondwana Link, bradby@gondwanalink.org

The July 2014 edition of the AWMS newsletter included a thought provoking article by Brad Purcell, where he put the case for dingo management to be guided by an overlapping consideration of ethical, ecological and economic considerations. A bit hard to argue against this approach, it seems decent and practical, and exactly what the public might expect from anyone working with wildlife. The article hit a particular chord for me as I had, along with some colleagues, just published a paper outlining the failure of a current program to incorporate such considerations (Bradby et al, 2014).

Western Australia's Rabbit Proof Fence was first constructed between 1902 and 1907 and, despite failing in its original objective has been added to many times since, including substantial additions made during the 1950's and 1960's on the advice of the Department of Agriculture's 'Emu and Grasshopper Committee'. For many years it was called the 'Vermin Barrier Fence' and considered a defence against species considered 'vermin', as dingoes, emus and kangaroos were regarded at the time.

In 2010, more than 100 years after initial construction, the WA Government, seemingly flush with funds through its Royalties for Regions program, announced an ambitious plan to upgrade and extend the fence so as to, as later became clear, completely seal south western Australia off from the rest of the continent, at least in terms of dingo, emu and kangaroo movement. Scant consideration was given to impacts on wildlife or the broader environmental values of the areas affected; funds were allocated and work commenced with barely a sideways glance at such issues. After all, there were no delays for Environmental Impact Statements when the Rabbit Proof Fence was first constructed, why should things be any different 100 years later?

Our paper takes a step back and examines the Barrier Fence upgrades and extension program from the vantage point of today's values and practices. We found it lacking on several fronts. Foremost, at least from a taxpayer's viewpoint, was the very superficial case developed claiming a positive cost-benefit. In relation to damage from wildlife, there has been an almost total reliance on anecdotal information originating from the farmers pushing for the fence upgrades, and some claims of damage that seem at least slightly exaggerated, such as suggestions that an extended fence would reduce vehicle collisions with wildlife some 30–50 km from the State Barrier Fence. Similarly, other assertions have been made in relation to the relative benefits that also seem misleading. For example, the then Minister for Environment stated, in support of the proposed fence, that ‘…wild dogs caused considerable damage to the environment, preyed on native wildlife and destroyed habitats’.

But it was not specified how 'habitats were being destroyed' and the Minister's claim is contrary to extensive published literature. And why would a Minister for the Environment be making promotional statements about a Barrier Fence proposal anyway? I remain confused on this, but can only assume that Government was seeking to override opposition by strongly promoting the fence proposal, with no intention of subjecting it to formal environmental assessment through the WA Environmental Protection Authority, a process in which the Minister for Environment is the final decision maker. Fortunately, a few years of adverse publicity seems to have encouraged WA's Department of Agriculture and Food to fund a biological survey of the proposed fence route and we now understand assessment through WA's EPA process may follow, and presumably also through the Federal EPBC Act, as the occurrence of a number of federally listed species has been confirmed.

But this seeming initial reluctance to accept the degree of independent environmental scrutiny that other industries accept as routine reflects poorly on the agricultural sector as a whole. We work closely with mining companies who accept that their development proposals will be independently assessed through high level state and national processes. If a few hundred hectares of mine site requires such a level of assessment, why wouldn't a 1000km barrier specifically designed to stop the movement of large wildlife?

Compounding this has been a bewildering disregard for basic animal welfare, to the extent that departmental spokespersons continually describe the fence as a 'non-lethal' control method, despite abundant documentation and photographic evidence of the harrowing death it causes to thousands, if not tens of thousands, of animals per year. All fencing is dangerous for wildlife, and every farmer knows the extent to which animals get tangled in fences and die excruciating deaths. A 1000km fence placed at right angles to major emu migration routes and across kangaroo paths is not just a lethal structure, it is cruelly lethal. Other agricultural enterprises have been subject to harrowing campaigns over their treatment of farmed animals, such as in the live export trade, intensive farming if poultry and pigs and mulesing of sheep.
Iconic wildlife or invasive vermin? Are we really still that confused?

The spotlight has not yet hit agriculture's treatment of wildlife, let's hope it finds better attitudes and practices when it does.

It is now over six years since the benefit-cost studies were done for the Barrier Fence upgrades and extensions, and over four years since the Minister for Agriculture and Environment announced their intention to proceed immediately. While the existing fence has now been upgraded, and a minor extension completed, the proposed major extension inland from Esperance remains a hotly contested program.

As do other wildlife management programs in Western Australia. Most notable in these has been the Government's attempts to bait and kill sharks off a number of beaches, implemented without independent assessment and which attracted adverse comment from many experts before being finally assessed and rejected by the WA EPA, and then abandoned by Government.

So it was refreshing to hear talks by South African wildlife behaviour expert Justin O’Riain when he was in Australia recently\(^1\). Wow, do they have some difficulties to work through juggling human settlements and livestock with all sorts of wildlife populations, from baboons to cheetahs. But they do work through those issues, and even if they decide to erect fences, as they have with baboon management around Table Mountain, it seems you can have a high degree of confidence it really is the most practical solution to a critical problem. There also seems to be a commitment to working through the issues from all perspectives, with the interests of wildlife high in their considerations, which probably comes from a national pride in their amazing wildlife species.

This pride could be the missing ingredient in Australia. But is our wildlife any less amazing, even if less numerous? Why can’t we have greater pride? In WA at least, much large wildlife management seems to be stuck in our colonial past, where wildlife was just ‘vermin’ to be dealt with harshly. The main change in recent years is that large wildlife is now dealt with under the label of ‘invasives’, at least by the WA Department of Agriculture, and that is not an improvement, but an additional layer of confusion.

They are not at all invasive, they are part of the essence of what makes Australia Australian.

Literature cited:
\(^1\)Audio at http://www.abc.net.au/radio/automotive/programs/bushtelegraph/wildlife-wars/5765242
Investigating Fine-scale Geographic Variation in the Australian Funnel-web Spider (Atrax sutherlandi) – Brief Introduction and Current Progress

Mark K. L. Wong, Research School of Biology, The Australian National University, markwong.research@outlook.com

Note: Mark is the recipient of the 2014 Honours and Undergraduate Student Travel Subsidy and that he will present his research at the 2015 AWMS Conference.

The Study

The newly described Australian funnel-web spider Atrax sutherlandi (Gray, 2010) (Figure 1) belongs to the same genus as the notorious Sydney funnel-web, and is named after the late toxicologist Professor Struan Sutherland. A. sutherlandi is distributed across south-eastern Australia, including the Tallaganda forests of New South Wales. Research suggests that during the cold periglacial episodes of past Pleistocene glacial-interglacial cycling (30,000–15,000BP), Tallaganda’s native eucalypts would repeatedly contract into low-lying, sheltered gullies to be replaced at higher altitudes by alpine grassland (Hope et al., 2004). Amidst the harsh climates, these isolated forest remnants or ‘refugia’ preserved local habitats, thus enabling a variety of species to persist in an otherwise inhospitable region. While the forest is now continuous, there exists substantial evidence to indicate that many of Tallaganda’s species still reflect this ancient isolation in their genetic makeup (Garrick et al., 2012). For example, in water skinks, velvet worms, springtails and flatworms, several distinct genetic forms are presently recognisable across the forest and their respective distributions coincide with the locations of refugia (Garrick et al., 2012). This genetic biodiversity and population structuring among Tallaganda’s refugia regions is also well documented for the funnel-web spider A. sutherlandi, where differences between six refugia populations are of a magnitude generally attributable to distinct species (Beavis et al., 2011).

Although the genetic differentiation and short-range endemism of Tallaganda’s fauna is well documented and has shown to be unequivocally associated with historical climate change, no studies have yet sought to investigate the possibility of corresponding geographic variation in their phenotype. Presented with this opportunity, and with the aim of elucidating the historical climatic effects on a species’ physical characteristics, I aim to survey geographic variation in the phenotype of A. sutherlandi populations at Tallaganda. These spiders have been selected as the study species owing to their extensive lifespans (>15 years), limited dispersal patterns, sensitivity to ecological disturbance and positions as top predators in many terrestrial microhabitats (King et al., 2002; Harvey 2002; Beavis et al., 2011), which together confer them a unique potential for retaining past signals of environmental and demographic change that may also be representative of the wider terrestrial invertebrate communities they predate. Three phenotypic characters deemed to be important to A. sutherlandi life history have been selected for study. These are venom yield, mass-specific metabolic rate and morphological structure. These characters will be studied for their specific patterns of geographic variation, which if congruent to the same patterns of six distinct populations from the spiders’ genetic makeup would potentially be telling of a historical climatic effect on phenotype.

Methods & Current Progress

Sampling & Housing

A total of twelve sites in Tallaganda have been sampled. Sampling at each site involves opportunistically turning over woody debris and rocks, then scanning the ground underneath for the burrow of A. sutherlandi (Figure 2). For extraction of spiders, a thin stick is first inserted into the burrow to reveal the direction of descent. Next, a trowel is employed to dig away loose soil adjacent to the burrow. Finally, the burrow is then deconstructed and the exposed spider transferred into a specimen jar with metal forceps. A total of 187 female specimens have been collected thus far. Specimens selected for use in venom milking and metabolic rate measurement were first acclimatized to identical housing conditions of 10°C and 100%RH with a regular diet of Tenebrio molitor larvae for at least 2 months, so as to avoid obtaining variation in the results originating from the differing field conditions of separate collection dates.

Venom Yields

Pilot tests for venom milking have been successful in establishing a standardized milking regime thus far. To obtain the maximum volume of venom from each spider, they will be milked daily in a 5-minute sitting over 3 consecutive days – this period substantially depletes the venom resources of all specimens tested and hence promises to deliver a consistent quantity for comparison across the study sample.

Continued on page 9
Investigating Fine-scale Geographic Variation in the Australian Funnel-web Spider (*Atrax sutherlandi*) – Brief Introduction and Current Progress

Continued from page 8

During each sitting, the spiders are transferred into a large glass dish and a wooden stirrer is employed to continuously agonize the subject into adopting a defensive rearing position with both fangs extended and venom droplets forming at their tips. These droplets are collected through capillary action using a 32mm (5µL) microcapillary tube (Model: P1799, Drummond Scientific, USA). This method averts the use of close-contact intrusive electrostimulation that present risks to specimen health and investigators’ safety (Nisani *et al*., 2007; Morgenstern & King, 2013), and similar milking methods have also been used with other funnel-web species (e.g. Atkinson & Walker, 1985).

**Metabolic Rate**
The mass-specific standard metabolic rate (ms-SMR) of each spider will be obtained using flow-through respirometry to measure CO$_2$ output. The setup comprises a gas exchange system (Model: LI-6400XT, Li-Cor Inc., USA) and a 70cm$^3$ brass animal chamber. A supply of dry ambient air (ca. 0%RH) is delivered through the chamber at 100 ml min$^{-1}$, and the gas analyser calculates the spider’s ms-SMR (µl CO$_2$ g$^{-1}$ h$^{-1}$) based on the CO$_2$ levels of air exiting the chamber and the spider’s weight. Preliminary results from 30 specimens present evidence of high variation in ms-SMR ($\bar{x} = 39.6 \pm 9.99$ µl CO$_2$ g$^{-1}$ h$^{-1}$) among *A. sutherlandi* at Tallaganda, and the congruence of this with geographic distributions of distinct genetic populations will be tested subsequently.

**Morphometric Measurements**
Specimens not utilized in either venom milking or metabolic rate measurement were preserved in 80% ethanol and used for morphometric measurement. These were made to the nearest 0.001mm using the software ImageJ (Abrâmoff *et al*., 2004) to analyse images of morphological structures obtained from a digital microscope (Model: P-400RV, Nikon, Japan). So far, preliminary analysis using Multivariate Analysis of Variance (MANOVA) to examine variation in 34 size-corrected linear exoskeletal measurements from 80 specimens have found 11 measurements which vary significantly among the six refugia populations ($p < 0.05$). This presents early evidence of morphological variation among the genetic populations of *A. sutherlandi*, and following morphometric measurement of the remaining specimens, Discriminant Analysis will be utilised to test the congruence between the patterns of morphological variation and genetic divergence at Tallaganda.

**Acknowledgements**
I would like to express my sincere appreciation to The Australasian Wildlife Management Society for not only providing me with support for this research, but also many valuable insights into the management and conservation of Australia’s native species.

**Literature cited:**


