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Newsletter of the Ecological Consultants Association of NSW

ECA
ECOLOGICAL
CONSULTANTS
ASSOCIATION
of NSW Inc

Magpie Goose with chicks - See page 8.
Photo courtesy of Lark Whittingham, PMHC

VOLUME 34 February 2015

INSIDE THIS ISSUE!

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Front Cover Photo: Eastern Quoll, Tasmania *Photo Courtesy and Copyright of Kathryn Chesnut*

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Message from the President

Dear members,

I have just celebrated 35 years as an ecological consultant and wonder how I have survived so long.

As a specialist in fauna, I have been fortunate to undertake surveys in many interesting and obscure areas of Australia and even overseas. But one exciting aspect of doing such work is surveying an area where the biodiversity is rich and a number of rare species are found.

It is always a delight to find such areas, but there is a dark cloud hovering over you when you realise that such an area will probably be modified to some degree and fauna will be lost.

This is always a problem confronting ecological consultants involved in impact assessments. How do you approach assessing a development which will, in all probability, affect the biodiversity of an area?

The obvious answer is that one needs to do the job to the best of one's capability and skills.

Early in my career, I read an approach to difficult assessments that I have tried to stick to over the years. The approach involves a story (probably apocryphal) called "Jesus's carpenter" – no, this isn't a subtle strategy for all to turn to religion, but it does have a message.

The story goes that when Jesus was sentenced to death by crucifixion, his followers were concerned that he would not be treated with respect. A carpenter, known to be the best carpenter in the district, volunteered to build a crucifix of the highest standard i.e. apply the highest of skills to an unpopular but worthy task. I have attempted a similar approach when obtaining and assessing data for projects.

Such an approach can always be thwarted by miserly clients wanting the cheapest option, and regulatory authorities no longer requiring the adherence to those standards set by themselves. The first aspect requires firmness of intent and an argument presented to the proponent that a thorough approach will be necessary to facilitate 'smooth' passage of approvals. This leads into the second aspect – adherence to regulatory standards.

Nowadays, one is not too sure what the regulatory standards are, or what standards the regulators wish to set. There are survey standards that are recommended by both the NSW Office of Environment and Heritage and the Commonwealth Department of the Environment, as well as guidelines for environmental impact

assessments. The BioBanking process gives set protocols to follow that are bound up with computer programs that ensure a systematic approach is undertaken. However, how often are these standards followed, and if not, is there any feedback from the regulators to ensure correct procedures and assessments are undertaken?

As a consultant specialising in fauna surveys and assessments (a dying breed), I suspect the answer to that question is probably a resounding "no".

I have noticed the weakening of standards over recent years. What standards? Well a lot of time was put into the development of the "*Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities Working Draft November 2004" Department of Environment and Conservation (DEC)*, including input from the ECA, which was represented on the committee that produced the guidelines. Even though this manual is not mandatory when undertaking flora and fauna surveys these Guidelines, as stated by the DEC, "have been prepared for use by decision makers when considering a proposed development, activity or action pursuant to Parts 4 and 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), and Part 6 of the *Threatened Species Conservation Act 1995* (TSC Act). The Guidelines also provide information and assistance to any other individuals or organisations that may be required to consider the effect of a proposal on threatened biodiversity or critical habitat".

In addition, there is a set of five guidelines issued by the Federal Department of Environment (then called DSEWPaC). These are also not mandatory, but do state the following in their introduction:

> "Failing to survey appropriately for threatened species that may be present at a site could result in the Department applying the precautionary principle with regard to significant impact determinations. That is, if no supporting evidence (such as survey results) is presented to support the claim of species absence, then the Department may assume that the species is in fact present. The Department will not accept claimed species absence without effective validation such as through these survey guidelines, other survey techniques (for example, a state guideline or an accepted industry guideline), or relevant expertise. Where a claim of absence is made, proposals should provide a robust evaluation of species absence".

There is a recognition that some of the survey techniques and survey efforts recommended in these guidelines are 'a bit over the top' i.e. would be impossible to satisfy within the time and resource constraints imposed by the industry or even one's capabilities. But they still provide good standards to which we should all attempt to aspire. However, over time these standards appear to have been weakened so that surveys cannot be considered to provide a complete picture of the biodiversity of an area.

One reason for this is the emphasis on threatened species to the detriment of other (Protected) species leading to a series of targeted surveys that do not cover the full range of flora and fauna. Even within the suite of threatened species, only those that could be "expected to occur" are targeted.

Part of the reason for this weakening of standards, is due to the cost in time and money that is required to undertake an adequate survey. In addition, some techniques, particularly in fauna surveys, do require expensive equipment and a time commitment. Consequently one can see some surveys being undertaken without the use of any form of ground and/or tree trapping – Elliott, cage or pit. Such techniques are replaced by hair funnels and remote cameras, both of which can be placed at a site and left without any human input for an arbitrary length of time. Such approaches are not within the standards set by the above guidelines and are also not within the spirit of an ecological investigation. The loss of data about species other than those listed as threatened, and the loss of part of the range of investigative techniques, can only lead to a diminished ability to clearly assess any potential impact and to provide advice on mitigation of the proposal to the whole faunal assemblage of the area.

Such a situation is not necessarily the fault of the ecological consultant, who as I point out, is constrained by clients who would rather cut corners and save money. More disturbingly, the decline in standards appears to be endorsed by the regulators. Too often I now read ecological impact assessments where there is a paucity of data about the biodiversity of an area to be assessed and this leads back to a weakening of the survey methodology

and lack of survey techniques. Yet, the reports have been endorsed by OEH and other regulators despite their own recommended standards of survey methodologies.

There is also another very concerning aspect to this trend. Like tends to beget like, and inadequate reporting in previous impact assessment studies will lead to later such inadequate studies being carried out by other consultants in the future. As a result of the trends I have highlighted, sub-standard assessment could end up becoming "the new black".

The slow eroding of standards within the practice of ecological assessments is possibly part of an overall general approach to impact assessment and development, but sadly, it will also ultimately lead to a lack of field data and preciseness in biodiversity description that will be missed by future generations. There will be no need for people to go into the field and the computer-based data currently available as a consequence of years of thorough survey work will be the only source of information for assessments and research.

Also, it is always great fun opening up a trap to see what you have captured – a bit like opening a present at Xmas.

Martin Denny

Professional Conduct Committee Report

Between August 2013 and 2014 the Professional Conduct Committee investigated a complaint against a member of the Ecological Consultants Association. As the complaint was associated with a relatively high profile development, it was necessary to carefully assess the complaint and to spend time ensuring a fair hearing was achieved. The complainant asserted that the member had breached at least six items of the Code of Business Practice, Professional Conduct and Ethics.

Interviews with the member resulted in providing adequate explanations of his actions in relation to some of the breaches of the Code or agreeing that an improvement to future assessment would address the others. Since then the member has resigned as a member of the Ecological Consultants Association of NSW.

This investigation showed some inadequacies in the process used to assess complaints and it is planned to revise the "Procedures to deal with Complaints of Breaches of the Code of Business Practice, Professional Conduct and Ethics" to ensure a more streamlined assessment process in the future.

The ECA Council meet every three months to discuss and deal with any current business of the association. The last meeting took place on the 9th of March and the next meeting is planned for the 15th of June 2015. Any member who wishes to view the minutes from any of the ECA council meetings may do so by contacting the Administration Assistant Amy Rowles admin@ecansw.org.au

EUROKY

Euroky: ***ability of an organism to adapt to changes in the environment***

If you have any interesting observations or useful hints and information that you would like to share in the euroky column, please forward them to the newsletter editor or administration assistant to be included in the next edition.

GLASSES CASE OR POUCH

Dr Stephen Ambrose,
Ambrose Ecological Services Pty Ltd

My eyesight is not as good as it once was, so I rely on two pairs of glasses: one for reading, and one for long-sightedness. I refuse to wear bifocals because I've had difficulty in the past adjusting to them.

Reliance on two pairs of glasses while doing field work can be frustrating. I need my long-distance glasses for driving and walking about on site, but my reading glasses for reading digital screens and paperwork. So one pair is usually kept in a hard glasses case in my back-pack, while the other is worn on my head, ready to be switched around when required.

Imagine how upset I was at the end of a day's field work west of Forbes recently, when I arrived at my motel and found that my reading glasses were missing. This was the third time in as many years that I'd lost a pair of glasses in the field!

The following day I attended a meeting with the client, another consultant, and a representative of OEH at the same site. Thoughts of the lost glasses were forgotten during what turned out to be a productive meeting. However, as we were driving out of the site along the clay track, Jenny Walsh (ngh Environmental) and David Geering (OEH) simultaneously spotted the glasses case in the distance. It had sprung open, obviously under the weight of the 4WD (probably when we drove to the site earlier that morning), its contents (reading glasses, clip-on sunglasses and a cleaning cloth) had spilled across the track. But miraculously, there was no damage to the glasses or the clip-ons, even though the glasses case was slightly worse for wear. The glasses case had saved the day, whereas I'm sure I would not have been so lucky if a leather or cloth pouch had been used. It's likely that my glasses case had been left on the roof of my vehicle the day before and had fallen to the ground as I was driving.

So, thanks to Jenny and David, I'm back in the land of those who can read, without the need to buy new glasses (again!). Maybe I should invest in leather straps to hang pairs of glasses around my neck when they are not in use, or reconsider wearing bifocals? Or perhaps have laser eye surgery? A good start would be to be more attentive about where I leave my case and its contents when in the field!

MAKING THE MOST OF DEVELOPMENT: RECYCLING HABITAT FOR BIODIVERSITY IN THE CUMBERLAND PLAIN

Peter Ridgeway
Greater Sydney Local Land Services

In Christmas 2014, the wildlife of Mulgoa (Western Sydney) received a rather unusual present – a donation of 50 tonnes of hollow logs.

The Cumberland Plain Woodland is one of the State's most threatened ecosystems, with less than 13% of the native vegetation remaining. However within this ecosystem, the impacts of development have been felt most severely by the terrestrial fauna with just two populations of native small ground mammals remaining.

The *Mulgoa Wildlife Recovery* program is helping recover one of these populations through Fox control and structural habitat recovery. The program targets a population of Bush Rat (*Rattus fuscipes)* and is a partnership between private landowners, Landcare, National Parks & Wildlife Service and Greater Sydney Local Land Services.

A key problem for the Bush Rat in the Cumberland Plain has been the shortage of old trees and the resultant shortage of terrestrial hollow logs. Hollow logs provide shelter from predators, refuge during low -intensity burns, and feeding habitat for invertebrate prey. Local woodland remnants have less than 1 tonne/ hectare of coarse woody debris compared to benchmark targets of 20-22 tonnes/hectare.

Recycling felled trees for hollow log translocation is the obvious solution to this problem. It is becoming increasingly popular as part of development offset packages with recent examples at Appin Rd and Edmondson Park. The Mulgoa project aims to direct these resources where they are most urgently needed and to combine this with intensive cross-tenure fox control.

Local property developers have so far supplied 50 tonnes of trees as hollow logs for the Mulgoa program. These have been installed on private and public bushland reserves using trucks, utes and helicopter depending on the accessibility of the receipt site. The logs are cleaned, inspected and weighed before installation, and monitoring is undertaken at the receiving sites as well as 'control' comparisons.

The first monitoring results from the program should be concluded by later this year. It is hoped that this new approach will mark a turning point for the wildlife of this region.

Do you work in the Cumberland Plain? We need your help! Developers can reduce the impact of habitat clearing by donating felled tree logs for habitat. The Greater Sydney Local Land Services can coordinate log donations and in many cases arrange free collection and transportation. Please contact Peter Ridgeway - Senior LSO (Biodiversity), Greater Sydney Local Land Services on Peter.Ridgeway@lls.nsw.gov.au or mob.: 0401 481 307

Recycled' hollow logs being installed at Mulgoa. Photos courtesy of Brendon Levot, Wildside Australia

NEW DEVELOPMENTS IN COST EFFECTIVE MOBILE GIS SOFTWARE

Will Steggall
Naturecall Environmental

If you are still navigating or collecting data in the field with a hand help GPS unit, you need to get with the times. The recent explosion in tablet and smart phone development means there is a wide variety of affordable gadgets that can be used for site navigation and efficient collection of spatial data in the field.

Up until recently, mobile-based mapping seemed to be focused on expensive custom mobile GIS applications on specialized devices eg tough windows tablets and trimble devices. Fortunately, mapping software for the average consultant is beginning to catch up with the mobile/tablet platform, and there is now a number of cost effective options available for mapping software specifically designed for tablets, phablets and smart phones.

These have a wide variety of applications, however I have found that apps with the following features are most useful:

- Ability to navigate and show GPS location
- Ability to import shapefiles and KMZs
- Ability to create, edit and export data as shapefiles or KMZ
- Selection of inbuilt background maps (eg google street/hybrid/satellite, bing maps)
- Importing and viewing of rasters (eg satellite imagery)
- Integration/compatibility with desktop GIS software

A search of the Apple app store listed to following GIS apps which feature some or all of these applications:

- **GIS Kit and GIS Kit Pro** - Basic version $129.99, pro version $299.99 (see my review in Volume 32 of consulting ecology).
- **GIS Cloud map portal** – $95 with online GIS cloud account required at extra cost.
- **ESRI ArcGIS app** – Free version with limited functionality. Commercial license available.

The Google playstore for android listed the following apps:

- **QGIS** - free open source GIS mobile app (tablet based version being developed)
- **Mappt** - $450 for first year and $199 for each subsequent year
- **ArcGIS mobile** – Free version with limited functionality. Commercial license available
- **Locus GIS** - $9.16 with in app purchases ranging from $1.26-$145.24 per item
- **Map it fast** – Free version with limited functionality. Commercial license available
- **GIS Cloud map portal** - $95 with online GIS cloud account required at extra cost

There is a plethora of other apps that are marketed towards GIS mapping, GPS navigation and data collection, however it pays to read the descriptions and reviews to see exactly what they are capable of. Be aware however that some descriptions are very vague. Many apps are also marketed as being free but then require an expensive license or account to become functional; while others might have a free version with limited features and offer in app purchases to unlock premium features.

It also pays to check if your device and operating system is compatible with the app. This is sometimes done automatically but the additional information at the bottom of the app description should list this.

Another mobile mapping system gaining popularity is cloud-based GIS. This requires purchasing a commercial license with a mapping company such as ESRI, GIS Cloud or Ag Terra Technologies. Their software is then made available to multiple devices and data can be uploaded, downloaded and stored in online or "cloud" accounts. Benefits of this setup include live online mapping in the field showing user contributions in real time, and collaboration of data from multiple devices in different locations. This system is best suited to large companies which require remote data access, large amounts of field data collection, or fleet management. GIS cloud systems also allow data to be made available to the general public. An example is open source street maps in which data can be captured and shared by users.

An exciting new development in mobile based mapping is QField Andriod GIS. This is currently being developed by the makers of QGIS which is a free open source GIS mapping program designed for desktop PC's. QGIS has a basic mobile version which can be used on some tablets, however it is not a mobile specific app and reviews have noted that it is difficult to use at present.

The QGIS team are developing QField from the ground up as a touch-oriented app to be used specifically on android mobile devices. They describe it as a data capture and management app that is fully compatible with QGIS. When developed, this will be made available for free on the Google Playstore with the option of donating via Paypal. The app is currently in the private testing phase, however interested parties can sign up for testing at http://www.opengis.ch/android-gis/qfield/installation/.

This app will see mobile GIS mapping capabilities become available to many new users, and is likely to lead to significant improvements and advancements in the technology. Stay tuned for a review of this app in future issues.

USE OF THE ECA LOGO

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MAGPIE GEESE COME TO PORT MACQUARIE

Will Steggall
Naturecall Environmental

The tertiary sewage treatment ponds in Port Macquarie have been graced with the presence of a male Magpie Goose along with his two females. Shortly after arriving, they surprised everyone by building a nest amongst the reeds and laying eggs which the females were sitting on for about 3 weeks. Around the 15th of March the eggs hatched and the mothers were found guarding a group of healthy chicks. It is unusual that they have chosen to breed in the sewage treatment ponds in urban Port Macquarie given the presence of large natural wetlands in the area, but they may be smarter than we think. The treatment ponds are fully fenced allowing protection from foxes and wild dogs, and there is less competition for space and resources from other waterbirds.

This a very rare occurrence on the NSW mid north coast and there are no Bionet records of Magpie Geese in the Port Macquarie-Hastings LGA. Most records and breeding events in NSW appear to be in the northern

Photo courtesy of Lark Whittingham, PMHC

tablelands (Uralla, Moree, Narrabri), around Grafton and Lismore/Casino, and in the vicinity of Hunter Wetlands where large numbers of juveniles were released from 1987-1990, with breeding occurring here since 1992. I wonder if the Magpie Geese came from the North or South?

Magpie Geese were once known to be common in NSW and were often seen as far South as Victoria depending on seasonal conditions. The large scale draining and modification of wetlands for development and grazing land in the early 1900s along with hunting is thought to have contributed to their decline. They are listed as Vulnerable in NSW under the Threatened Species Conservation Act. In recent years they appear to be making a recovery and are extending their range further South into coastal NSW from strongholds in Queensland.

Photos courtesy of Lark Whittingham, PMHC

PHOTO COMPETITION

Congratulations! to ***Kathryn Chesnut*** for winning the last photo competition with her photograph featured on the front cover of an Eastern Quoll.

Thank you to everyone who entered our photo competition. All entries have been included in the ECA Photo Gallery on the back cover and central pages of the newsletter.

Email your favourite flora or fauna photo to admin@ecansw.org.au to enter a competition and have your photo on the cover of the next ECA newsletter. Win your choice of one year free membership or free entry into the next ECA annual conference. The winner will be selected by the ECA council. Runners up will be printed in the photo gallery

Photos entered in the competition may also be used on the ECA website

UPCOMING ECA EVENTS IN 2015

SHOREBIRD IDENTIFICATION AND ASSESSMENT WORKSHOP

Date: 20th April 2015
Location: Hunter Wetlands Centre
Cost: $110 Members; $140 Non-members
Details: See below

FUNGI : ECOLOGY, IDENTIFICATION AND CONSERVATION STATUS WORKSHOP

Date: 17th June 2015 (alternative weather date 24th June)
Location: Cove Room, Lane Cove Council and Lane Cove Bushland Park.
Cost: $50 Members; $80 Non-members
Details: See Page 10

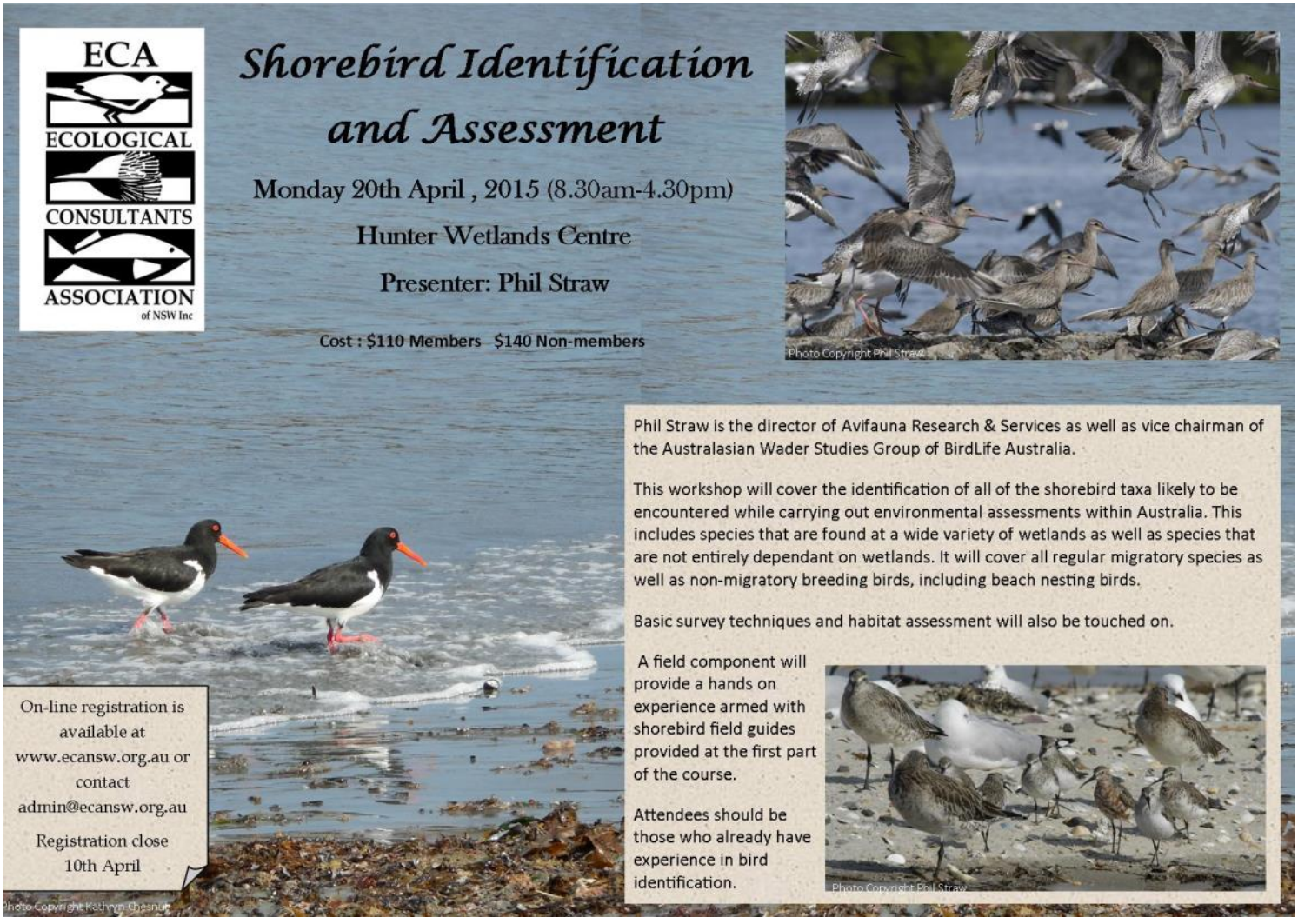
ECA 2015 CONFERENCE AND AGM: Recent advances in ecological survey methods and mitigation measures

Date: Friday 31st July 2015
Location: Darling Island Wharf, Pyrmont, Sydney
Cost: to be advised
Details: See Page 11

• PROPOSED ECA WORKSHOPS 2015-2017

- **Business Development and Practices Workshop**
- **Invertebrates**

The dates and venues for these workshops are yet to be determined. You may register your interest in any of these workshops by emailing admin@ecansw.org.au.



Non ECA Events

- **Australian Mammal Society Conference 2015**

Date: 6-10th July 2015

Location: Hobart

Details: https://australianmammals.org.au/events/5_ams_conference_2015

- **Ecological Society of Australia**

Date: 29th November - 3rd December 2015

Location: Adelaide

Details: http://www.ecolsoc.org.au

- **Fire and restoration: working with fire for healthy lands**

Date: 26-27th May 2015

Loaction: NSW Teachers Federation Conference Centre, Sydney

Details: http://www.nature.org.au/healthy-ecosystems/bushfire-program/conferences/

- **Introductory analytics with R: for ecologists, natural resource managers, government researchers and environmental consultants.**

Date: 11-12th May, 2015

Location: The Sydney Institute of Marine Science

Details: harbouranalytics.com.au

Members may email any ideas for future ECA workshop topics or conference themes to Amy Rowles admin@ecansw.org.au

Ecological Consultants Association of NSW

Annual Conference 2015

Friday 31st July 2015

Darling Island Wharf, Pyrmont, Sydney

RECENT ADVANCES IN ECOLOGICAL SURVEY METHODS AND MITIGATION

This years conference endeavours to share recent advances in ecological survey methods and mitigation measures amongst ecological consultants and other ecologists. We have a mix of flora and fauna topics, including the following presentations:

- Dr Colin Bower of Flora Search will present his pollination work and assessment of the Critically Endangered Orchid *Genoplesium littorale.*
- Dr Colin Driscoll of Hunter Eco will present his work on translocating the threatened *Tetratheca juncea* on the Central Coast.
- Nathan Garvey of Biosis has been using LIDAR to map and assess subsidence impacts on vegetation in the Southern / Illawarra Coalfields.
- Geoff Sainty of Sainty and Associates, will present his work on saltmarsh translocation and other mitigation and survey methods.
- Dr Frank Lemckert of Niche will present his frog work on the Princes Hwy Project, as well as frog and study group issues.
- Phil Straw of Avifauna Research will illustrate some interesting mitigation measures for some shorebird projects.
- Paul Meek of DPI will enlighten us on the advances in camera trap survey methodology for native and introduced mammals
- We also propose a presentation on recent developments in bat survey methodology and equipment

Registration Open 1st May

Photo taken from www.doltonehouse.com.au

February 2015 ECA Membership Report

Amy Rowles
ECA administrative assistant

In total we have 165 members, comprised of 126 Practising Ecological Consultants, 5 Associate (Consultants), 18 Associate (Government Ecological/ Environment Officer), 11 Associate (Non-practicing), 2 Associate (Subscriber) and 3 Students. We have had nine new members and three current applicants over the last six months. The new members are introduced below:

- Jessica O'Leary
- Jay Stricker
- Heidi Stricker
- Robert Jessop
- Catherine Lockyer
- Amy Nelson
- Kathy Owen
- Brenton Hays
- Jessica Wait

Recent Literature and New Publications

Recent Journal Articles / Literature

Silcock J., Healy A. and Fensham R. (2015) **Lost in time and space: re-assessment of conservation status in an arid-zone flora through targeted field survey.** *Australian Journal of Botany* 62(8) 674-688 http://dx.doi.org/10.1071/BT14279

Tokushima H. and Jarman P. (2015) **Ecology of the rare but irruptive Pilliga mouse, *Pseudomys pilligaensis*. IV. Habitat ecology** *Australian Journal of Zoology* - http://dx.doi.org/10.1071/ZO14057

Doty A.. et al (2014) **Increased lyrebird presence in a post-fire landscape.** *Australian Journal of Zoology* - http://dx.doi.org/10.1071/ZO14053

Wilson N., Seymour J. and Williams C. (2015) **Predation of two common native frog species (*Litoria ewingi* and *Crinia signifera*) by freshwater invertebrates.** *Australian Journal of Zoology* 62(6) 483-490 http://dx.doi.org/10.1071/ZO14026

Meek P. et al. (2015) **The history of wildlife camera trapping as a survey tool in Australia.** *Australian Mammalogy* 37(1) 1-12 http://dx.doi.org/10.1071/AM14021

Meek P., Ballard G. and Fleming J. (2015) **The pitfalls of wildlife camera trapping as a survey tool in Australia .** *Australian Mammalogy* 37(1) 13-22 http://dx.doi.org/10.1071/AM14023

Berry L. et.al. (2015) **The use of topographic fire refuges by the greater glider (*Petauroides volans*) and the mountain brushtail possum (*Trichosurus cunninghami*) following a landscape-scale fire.** *Australian Mammalogy* 37(1) 39-45 http://dx.doi.org/10.1071/AM14027

Hill D., Armstrong K. and Barden P. (2014) **Preliminary assessment suggests that acoustic lures can increase capture rates of Australian echolocating bats** *Australian Mammalogy* 37(1) 104-106 http://dx.doi.org/10.1071/AM14019

McLean C., Varhammar A. and Mikac K. (2015) **Use of motion-activated remote cameras to detect the endangered spotted-tailed quoll (*Dasyurus maculatus*): results from a pilot study** *Australian Mammalogy* 37(1) 113-115 http://dx.doi.org/10.1071/AM14034

Cockayne B. et.al. (2015) **Lake Eyre golden perch (*Macquaria* sp.) spawning and recruitment is enhanced by flow events in the hydrologically variable rivers of Lake Eyre Basin, Australia** *Marine and Freshwater Research* - http://dx.doi.org/10.1071/MF14242

Lintern A. et al (2015) **Digging up the dirty past: evidence for stormwater's contribution to pollution of an urban floodplain lake.** *Marine and Freshwater Research* - http://dx.doi.org/10.1071/MF14111

Simpfendorfer C. and Wetherbee B. (2015) **Shark and ray life history.** *Marine and Freshwater Research* 66(4) i-ii http://dx.doi.org/10.1071/MFv66n4_ED

Mogoutnov A. and Venning J. (2014) **Remnant tree decline in agricultural regions of South Australia.** *Pacific Conservation Biology* 20(4) 366 - 375

Macgregor J. et al (2014) **Novel use of in-stream microchip readers to monitor wild platypuses** *Pacific Conservation Biology* 20(4) 376 - 384

Garkaklis M. (2014) **Biodiversity Monitoring in Australia** *Pacific Conservation Biology* 20(4) 403 - 404

Nield A., Enright N. and Ladd P. (2015) **Study of seed dispersal by Emu (*Dromaius novaehollandiae*) in the Jarrah (*Eucalyptus marginata*) forests of south-western Australia through satellite telemetry** *Emu* 115(1) 29-34 http://dx.doi.org/10.1071/MU13113

Brown W., Ramsey D. and Gaffney R. (2015) **Degradation and detection of fox (*Vulpes vulpes*) scats in Tasmania: evidence from field trials** *Wildlife Research* - http://dx.doi.org/10.1071/WR14152

Sharp A. et. al. (2015) **Population recovery of the yellow-footed rock-wallaby following fox control in New South Wales and South Australia** *Wildlife Research* 41(7) 560-570 http://dx.doi.org/10.1071/WR14151

Groom C. et. al. (2015) **Attachment and performance of Argos satellite tracking devices fitted to black cockatoos (*Calyptorhynchus* spp.)** *Wildlife Research* 41(7) 571-583 http://dx.doi.org/10.1071/WR14138

Major R., Ashcroft M. and Davis A. (2015) **Nest caging as a conservation tool for threatened songbirds** *Wildlife Research* 41(7) 598-605 http://dx.doi.org/10.1071/WR14136

Images from the 2014 ECA Conference held at Noahs at Newcastle. (*Photos courtesy of Deryk Engel and Amy Rowles)*

Sharp A. et. al. (2015) **Population recovery of the yellow-footed rock-wallaby following fox control in New South Wales and South Australia** *Wildlife Research* 41(7) 560-570 http://dx.doi.org/10.1071/WR14151

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Recent Book Releases

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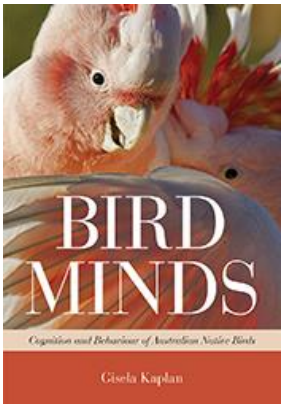

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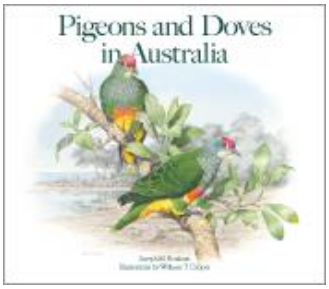

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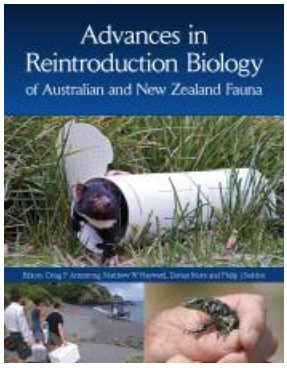

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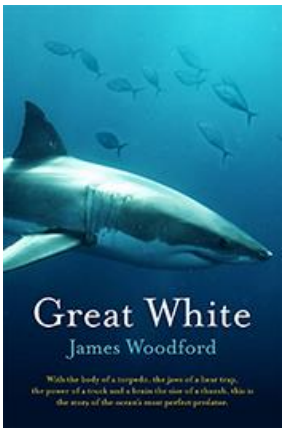

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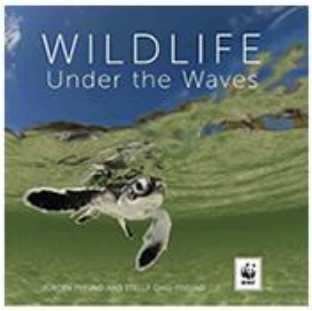

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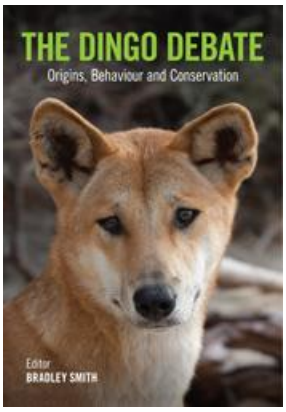

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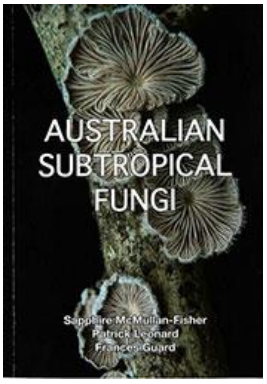

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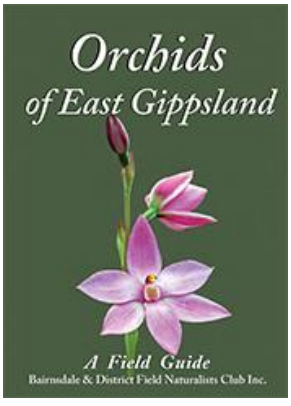

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Ecological Consultants Association of NSW
Student and Research Grants 2015

- ECA of NSW Conservation Grant ($2000)
- Ray Williams Mammal Research Grant ($2000)

The Ecological Consultants Association of NSW supports ecological research in Australia and would like to award two grants each year to assist researchers to carry out their ecological projects.

Eligibility

To be eligible for either of the grants the applicant and project must fit the following criteria:

- Applicant must be or become a member of the Ecological Consultants Association of NSW in the year the grant is awarded
- The project must be carried out in Australia and its territories (preference will be given to projects that have application in NSW)
- The project must be an ecological study
- Applicant may be an enrolled undergraduate Honours student, a postgraduate Masters or PhD student or an ecologist undertaking a voluntary project (i.e. an unpaid research project)
- Applicant must obtain all necessary permits and licences to carry out the project.
- Applicant must be prepared to sign a grant agreement, which includes: the provision of a report on budget usage; a scientific paper for the ECA biannual newsletter *Consulting Ecology* within 12 months of the grant being awarded; a poster or spoken presentation at the ECA annual conference within 18 months of the grant being awarded.
- Successful applicants are eligible to reapply in subsequent years, however they must be able to demonstrate that progress has been made with the project.
- Unsuccessful applicants may apply in subsequent years.

Application and Assessment

- Applications must be submitted electronically to admin@ecansw.org.au by the **31st of March 2015** . You will be notified that your application has been received.
- The same application form may be used to apply for either grant.

- □ Applications must include an application form, accompanied by a current CV or academic transcript. Applications must be supported by two referees, which should include your academic supervisor if you have one.
- □ Applications will be assessed by the Student Liason and Grants Sub-committee of the Ecological Consultants Association of NSW Council. Applicants will be notified of the outcome by the **15th of May 2015**.
- □ The following points will be used to assess applications:
    - The value of the project to conservation
    - The quality of the project
    - Justification of how the grant will be used
    - The track record of the applicant and the likelihood of the objectives being achieved
    - The relevance of the project to ecological consulting in NSW

Payment

- □ Prior to the provision of the grant funds, copies of all necessary permits and licences to carry out the project must be provided to the Ecological Consultants Association of NSW.
- □ Successful applicants must sign a **Grant Agreement** to receive 90% ($1800) of the funding.
- □ The final 10% ($200) received on provision of the budget report and scientific paper for inclusion in *Consulting Ecology.*

Conditions of the Grant Agreement

- □ Grant funds are to be exempt from organisational administration charges
- □ Successful applicant will provide the Ecological Consultants Association of NSW with a report of budget usage and a scientific paper for *Consulting Ecology* within 12 months of receipt of the grant. The scientific paper must include photographs and be more than 4 pages in length.
- □ Successful applicant will present a poster or spoken presentation at the ECA annual conference within 18 months of the grant being awarded.
- □ Successful applicant must acknowledge the assistance of the Ecological Consultants Association of NSW and list the award name (i.e. Ray Williams Mammal Research Grant or ECA Conservation Grant) in all documentation or presentation of the research undertaken.
- □ Academic supervisor/s have been made aware that your application is successful.
- □ The grant is to be used to fund direct costs of the project.

WHAT IS TERN?

Martin Denny
ECA President
Biodiversity Monitoring Services

OK, it can be considered a bird, but TERN keeps popping up in my interests in science and environment. Posters at conferences introduced me to TERN and, consequently, I have travelled to some meetings put on by TERN. Little did I realise that there is a whole world of information about the environment that is accessible to the public that will be of great benefit to ecological consultants.

TERN stands for Terrestrial Ecosystem Research Network (get used to acronyms, there are plenty more to come), and it is defined as a system that connects ecosystem scientists and enables them to collect, contribute, store, share and integrate data across disciplines. TERN is supported by the Australian Government and was created in 2009 by the Department of Innovation, Industry, Science and Research (DIISR) via a $20m funding program through the National Collaborative Research Infrastructure Strategy (NCRIS); and $4.1m from the Queensland State Government. An additional $25.63m was provided to TERN in 2011 as part of an additional funding allocation from the Australian Government under the Education Investment Fund (EIF) Super Science Initiative. Further funding and in-kind contributions have been received from numerous other partners.

TERN provides the infrastructure and networks that are enabling Australia's ecosystem science community to:

- collect and integrate ecosystem data across broad spatial and temporal scales
- safely store, access, share and manage data
- establish collaborative working relationships to address key questions in ecosystem science
- make multidisciplinary, national-scale contributions to addressing key problems in Australian ecosystem science and environmental management, now and in the future.

Consequently, there are many universities and government research facilities that are connected with, and funded by, TERN. In addition, individual researchers are funded to undertake specific projects that contribute to TERN. At present, there are 17 universities, 25 State and Federal Agencies, and several organisations here and overseas associated with TERN.

To give some idea of the size of TERN the following facilities are available for access:

TERN Central – providing overall coordination of TERN and management of the TERN Data Discovery Portal, which provides access to all TERN data and data contributed by other researchers.

AusCover – producing nationally consistent, long time series of satellite images, satellite-based biophysical map products, next generation remote sensing research data, and product validation for Australian conditions.

AusPlots - establishing and maintaining a national network of plots undertaking baseline assessments of ecosystems across the country.

Australian Supersite Network (ASN) - a national network of multidisciplinary ecosystem observatories collecting detailed data on flora, fauna and biophysical processes to improve understanding of how key ecosystems respond to environmental change.

Australian Transect Network - informing predictions about possible future ecosystem changes by studying ecological and genetic structure and processes, patterns and trends, along four sub-continental transects.

Australian Centre for Ecological Analysis and Synthesis (ACEAS) – enabling multidisciplinary analysis and synthesis among

ecosystem scientists and ecosystem managers, essential for planning sustainable management of Australia's environment into the future.

Australian Coastal Ecosystem Facility (ACEF) – producing an accessible time series of research data on field surveys, spatial data, and satellite/ airborne image data sets, covering flora, fauna and biophysical properties of Australia's coastal ecosystems.

Eco-Informatics – enabling storage, sharing, integration and visualisation of ecological plot data through the Australian Ecological Knowledge and Observation System (AEKOS) and other products.

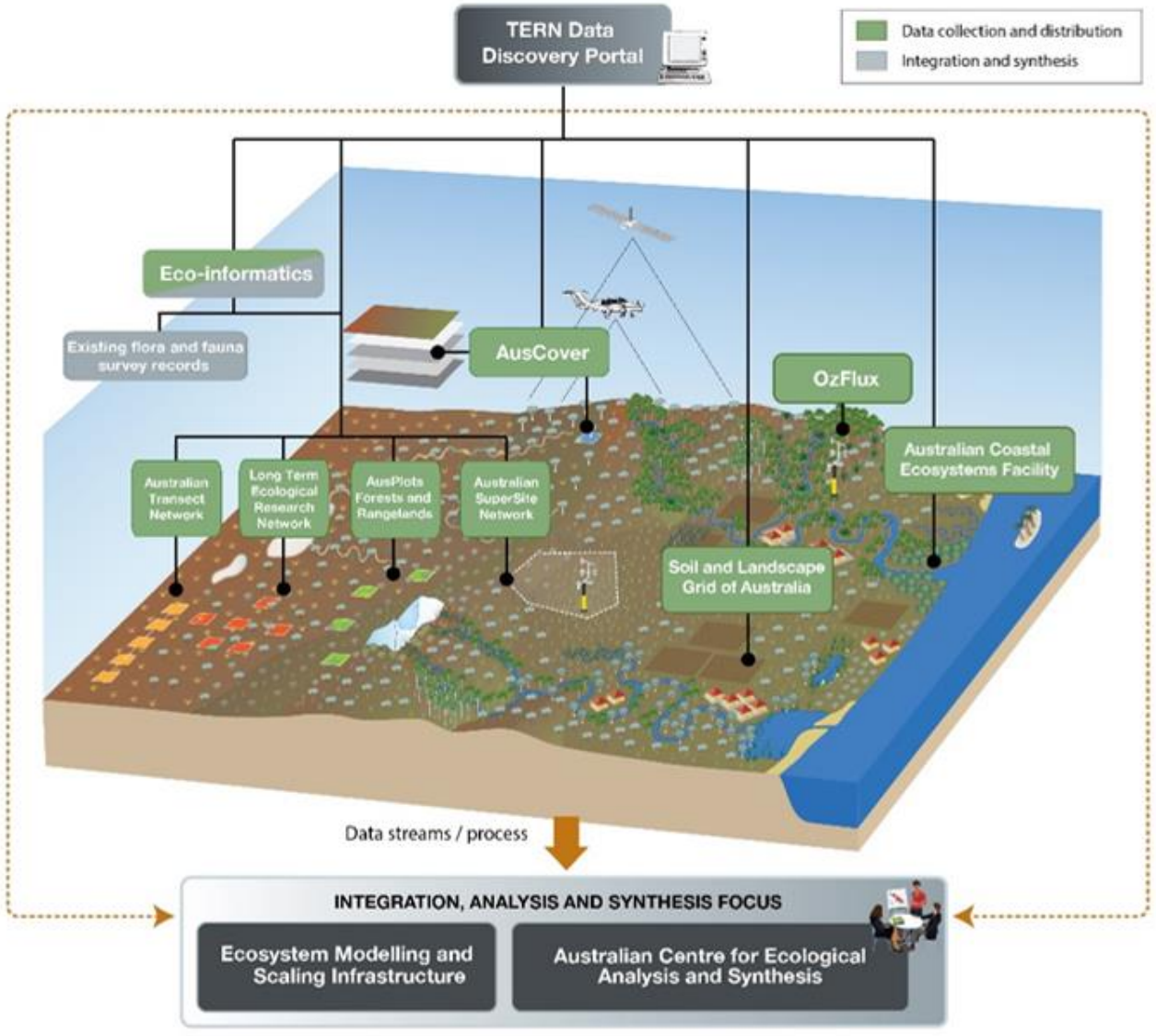
Ecosystem Modelling and Scaling Infrastructure (eMAST) – enabling the collection, integration and scaling of site/plot, flux tower, remote sensing and eco-informatics data for use in developing, benchmarking and applying ecosystem models.

Long-Term Ecological Research Network (LTERN) - linking twelve existing long-term ecological plot-based monitoring programs across a range of Australian ecosystems, collecting detailed information about vegetation, soils, fauna, genetics and phenology to better understand environmental change.

OzFlux – measuring key energy, water and carbon dioxide fluxes and making the data available for multiple ecosystem science and modelling applications.

Soil and Landscape Grid of Australia – producing a high-spatial resolution soils grid for Australia and a network for collaboration and sharing of field and spatial data sets, models, and analytic approaches on soil landscapes and dynamics.

The figure showing the integration of these facilities helps to show how important TERN can be in providing data and analytical tools for work undertaken by ecological consultants.



Data from all of these facilities can be accessed via the TERN Data Discovery Portal (http://portal.tern.org.au/) or go to the TERN site (http://www.tern.org.au/) and click on Data Discovery Portal.

For an ecological consultant, perhaps one of the most useful links is to the Eco-Informatics Facility (http://www.tern.org.au/Eco-informatics). The AEKOS Data Portal within the Eco-informatics site leads you to search tools to obtain information about a variety of ecological parameters associated with study locations or datasets – you can search by area on a map and/or by species. The AEKOS portal is a bit complex but can be mastered quickly (there are instructions) and data will be sent to you via email. It is also possible to provide data to AEKOS via SHaRED (Submission, Harmonisation and Retrieval of Ecological Data) that provides you with an online questionnaire to help you write structured metadata when you upload your data files.

Although not directly linked to the TERN Data Portal, the Atlas of Living Australia is a good site to obtain species records for an area as it uses data from a large number of sources including OEH, museums, herbaria, Bird Atlas, etc (153 collections are used). One can plug in a place or grid reference and obtain species records from a defined surrounding area, this includes plants, vertebrates and invertebrates – usually sufficient to obtain an idea of the bio-diversity of a specific site. This can be accessed at www.biocache.ala.org.au.

With the expenditure of approximately $60 million over five years and the cooperation of a vast number of institutions and individuals, it would seem likely that TERN would be a house-hold word, but somehow it has passed 'under the radar' and is not as well known or used as intended. TERN is an important tool for anyone interested in ecological matters and particularly so for ecological consultants. There is a rich harvest of useful data available if you are willing to dig through the acronyms and layers of instructions. TERN can be used by consultants and the scheme is attempting to ensure that such people take from and contribute to the scheme, particularly the Eco-Informatics facility. I have been appointed to the Eco-Informatics Data User Reference Group (DURG) to represent ecological consultants and as such welcome any comments and suggestions you may have. If we can provide some of the data we collect during surveys then TERN can continue to be a useful tool. Remember "every good tern deserves another".

THE NEW BIODIVERSITY ASSESSMENT AND OFFSET POLICY FOR MAJOR PROJECTS IN NSW: HAVE WE TIPPED THE BALANCE BETWEEN PROTECTING OUR ENVIRONMENT IN ORDER TO FACILITATE MAJOR DEVELOPMENT?

David C. Paull
Ethical Ecology

Late last year, the NSW Government released a 'whole of government' Framework for Biodiversity Assessment' (FBA) and 'Biodiversity Offset Policy for Major Projects'.

When conducting of review of the new policy, both of these sister documents need to be considered together as one informs the other in relation to decision pathways for how biodiversity is to be assessed and impacts mitigated and offset. As a new policy framework, one would expect that the intent of the three objectives and six 'principles' of the new policy would be to improve biodiversity impact assessment and decision making using the latest techniques and knowledge without compromising environmental outcomes given the broader context of climate change.

There are some improvements to how assessment and mitigation is to be conducted in NSW as a result of the new policy and framework. For one thing, following the 1st Objective of the new policy, the FBA enshrines a standardised assessment methodology ensuring a consistent standard for major project biodiversity assessment reporting (a Biodiversity Assessment Report), including the use of the revised BioBanking Assessment Methodology (BBAM) as the tool to measure impact for all major projects. As well, Objective 2 of the policy establishes the requirement to create offset sites using a BioBanking Agreement (ie an in-perpetuity mechanism), as a mandatory requirement which was lacking in the previous interim offset policy where it was merely optional.

However, the 'transitional arrangements' provide for a delay of the full policy, and will apply for the duration of time that is taken to establish the Biodiversity Offset Fund as well as other administrative issues: the time-frame for which is uncertain.

Despite some questionable assumptions which remain within the FBA*, it should be regarded as a reasonably credible tool for assessing biodiversity loss and gain through the use of biodiversity credits, a system which has gained recognition around the world. As well, there is much promise that with a functioning Biodiversity Offset Fund, and consistent with Objective 2 of the policy, that significant conservation gains can be made on private land using BioBanking Agreements - a mechanism which has had disappointing take up since its inception in 2008.

But in terms of the capacity to detect and prevent biodiversity loss and population decline: has the new policy framework sanctioned pathways for increased levels of biodiversity loss? For one thing, despite efforts to incorporate assessment of Commonwealth-listed species into the new policy, this new offset policy for NSW creates a different (lower) standard than the offset outcomes that are currently contained within the Commonwealth standard. I believe we are entering dangerous territory for future biodiversity loss; and the new framework has serious scientific limitations by increasing 'flexibility' pursuant to the 3rd Objective and reducing the adequacy of future assessments to be able to detect and mitigate against biodiversity loss. Central to this argument is the following pertinent facts about the new framework and policy: the loss of the 'precautionary principle' in relation to biodiversity loss; the termination of the concept of 'red flags' or minimum retention thresholds for species and ecological communities; loss of the concept of 'no net loss'; watering down of the principle of 'like-for-like' through 'variations'; loss of the concept of 'significant impact' for major projects; and lastly, the introduction of an unclear offset standard within the Mining SEPP.
I will briefly review each of these issues below.

The end of the concept of 'no net loss'

Objective 3 of the new policy states plainly that it is the intention to, "*provide a practical and achievable offset scheme for proponents*" by that it is, "… *providing various offset options while ensuring that the best and most credible offsets are provided*."

While the concept of 'no net loss' was widely recognised to be fraught under several offset scenarios (Gibbons and Lindenmayer 2007), the introduction of more 'flexible' options for proponents has finally seen the official death of this concept in NSW.

These flexible options include 'supplementary measures' where proponents can provide funds when offsets are not available that will, "… *benefit biodiversity but do not specifically involve protecting and managing a site*." While the policy details what kind of supplementary measures are most suitable for any particular matter, essentially it involves the conversion of unretired biodiversity credits to dollars to fund actions that are not necessarily related to the site or region of the impact.

Though Principle 6 states that the supplementary measure may fund actions outlined in threatened species recovery programs; actions that contribute to threat abatement programs; biodiversity research and survey programs; and rehabilitating degraded aquatic habitat: the very presence of supplementary measures assumes a net loss.
Another 'flexibility' innovation is that of the introduction of upfront credits for mine site 'ecological'

*Under the old BBAM, there was no requirement to provide site flora lists and cover-abundance data, though in practice this was necessary in order to justify the identification of plant and ecological communities. The FBA has corrected this situation by making the collection of this data mandatory. However, the Biometric site values still do not cover the range of habitat variables which could be used for a more robust measure of fauna habitat value. There are also tensions in the somewhat arbitrary dichotomy between 'ecosystem' and 'species' credit species, particularly, the lack of the need to conduct surveys for 'ecosystem credit' threatened species that will inhibit the collection of data that may inform future assessments of their conservation status. The assumption that species credit species are regarded as not being present if targeted surveys are not successful in identifying them onsite (despite various degrees of detectability) is questionable. It is also questionable whether the habitat preferences of 'vagrant' species couldn't be predicted. Lastly, it is an arbitrary threshold to state that where the records of species presence are at least 20 years old - they should not be considered. This makes the assumption that survey effort has been consistent over the last 20 years when a lack of data is more than likely an artefact of lack of survey effort in that location and should be used if verifiable.

rehabilitation, "… *in calculation of offsets where there are good prospects of biodiversity being restored*". This is an extremely contentious concession to mining proponents because, as noted during the recent Mining Rehabilitation Conference in Singleton last year, the creation of Plant Community Types (PCTs) and indeed discrete ecosystems anywhere in Australia is not supported by any published scientific data.

While some good results have been achieved under the *best* conditions for some rehabilitation projects (ie from rehabilitated strip sand mining sites in Western Australia and the Northern Territory), the end result still cannot recreate the indigenous vegetation community. Other examples of rehabilitation projects in the Hunter Valley on mine spoil and geofluvial landscapes show promising but mixed results, and questions remain with respect to the persistence of this vegetation and the ability to establish and retain native groundcover and understorey given problems with sodic and highly erosive substrates. The NSW Office of Environment and Heritage are currently trialling rehabilitation techniques on mine spoil, though the results are still out.

Whatever the good intentions of some researchers, the fact is that to provide upfront credits for un-established rehabilitation on unnatural substrates must be considered a net loss for the removal of remnant vegetation. A loss that is unlikely to be ever met. It should also be noted that Rehabilitation Guidelines are being prepared at the moment and include the use of nest-boxes to offset the loss of hollows – at the very best, this is a temporary and non-targeted measure.

As the old Mine Operation Plan system already required the establishment of vegetation on rehabilitated lands in order to prevent pollution, one has to wonder if the concession to be able to use mine rehabilitation as an offset for the removal of remnant vegetation is a step too far and undermines the credibility of the BBAM. This is even more ironic when you consider the reluctance of mining companies to accept a credit liability for the removal of rehabilitated areas during past mine expansions (personal experience with some major projects). One would have to assume that mining companies would now accept that liability.

Watering down of 'like-for-like' requirements

Given the retirement of the concept of 'no net loss', the watering down of 'like-for-like' requirements seems to be consistent within this context. This has been achieved through the system of 'variations' to the like-for-like requirement, "… *recognising that exactly the same biodiversity is not always available for an offset, the policy allows for variations in the 'like-for-like' requirement so offsets do not always need to be strictly matched to the biodiversity impacted on, but can be targeted to relevant equal or higher conservation priorities*."

While Principle 3 states that the default position is that impacts are offset in a like-for-like manner, and that offsets must be targeted to the biodiversity values being lost or to higher conservation priorities, the variation rules are there to facilitate offsetting where like-for-like is not available after taking 'reasonable steps'. This will allow offsets for ecosystem credits which are from within the same Keith formation, though may be outside the IBRA subregion and for species credits where the offset credits are from the same taxonomic order for fauna species and family for plant species and from within the same IBRA region (but not necessarily IBRA subregion). Such concessions do not in any way reduce the impact on locally affected threatened species.

As a seeming concession for sensitive matters, these variation rules do not apply to critically endangered species and communities or threatened species and ecological communities that are considered nationally significant (listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*) which must be offset in a like-for-like manner.

Principle 3 states that the aim of these rules is to ensure alternative offsets are still reasonably similar to the entities being impacted for these matters. However, the offset policy still allows the provision of supplementary measures *should no suitable offset be available*! On top of this, the policy introduces the concept of 'additional offsets' which are offsets that do

not have to bear any relationship to the matter being impacted. This is in effect is the final nail in the coffin for any requirement for 'like-for-like' under the new offset policy in NSW, and in effect means that there is no impact on any matter regardless of how threatened it may be, which cannot be offset.

Nothing is off-limits

The FBA has retired the concept of 'red flags' as they existed under the old BBAM, and has been replaced with the concept of '*matters requiring further consideration'*. The FBA also replaces the requirement to consider 'significant impact' as per the Assessment of Significance test (or 7 Part test) found in the *Threatened Species Conservation Act 1995* and the *Environmental Planning and Assessment Act 1979*. Currently the FBA only applies to assessment of Major Projects as determined by the consent authorities in NSW, and so the 7 Part Test will still apply to Part 4 and 5 matters where local government is the consent authority. However, given the current review of biodiversity legislation in this state, it appears that most things are on the table for review.

As Principle 1 of the offset policy states, biodiversity offsets sit within a hierarchy of 'avoid, minimise, offset', with no mechanism for refusal except at the discretion of the consent authority for 'severe' impacts on 'matters requiring further consideration'.

Principle 1 states that, "*If a project proposes to have an impact requiring further consideration, the prima facie position is that a project should not proceed, given the severity of the impact. The consent authority may, however, consider if there are other factors that might allow the project to proceed with these impacts. This could include consideration of social and/or economic benefits of a project and if the impact can be appropriately ameliorated through additional conservation measures.*" This seeming contradictory position, is re-iterated in the FBA, where the courses of action that a consent authority may consider include (a) refusal of the project, (b) approval with modification of the project, or (c) approval with additional offsets or supplementary measures. As these are presented as non-hierarchical options, there is, therefore no *prima facie* position that any development should not proceed under the new policy.

What does 'matters requiring further consideration' mean for the assessment of sensitive and highly threatened matters? There are four criteria.

With respect to the first criterion regarding species extinction or decrease in viability, Principle 1 makes the misleading assertion that this includes impacts which may, "… *cause extinction of a species from a local area* …" In fact the FBA states that impacts which require further consideration include "… *an impact that is likely to cause the extinction of a species from an IBRA subregion, including where it will significantly reduce the viability of a species, population or ecological community.*" Any IBRA sub-region may in fact contain several discrete or 'local' populations. While the Biodiversity Assessment Report (BAR) asks the proponent to detail the characteristics of the local population, the assessment of impact according to a reasonable reading of this condition would not be a matter for further consideration if it did not mean the demise or decrease the viability all populations of any species in any IBRA sub-region. One thing is for certain: these statements are not well written and leave open a number of interpretations.

The second criterion relates to a matter that is listed on the *Register of Critical Habitat in NSW.* This register contains very few items. In addition, there was conjecture that this register may be sunk as it was not consistent with the definition of 'important habitat' as contained in the EPBC Act. As it stands, this criterion will account for very few matters in this state.

The third and fourth criteria relate to impacts to the connectivity of riparian buffer zones on significant streams and 'identified' movement corridors providing significant linkages in the state. These are welcome attempts to deal with landscape connectivity issues and impacts on the dispersal of fauna which was lacking in previous assessments using the '7 Part test'. However at present, there is no 'identified' or widely accepted system of linkages in NSW, aside from those relating to important streams as detailed in the third criterion.

Given the likelihood of a significant expansion in major projects in NSW, unless corrected, these loopholes in the criteria are likely to result in further loss of populations and genetic diversity among our most threatened biodiversity. This has to be considered in contradiction to our international obligations as outlined in Article 8 the UN Convention on Biological Diversity (1992) which states:

> *(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings; and*
>
> *(k) Develop or maintain necessary legislation and/or other regulatory provisions for the protection of threatened species and populations.*

Other issues

What seems to have fallen by the wayside in NSW, is recognition that ecosystems should have minimum retention levels. Such a regulatory mechanism would be a safeguard to prevent the extinction of ecosystems within IBRA regions or catchments. The Catchment Management Plans have such targets, but unfortunately have no regulatory teeth and so have been consistently ignored by state authorities. Their future now seems uncertain given the current Biodiversity Legislation Review. We seem to have replaced this approach with one of accepting ongoing biodiversity decline.

There are other issues with the new offset policy itself, particularly in relation to inconsistencies with the Commonwealth EPBC Act which uses the precautionary principle in its Significant Impact Guidelines for Matters of National Environmental Significance. In NSW, the precautionary principle was removed over matters relating to biodiversity, though is still retained in the *Protection of the Environment Operations Act 1997*. The Commonwealth guidelines also treat critically endangered and endangered species using the same significance impact criteria, though now in NSW, endangered and critically endangered species are treated differently. Given the paucity of matters listed as critically endangered in NSW, surely endangered species and populations warrant special consideration given they are threatened with extinction?

In terms of duplication of existing conservation measures, Principle 4 states that offsets must be additional to other legal requirements and requires that credits generated on pubic lands are discounted by only 5-7.5% where management actions already exist, and carbon credits do not count and no discount is required for biodiversity credits over the same areas. These positions are not consistent with the Commonwealth Offset Policy.

It seems that the NSW Offset Policy has been written with a view to take account of Commonwealth matters, though looking at the inconsistencies between the two offset policies and impact assessment guidelines, has only been partially successful. What the ramifications are for the Bilateral Agreements that the NSW and Commonwealth Governments are pursuing is outside the scope of this article - these issues could raise judicial questions.

Finally, with respect to the 2013 amendment to the Mining SEPP which allows a 'certification' of an offset strategy as being 'adequate' when applied for the first time to the Warkworth Continuation Project, this pathway allowed a certification using unretired biodiversity credits and a poor adherence to the new policy. This precedent in fact threatens to undermine the transparency of the new offset policy itself.

In our attempts to provide transparency and surety for government agencies and developers for an improved impact assessment and offset regime in NSW, have we thrown out the biodiversity baby with the bathwater? We have accepted further loss when it is generally accepted in scientific circles that we need to rehabilitate the landscape in order to cope with further wide-scale environmental habitat decline. I for one wish to see an Australia that preserves as much of our unique heritage for future generations as we possibly can and fear we are on a path that may sacrifice our biodiversity for short-term development expediency.

Reference

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IMPACTS OF FIRE, THINNING AND HERBIVORY ON SPECIES DIVERSITY IN EASTERN SUBURBS BANKSIA SCRUB*

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**Taken from an in press publication in the Journal Cunninghamia. "An evaluation of two management options to restore species diversity of Eastern Suburbs Banksia Scrub". Lambert J.[1], Lambert G.[1] & Pellow B.[2]*

[1].North Head Sanctuary Foundation, PO Box 896, Balgowlah NSW 2094

[2].Australian Museum Consulting, 6 College St, Sydney NSW 2010

Eastern Suburbs Banksia Scrub (ESBS) is an endangered ecological community which is thought to become senescent and lose species diversity in its plant cover in the long-term absence of-fire. However, the reintroduction of fire into remnant vegetation within urban areas, where this community often occurs, presents management challenges.

In 2012-13 the North Head Sanctuary Foundation (NHSF), in partnership with the Australian Wildlife Conservancy (AWC), conducted a study on two treatments, the use of fire, and selective thinning, as tools for the restoration of senescent ESBS at North Head, Sydney.

Two peri-urban ESBS sites at North Head, Sydney NSW, scheduled for hazard reduction burns to protect assets, were surveyed pre-burn for their floristic attributes. Surveys were carried out in 7 x 7 metre quadrats, one third of which were fenced to assess predation by herbivores. Similar quadrats were established on adjoining unburnt sites from which dominant species were removed through selective thinning.

Prior to the burns, a total of 36 quadrats were allocated by a randomisation process across burn sites (31 quadrats) and thinning sites (5 quadrats). Within the central 5 x 5 metre core of each quadrat, four 1 x 1 metre plots were selected randomly and permanently tagged.

In the immediate post-treatment period, to prevent access by herbivores, fences were established around 10 burned quadrats and all five thinned quadrats. The wire mesh and star-picket fence design included a pegged skirt to deter burrowing.

Thinning was undertaken by removal of the dominant overstorey of *Leptospermum laevigatum* and *Monotoca elliptica* using chainsaws, with as little other disturbance to the site as possible. The process sought to approximate vegetation removal consistent with alternative fire risk management practices. Removal of the dominant species resulted in a nearly 100% opening up of the previous canopy, with only a few low-growing species and *Leptospermum* seedlings remaining.

Quadrat surveys were carried out prior to the burn and at 6 and 12 months post-treatment to record the following attributes:

- species identification;
- species count;
- classification as "Native" or "Weed";
- developmental stage (seedling, juvenile, mature);
- reproductive status when observed (flowering, seeding, etc.); and
- height in centimetres

Six months after treatment

Data collected 6 months after the burn showed considerable variation between quadrats.

Mean canopy cover and median plant height were the same in thinned and burned plots. There was little difference in the number of plants (all or native) in fenced-burned versus fenced-thinned plots. The fenced -thinned plots were slightly more diverse.

Almost twice as many weeds were found in the thinned plots compared with those in the burned plots. There were also differences in the mix of native species present in burned *vs* thinned plots.

Twelve months after treatment

By 12 months after treatment, much more plant growth had occurred.

The plots that had been burned had more plants, more plant species, and more native species compared with thinned plots. The diversity of species present in burned *vs* thinned plots were almost identical, however analysis indicated a pronounced lack of overlap of species between burned-fenced and thinned -fenced plots.

The median height of plants in the burn plots at 12 months was greater than the median height at 6 months. This difference was not seen with thinned plots.

Effects on ESBS species at 12 months

Twelve months after burning or thinning, the fenced-burned plots had a greater diversity of ESBS indicator species per plot than did fenced-thinned plots. There was also a greater abundance of ESBS plants in the fenced-burned plots than in the fenced-thinned plots.

Impacts of disturbance on weeds

Compared with the native species present, there were relatively few weeds found in both burnt and thinned plots. At both 6 and 12 months after treatment the fenced-burn plots had fewer weeds and fewer weed species than did the fenced-thinned plots. Despite removal of identified weeds after assessment of the plots at 6 months, diversity and numbers of weed species were generally greater at 12 months than at 6 months.

Herbivore predation

The differences between fenced and unfenced quadrats which had been burned were striking Figure 1 and 2. At 6 months after burning, quadrats with rabbit exclusion fences appeared to be rabbit-free and had significantly more plants than the unfenced quadrats and a slightly greater number of native species. Plant cover was twice as high in fenced quadrats. The median height of native plants in the unfenced plots was slightly smaller (but not significantly so) than those in the fenced plots. However, the frequency distribution of heights at 6 months were highly skewed and indicated a far greater proportion of seedling, juvenile or eaten-down plants in the unfenced plots at 6 months. After 12 months this effect was less pronounced.

By 12 months after fire, the fenced plots still remained rabbit-free. Fenced-burned plots contained almost twice as many individual plants as did the unfenced-burned plots. The number of native plant species present in the fenced-burned plots was 19% higher than in the unfenced-burned plots and plant cover was 160% higher. The species present in both types of quadrats were essentially identical.

These results show that there was a greater increase in floristic richness in the plant cover of burned quadrats than in that of unburned quadrats in which cover of the dominant species was removed by selective thinning instead of burning. There was a highly significant lack of species overlap, with the two treatments affecting emergence of different species in different ways. These results support the proposition that although plant cover of long unburnt ESBS may be species poor, species diversity is maintained in the soil seed bank.

One of the strongest messages to emerge from this small project is the importance of protecting recently burned or cleared areas from predation by rabbits and other herbivores. Plots in the fenced quadrats had more native plants and fewer weeds than plots in unfenced quadrats.

Figure 1: Difference between fenced and unfenced areas 12 months after the burn Source: B. Pellow

Figure 2: Difference between fenced and unfenced areas 30 months after the burn. Source: G. Lambert

THE MITEY CHALLENGE OF FIELDWORK

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Introduction

It was 35 years ago when I first experienced a mass mite attack. I spent the afternoon walking through dense coastal dune heath about 80 km north of Perth, in search of a suitable area to study of the ecology of the White-browed Scrubwren (*Sericornis frontalis*) for my PhD. By the evening I had unbearably itchy skin rashes up to my waistline. It was probably only my tight trouser belt that had prevented the mites climbing up to higher regions of my body. To this day, I don't know what species of mite was responsible, but the itchiness lasted for weeks and, although the site was great for scrubwrens, I abandoned the idea of using it for my PhD research! Ever since then I have always been mindful of mites, especially when walking through heath.

So what mite species feed on or annoy humans in Australia, can they transmit diseases, and what precautions can we take to avoid becoming infested with them when we are in the field?

Introducing "The Mite".

Mites and ticks form a diverse group of animals with over 55,000 species worldwide described, but a million or more species are estimated to exist. Their classification is as follows (Walter & Proctor 2013):

Class Arachnida (spiders, ticks and mites)
- Subclass: Acari
  - Superorder: Parasitiformes
    - Order: Ixodida (ticks).
    - Order: Opilioacarida (primitive scavenging & predatory mites)
    - Order: Holothyrida (free-living scavenging mites).
    - Order: Mesostigmata (free-living predatory mites).
  - Superorder: Acariformes
    - Order: Trombidiformes (plant parasitic mites, snout mites, chiggers, hair follicle mites, velvet mites, water mites).
    - Order: Sarcoptiformes
      - Suborder: Oribatida (moss mites, beetle mites and box mites).
      - Suborder: Astigmata (biting mites and feather mites).
      - Suborder: Endeostigmata ('segmented' mites)

Over 2,620 Australian mite species have been described (Halliday 1998). About 655 species, across 41 families and 188 genera are known to be parasitic on or associated with Australian vertebrates (Domrow 1992).

Australian Mites Associated With Humans

Domrow (1992) defines a human-associated mite as a species that (a) casually affects a host, particularly humans; (b) no more than one remove from their usual vertebrate host (e.g. *Ornithonyssus* and *Cheyletiella* species); or (c) infest stored food/household situations (e.g. *Cheyletus* and *Tyrophagus* species).

At least 218 Mesostigmata mite species (Domrow 1987), 228 Prostigmata mite species including chiggers (Family Trombiculidae) (Domrow 1991, Domrow & Lester 1985) and 205 Astigmata mite species (excluding feather mites) are associated with native and introduced vertebrates in Australia and which have the potential of being transferred to humans. Useful lists of known mite species associated with each vertebrate species are provided in each of these monographs.

However, Walter & Proctor (2013) indicate that only a few species of mites bite humans and these encounters are usually accidental because (a) a bird or mammal is nesting near people, and (2) the host animal is not available.

The following species have been found on humans in Australia and are known to cause skin irritation and/or other immune reactions:

Order Mesostigmata (Domrow 1987):

- Chicken Mite (*Dermanyssus gallinae*) (Family Dermanyssidae);
- Tropical Rat Mite (*Ornithonyssus bacoti*) (Family Macronyssidae);
- Tropical Fowl Mite (*Ornithonyssus bursa*) (Family Macronyssidae); and
- Northern Fowl Mite or Starling Mite (*Ornithonyssus sylviarum*) (Family Macronyssidae).

Suborder Prostigmata (Order Trombidiformes) (Domrow 1991, Domrow & Lester 1985):

- Cat Mite (*Cheyletiella blakei*) (Family Cheyletidae);
- Domestic Dog Mite (*Cheyletiella yasguri*) (Family Cheyletidae);
- *Cheyletus malaccensis* (Family Cheyletidae);
- Human Sebaceous Gland Mite (*Demodex brevis*) (Family Demodicidae);
- Human Hair Follicle Mite (*Demodex folliculorum*) (Family Demodicidae);
- *Odontacarus adelaideae* (Family Leeuwenhoekiidae);
- Sydney Grass Itch Mite *Odontacarus australiensis* (Family Leeuwenhoekiidae);
- *Odontacarus barrinensis* (Family Leeuwenhoekiidae);
- Tropical Scrub Itch Mite (*Eutrombicula hirsti*) (Family Trombiculidae);
- *Eutrombicula samboni* (Family Trombiculidae);
- Blacksoil Itch Mite or Scrub Itch Mite (*Eutrombicula sarcina*) (Family Trombiculidae);
- *Eutrombicula macropus* (Family Trombiculidae);
- *Neotrombicula mackayensis* (Family Trombiculidae); and
- *Leptotrombidium deliense* ((Family Trombiculidae).

Suborder Astigmata (excluding feather mites) (Domrow 1992):

- House-dust Mite (*Dermatophagoides pteronyssoides*) (Family Pyroglyphidae);
- Mould or Storage Mite (*Tyrophagus putrescentiae*) (Family Acaridae); and
- Itch Mite (*Sarcoptes scabei*) (Family Sarcoptidae).

Therefore, just over three percent of mite species that are listed in these monographs as external parasites of Australian vertebrates are known to infest humans. Descriptions of the distribution, habitat host species and life cycles of each of these species are presented in Tables 1 to 10.

Diseases Caused by Mites

Mites as Primary Pathogens

It appears that the role of mites in causing human diseases in Australia has largely been unstudied. Therefore, most information about mite-caused diseases is based on overseas studies. Some mite species cause an immune reaction by burrowing under the layers of a person's skin, so must be regarded as pathogens themselves, as well as potential vectors of other pathogens (Walter & Proctor 2013).

Adult female Itch Mites *Sarcoptes scabei* burrow between the stratum corneum and stratum granulosum, which are upper layers of the skin (Walter & Shaw 2005). The burrows are usually a few millimetres to one centimetre in length and within these burrows the mites feed, defaecate and lay 2 or 3 eggs per day for about six weeks. Our immune systems respond to the antigens in the mite products, slowly at first (3 to 6 weeks in a primary infection), but almost immediately on a secondary infection. The immune response results in welts, rashes or pustules in affected areas, especially the webbing between the fingers, the skin folds of the wrist, elbow or knee, the penis, the breast or shoulder blades. These areas become very itchy, especially at night; scratching can create sores which, in turn, can result in secondary infection from bacteria such as *Staphylococcus* and *Streptococcus* species (Johnston & Sladden 2005).

Most mite species found on humans are biting mites. They usually live in the nests of their principal hosts, or on the principal hosts themselves. However, when their principal hosts die or leave the nest, the nest is swarming with too many mites, or if the principal hosts are handled by humans, then the mites can move onto humans and into our habitats (Walter & Proctor 2013). These species can cause transient dermatitis in humans, but are known to spread diseases in the populations of their principal hosts and at least one species, the Tropical Rat Mite (*Onithosnyssus bacoti*), is a suspected or potential vector of disease to people (Walter & Shaw 2005).

Cheyletidae mites live on the epidermis of their vertebrate hosts. Mange (cheyletiellosis) can occur in hosts that are sensitive to the mite, or when there is a large infestation. Symptoms of mange include itching, hair loss, skin flakes, scabbing and general deterioration of the epidermis. The occasional mite that moves onto humans can cause transient dermatitis characterised by red wheals with a central blister around the bite area (Walker & Proctor 2013).

Leeuwenhoekiidae mites are generalist parasites of lizards, birds and mammals (Walker & Proctor 2013). For instance, the Sydney Grass Itch Mite (*Odontocarus australiensis*), which occurs along the east coast of Australia, causes dermatitis and scrub itch in humans, cats, dogs and horses. Nymphal and adult mites in this group are predators of small arthropods and their

eggs, but the larval stage (the chigger) feeds externally on the host with the mouthparts penetrating the skin and saliva injected to form a tube-like stylostome that carries lymph fluid and cell contents to the mite's mouth. Chiggers that normally feed on reptiles or birds cause the most itchy reactions in humans, whereas mammal chiggers are more benign (Nutting 1985).

Mites as Vectors of Pathogens

Trombiculidae mites that normally feed on small mammals, especially *Leptotrombidium* spp., can carry the bacterium *Orientia* (*Rickettsia*) *tsutsugamushi* which is responsible for Scrub Typhus (Chigger-borne Rickettsiosis) (Walter & Proctor 2013). *Leptotrombidium deliense* is known to be a vector of this pathogen in tropical Australia (Walter 2003). Although mites can transfer this pathogen from rodents to humans, the mites themselves appear to be the primary reservoir of the disease (Frances 2005; Kuo *et al*. 2011; Phasomkusolsil *et al*. 2012). Leeuwenhoekiidae mites (the chigger mites) are also thought to vector Scrub Typhus (Walter & Proctor 2013).

Scrub Typhus symptoms start one or two weeks after infection and include fever with headache, profuse sweating, lethargy, muscle pain, nausea and other non-specific indicators similar to dozens of other diseases, and in severe cases can be fatal (Walter 2003). A rash often develops after one week, but the best indicator of infection is an ulcerous scab 4-8 cm in diameter at the site of mite attachment, which is usually around the genitals, buttocks, lower abdomen, arm or armpit (Walker & Proctor 2013).

Dermanyssidae and Macronyssidae mites, especially those associated with birds and rodents, occasionally bite people, and these species are known vectors of Rickettsial Pox (*Rickettsia akari*), a worldwide disease (Renvoise´ *et al*. 2012).

Prevention and Management of Mite Infestations

Hahn & Asceno (2008) advise that, before going into a place where mites may be present, protect, a person should be protected with a repellent that has the active ingredient DEET (N,N,-diethyl-m-toluamide).

The repellent should be applied to clothing by rubbing or spraying it on without saturating the fabric. Some types of rayon and other synthetic fabrics may be damaged by the repellents, whereas nylon, cotton, and wool will not be harmed.

In treating clothing, the repellent should be applied along the inside and outside edges of all openings, such as cuffs, neck, and waistband areas. Be sure to treat all the way around the upper edges of socks. Cotton and wool socks absorb repellent better than other materials. Apply the repellent lightly to the arms or legs if they are not covered by clothing.

Mites can infest inanimate objects lying on the ground, such as clothes and blankets. Avoid setting such articles on the ground if you believe mites are present. Clothes and blankets suspected to be infested with mites should be washed in hot water.

Hahn & Asceno (2008) also indicate that a person may not know that they have been attacked by mites until welts appear and itching begins. They advise taking a bath as soon as possible upon returning from a mite-infested area. Apply a thick lather, rinse, and then repeat. This action kills most attached mites and ones not yet attached. Next, apply an antiseptic to the welts; this kills any remaining chiggers and prevents infection.

Killing the mites reduces the itching but does not stop it. The fluid injected by the mites causes the itching, and no practical way to remove it has been found. For temporary relief of itching, Hahn & Asceno recommend applying ointments that contain benzocaine, hydrocortisone, or those used for relief of poison ivy itching.

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Table 1 Summary Information about the Chicken Mite (*Dermanyssus gallinae*) and Tropical Rat Mite (*Ornithonyssus bacoti*)

	Chicken Mite ***Dermanyssus gallinae* de Geer 1778**	**Tropical Rat Mite** ***Ornithonyssus bacoti* Hirst 1913**
Distribution	Japan, Australia, Brazil, and most of Northern Hemisphere including Europe and the USA. In Australia, found mostly in Victoria, south-eastern South Australia and Tasmania.	Worldwide distribution, except in the arctic and Antarctic regions. In Australia, within 200 km of seaports, including Tasmania. First reported in Australia in 1913.
Habitat	A major pest of poultry farms.	Most rodent habitats, including human habitation.
Host Species in Australia	**BIRDS** Chicken (Red Junglefowl) (*Gallus gallus*).	**MAMMALS** **Rodentia:** House Mouse (*Mus musculus*), Mitchell's Hopping Mouse (*Notomys mitchelli*), Smoky Mouse (*Pseudomys fumeus*), Bush Rat (*Rattus fuscipes*), Australian Swamp Rat (*Rattus lutreolus*), Brown Rat (*Rattus norvegicus*), Black Rat (*Rattus rattus*), Long-haired (*Rattus villosissimus*) and Giant White-tailed Rat (*Uromys caudimaculatus*), Northern Palm Squirrel (*Funambulus pennanti*). **Marsupialia:** Dibbler (*Parantechinus apicalis*), Fat-tailed False Antechinus (*Parantechinus macdonnellensis*), Kaluta (*Dasykaluta rosamondae*), Brown Antechinus (*Antechinus stuartii*), Eastern Pygmy-possum (*Cercatetus nanus*), Sugar Glider (*Petaurus breviceps*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Fat-tailed Dunnart (*Sminthopsis crassicaudata*). **Lagomorpha:** Rabbit (Oryctolagus cuniculus).
Life Cycle	*D. gallinae* feeds on the blood of resting birds at night. After feeding, they hide in cracks and crevices away from daylight, where they mate and lay eggs. The mite progresses through 5 life stages: egg, larva, protonymph, deutonymph and adult. Under favourable conditions this life cycle can be completed within seven days, so populations can grow rapidly - causing anaemia in badly affected flocks of poultry. Young birds are most susceptible. The mites can also affect the health of the birds indirectly, as they may serve as vectors for diseases such as Salmonellosis, avian spirochaetosis and *Erysipelothrix rhusiopathiae*.	*O. bacoti* has five life stages: egg, larva, protonymph, deutonymph, and adult. The only two stages that feed are the protonymph and the adult. Once they have fed, they either drop off the host to molt or lay up to a 100 eggs, respectively. An egg will take one and a half days to hatch into a larva which will then attach to a host and take one to two days to molt into a protonymph. A protonymph then molts into an adult. The whole life cycle takes anywhere from 7 to 16 days to complete. It takes a minimum of 13 days to go from egg to egg. The larva is the only stage that has three legs as opposed to four.

Table 2 Summary Information about the Tropical Fowl Mite (*Ornithonyssus bursa*) and Northern Fowl Mite (*Ornithonyssus sylviarum*)

	Tropical Fowl Mite ***Ornithonyssus bursa* Berlese 1888**	**Starling Mite (Northern Fowl Mite)** ***Ornithonyssus sylviarum* Sambon 1928**
Distribution	Occurs in the warmer regions of the world, mostly in tropical and sub-tropical regions, but also introduced into some temperate regions In Australia, found in eastern Australia (including Tasmania), South Australia and the Northern Territory.	Worldwide, but more abundant in temperate regions. One of the most common mites found on wild birds. In Australia: Coastal southern Australia (south-east Qld to south-west WA, including Tasmania.
Habitat	In and around nests of host species. It has become a pest in human habitats where birds are allowed to roost on roofs, around the eaves of homes, and office buildings. After the birds abandon their nests, the mites move into the building through windows, doors, and vents and bite the occupants.	In and around nests of host species.

Table 2 Summary Information about the Tropical Fowl Mite (*Ornithonyssus bursa*) and Northern Fowl Mite (*Ornithonyssus sylviarum*)

	Tropical Fowl Mite *Ornithonyssus bursa* **Berlese 1888**	**Starling Mite (Northern Fowl Mite)** *Ornithonyssus sylviarum* **Sambon 1928**
Host Species in Australia	**BIRDS** **Suliformes**: Little Pied Cormorant (*Phalacrocorax carbo*). **Charadriiformes**: Black Noddy (*Anous minutus*), Brown Noddy (*Anous stolidus*). **Gruiformes**:Lewin's Rail (*Rallus pectoralis*). **Anseriformes:** Mallard (*Anas platyrhynchos*). **Accipitriformes:** Black-shouldered Kite (*Elanus notatus*). **Falconiformes:** Australian Kestrel (*Falco cenchroides*). **Strigiformes**: Eastern Barn Owl (*Tyto alba*). **Cuculiformes:** Pheasant Coucal (*Centropus phasianinus*), Common Koel (*Eudynamys orientalis*). **Columbiformes**: Feral Pigeon (*Columba livia*). **Psittaciformes:** Pale-headed Rosella (*Platycercus adscitus*). **Coraciiformes:** Laughing Kookaburra (*Dacelo novaeguineae*). **Galliformes:** Red Junglefowl (Chicken) (*Gallus gallus*), Wild Turkey (*Meleagris gallopavo*). **Passeriformes:** Fairy Martin (*Petrochelidon ariel*), Australian Magpie (*Cracticus tibicen*), Apostlebird (*Struthidea cinerea*), European Sparrow (*Passer domesticus*), Common Starling (*Sturnus vulgaris*). **MAMMALS** **Marsupialia:** Northern Brown Bandicoot (*Isoodon macrourus*). **Perissodactyla:** Horse (*Equus ferus*).	**BIRDS** **Falconiformes:** Australian Kestrel (*Falco cenchroides*). **Galliformes:** Red Junglefowl (Chicken) (*Gallus gallus*). **Coraciiformes:** Laughing Kookaburra (*Dacelo novaeguineae*). **Passeriformes:** Welcome Swallow (*Hirundo neoxena*), Fairy Martin (*Petrochelidon ariel*), Little Wattlebird (*Anthochaera chrysoptera*), Noisy Miner (*Manorina melanocephala*), Golden Whistler (*Pachycephala pectoralis*), Magpie-lark (*Grallina cyanoleuca*), Dusky Woodswallow (*Artamus cyanopterus*), Little Grassbird (*Megaleurus gramineus*), Canary (*Serinus canaria*), European Sparrow (*Passer domesticus*), European Blackbird (*Turdus merula*), Common Starling (*Sturnus vulgaris*).
Life Cycle	*O. bursa* has five stages - egg, larva, protonymph, deutonymph, and adult. In the laboratory, it lays most of its eggs in the litter away from its hosts. In the field, it lays its eggs on the host or in the nest. Eggs hatch within three days. The non-feeding larvae moult in about 17 hours. The protonymph will moult in one or two days, but the length of the deutonymphal stage has not been determined. The nymphs and adults take blood meals. On birds, most of the breeding takes place in the nests. Only a few mites are found on birds that are in flight. On chickens, the mites prefer the fluffy downy feathers and are numerous about the vent, accumulating on a few feathers.	The adult female *O. sylvarium* lays eggs on its bird host. Depending on the temperature and humidity, the eggs will hatch in 1 to 2 days. The larvae that hatch from the egg do not feed, but moult to the nymphal stage in around eight hours. The nymph has biting mouthparts and pierces the host bird's skin for a blood meal. The nymphs mature to adults in 4 to 7 days. The adult female mites take a blood meal and complete egg laying in two days. The number of eggs laid averages only 2 to 5 per female mite. The complete life cycle from egg to egg-laying adult can be completed in 5 to 7 days or longer, depending on temperature and humidity. Adult Northern Fowl Mites spend most of their lives on the host, but will also wander. The preferred sites on the host are the vicinity of the vent (cloacal opening) and on the back. Although the female mites do not lay large numbers of eggs, mite populations can nevertheless increase rapidly once a bird has been infested. Under optimal (for the mites!) conditions, newly-infested chickens can support mite populations in excess of 20,000 per bird in 9 to 10 weeks. Mite populations of approximately 200,000 per bird may cause death from blood loss.

Table 3 Summary Information about the Cat Mite (*Cheyletiella blakei*) and Domestic Dog Mite (*Cheyletiella yasguri*)

	Cat Mite *Cheyletiella blakei* Smiley 1970	**Domestic Dog Mite *Cheyletiella yasguri* Smiley 1965**
Distribution	Worldwide distribution, associated with cats (*Felis catus*).	Worldwide distribution, associated with Domestic Dog (*Canus familiaris*).
Habitat	All habitats where cats occur.	All habitats where dogs occur.
Host Species in Australia	**MAMMALS** **Carnivora:** Cat (*Felis catus*) (feral and domestic).	**MAMMALS** **Carnivora:** Domestic Dog (*Canus familiaris*).
Life Cycle	The life cycle is spent entirely on the cat. These are non-burrowing mites, residing in the keratin layer of the epidermis. They are never associated with hair follicles. There are five developmental stages in the life cycle of this surface dwelling mite: egg, larva, nymph I, nymph II and adult. The adult mite attaches eggs to hair. The larvae which emerge from the eggs have three pairs of legs while each subsequent nymphal stage and the adult stages possess four pairs. Should the motile stages of this mite leave the definitive host, they usually die within 48 hours, however female mites have been known to survive for as long as 10 days off the host under refrigerated conditions. The prepatent period for *Cheyletiella* species has been reported to range from 21 to 35 days. The mites are very mobile and, as a result, are very contagious by direct contact. “Walking dandruff” can spread easily through a cattery. Mites of *Cheyletiella* species have been found on fleas, flies and lice, suggesting that these larger ectoparasites may play a significant role in the animal to animal spread of cheyletiellosis.	Similar to C. *blakei*. The adult female may survive as many as ten days away from a host animal. This means that, days later, animals and people can become infested from the environment where the host animal has been.

Table 4 Summary Information about *Cheyletus malaccensis*, Human Sebaceous Gland Mite (*Demodex brevis*) and Human Hair Follicle Mite (*Demodex folliculurum*)

	***Cheyletus malaccensis* Oudemans 1903**	**Sebaceous Gland Mite *Demodex brevis* Akbulatova 1963 and Hair Follicle Mite *Demodex folliculurum* Simon 1842**
Distribution	Worldwide	Worldwide.
Habitat	Free-living. Can be found in large numbers in grain silos and have a beneficial impact of consuming fungi and preying on insects that spoil grain.	*Demodex folliculorum* lives in the hair follicles and *Demodex brevis* lives in the sebaceous glands of humans. Both speies can live on all body parts wherever there are hair roots and sebaceous glands. However, they are most prevalent in the facial area, especially the nose, forehead, chin, and cheeks. These areas have the most favourable living and breeding conditions and provide an optimum temperature for them to thrive. *D. folliculorum* can also live in the eye lash roots and can be the reason for blepharitis, itching and infections. The hair follicles from the scalp are also often infected with itching as a result. Since *Demodex* spend all their lives inside the sebaceous glands, they physically and chemically affect the skin, reducing its immune competence, and causing allergic reactions in some parts of skin tissues, where acne breaks out.

Table 4 continued….

	***Cheyletus malaccensis* Oudemans 1903**	**Sebaceous Gland Mite *Demodex brevis* Akbulatova 1963 and Hair Follicle Mite *Demodex folliculurum* Simon 1842**
Habitat *cont….*		In a survey of 370 people, Sengbusch & Hauswirth (1986, cited by Walker & Proctor 2013) found 55% had one or both species, 31% had *D. brevis* only, 11% had *D. folliculorum* only, and 14% had both.
Host Species in Australia	No host; free-living species that are often found in tropical grain storages. Prey on mould mites and eggs, larvae and nymphs of insect pests, especially booklice (Psocoptera). Have the ability to move onto humans who are in close contact with the species, especially in grain stores. Domrow (1991) documents a case where an individual of this species was extracted from under a person's fingernail which had a fungal infection.	**MAMMALS** **Primates:** Human Being (*Homo sapiens*)
Life Cycle	Eggs of this predatory mite hatch and develop through a larval and two nymphal stages before emerging as adults. Under optimal conditions of 30 ºC and 75% relative humidity, the life cycle is completed in 19-20 days. Female mites can also reproduce parthenogenetically in the absence of males.	Mating takes place in the follicle opening and eggs are laid inside the hair follicles or sebaceous glands. The six-legged larvae hatch after 3-4 days, and the larvae develop into adults in about 7 days. It has a 14-day life cycle. The total lifespan of a *Demodex* mite is several weeks. The dead mites decompose inside the hair follicles or sebaceous glands.

Table 5 Summary Information about *Odontacarus adelaideae* and the Sydney Grass Itch Mite (*Odontacarus australiensis*)

	***Odontacarus adelaideae* Womersley 1934**	**Sydney Grass Itch Mite *Odontacarus australiensis* Hirst 1925**
Distribution	Northern Qld (including Atherton Tableland); sub-coastal central Qld and south-eastern South Australia.	Coastal and sub-coastal eastern NSW and Qld as far north as the Atherton Tableland.
Habitat	Host species and their nest, burrows and resting areas.	Host species and their nest, burrows and resting areas.
Host Species in Australia	**BIRDS** **Passeriformes:** Blue-faced Honeyeater (*Entomyzon cyanotis*), Apostlebird (*Struthidea cinerea*). **MAMMALS** **Marsupialia:** Eastern Grey Kangaroo (*Macropus giganteus*), Red Kangaroo (*Macropus rufus*). **Rodentia:** Giant White-tailed Rat (*Uromys caudimaculatus*). **Carnivora:** Cat (*Felis catus*). **Artiodactyla:** Sheep (*Ovis aries*), Feral Pig (*Sus scrofa*).	**BIRDS** **Accipitriformes:** Black-shouldered Kite (*Elanus notatus*). **Falconiformes:** Australian Kestrel (*Falco cenchroides*). **Galliformes:** Red Junglefowl (Chicken) (*Gallus gallus*). **Passeriformes:** Noisy Friarbird (*Philemon cuniculatus*), Lewin's Honeyeater (*Meliphaga lewinii*), Grey-crowned Babbler (*Pomatostomus temporalis*), Rufous Whistler (*Pachycephala rufiventris*), Black-faced Cuckoo-shrike (*Coracina novaeholandiae*). **MAMMALS** **Marsupialia:** Northern Brown Bandicoot (*Isoodon macrourus*), Long-nosed Bandicoot (*Perameles nasuta*), "wallabies". **Perissodactyla:** Horse (*Equus ferus*). **Carnivora:** Dog (*Canis familiaris*).
Life Cycle	Little is known about the life cycle of this species. Southcott (1989) describes the larval and nymphal stages that had been collected from the ears of domestic cats in the Adelaide area. There are two nymphal instar stages (protonymph and deutonymph). Larva to deutonymph transformation under laboratory conditions took 15-29 days.	Eggs transform into an active prelarval stage before hatching into active larvae that seek out hosts using carbon dioxide, body heat and other host cues. After wandering on the host's body, the larva finds a protective spot, usually around the eyes or genitals or in the ears. The larva feeds externally, but the injected digestive saliva gives the false impression that the mite has burrowed into the skin. A quiescent stage, the protonymph, is passed within the cuticle of the fully engorged larva, which eventually detaches and gives rise to the predatory deutonymph. Deutonymphs feed on other arthropods or their eggs until they have increased greatly in size. A quiescent tritonymphal stage is passed within the deutonymphal cuticle. Adults emerge directly from the combined deutonymphal-tritonymphal cuticle and are several millimetres long (Walter & Shaw 2005).

Table 6 Summary Information about *Odontacarus barrinensis* and the Tropical Scrub Itch Mite (*Eutrombicula hirsti*)

	Odontacarus barrinensis	**Tropical Scrub Itch Mite *Eutrombicula hirsti* Sambon 1927**
Distribution	Queensland (Atherton Tableland).	Coastal Qld (including Atherton Tableland).
Habitat	Free-ranging specimens collected from rainforest habitats on the Atherton Tableland.	Host species and their burrows and resting areas.
Host Species in Australia	**Primates:** Human Being (*Homo sapiens*). Larvae were successfully reared on the House Mouse (*Mus* musculus) under laboratory conditions (Southcott & Frances 1991). Therefore, *O. barrinensis* is potentially an ectoparasite of rodents in its natural habitat.	**REPTILES** **Squamata:** Australian Water Dragon (*Physignathus lesuerii*), "skink". **MAMMALS** **Marsupialia**: Northern Brown Bandicoot (*Isoodon macrourus*), Agile Wallaby (*Macropus agilis*), Long-nosed Bandicoot (*Perameles nasuta*), Brushtail Possum (*Trichosurus vulpecula*). **Rodentia**: Fawn-footed Melomys (*Melomys cervinipes*), Grassland Melomys (*Melomys lutillus*), Bush Rat (*Rattus fuscipes*).
Life Cycle	Southcott & Frances (1991) reared unfed larvae collected from rainforest habitats near Innisfail, Qld on suckling mice under laboratory conditions. Larvae reached full engorgement (3-5 days after placement), then to deutonymphs (first seen 18 days after placement), tritonymphs (first observed 49 days after placement), and adults (62 days after placement).	Similar to other Trombiculid species. See account for *Eutrombicula sarcina* as an example of a life cycle of a typical chigger mite.

Table 7 Summary Information about *Eutrombicula samboni* and the Blacksoil Itch Mite (*Eutrombicula sarcina*)

	***Eutrombicula samboni* Womersley 1939**	**Blacksoil Itch Mite or Scrub Itch Mite *Eutrombicula sarcina* Womersley 1944**
Distribution	South-eastern South Australia.	Inland central areas of Queensland and NSW
Habitat	Host species and their burrows and resting areas.	Host species and their resting areas. Consequently, they prefer areas of savannah and grassland scrub. The primary sites of infestation are the host's legs (particularly on the inside of the leg) and feet.
Host Species in Australia	**MAMMALS** **Artiodactyla:** Cow (*Bos taurus*), Sheep (*Ovis aries*). **Perissodactyla:** Horse (*Equus ferus*).	**MAMMALS** Although the Eastern Grey Kangaroo is the principal host, it is a significant ectoparasite of sheep (Taylor *et al*. 2007). **Marsupialia**: Eastern Grey Kangaroo (*Macropus giganteus*), wallaroos, wallabies. **Artiodactyla:** Sheep (*Ovis aries*). **Carnivora:** Domestic Dog (*Canus familiaris*).
Life Cycle	Similar to other Trombiculid species. See account for *Eutrombicula sarcina* as an example of a life cycle of a typical chigger mite.	Female mites deposit spherical eggs in damp but well-drained soil. The larvae ascend grass stems to await passage from a suitable host on which they cling. Larvae are picked up on the faces and legs of grazing animals. The mite feeds on the host for several days before falling off and entering a quiescent phase before moulting into the protonymph. There are three nymphal stages, but only the middle one (the deutonymph) is active (Bates 2012). *E. sarcina* can breed throughout the year, but it is particularly abundant from November to February, after summer rain.

Table 8 Summary Information about *Eutrombicula macropus* and *Neotrombicula mackayensis*

	***Eutrombicula macropus* Womersley 1936**	***Neotrombicula mackayensis* Womersley 1954**
Distribution	Northern Territory, Queensland, Victoria and South Australia.	Coastal Queensland (including Atherton Tableland), New South Wales and Victoria.
Habitat	Host species and their resting areas. Consequently, they prefer areas of savannah and grassland scrub. The primary sites of infestation are the host's legs (particular on the inside of the leg) and feet.	Host species and their habitats.
Host Species in Australia	**MAMMALS** **Marsupialia**: Agile Wallaby (*Macropus agilis*), Western Grey Kangaroo (*Macropus fuliginosus*), Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallaby (*Macropus rufogriseus*).	**MAMMALS** **Marsupialia**: Brown Antechinus (*Antechinus stuartii*), Long -nosed Bandicoot (*Perameles nasuta*) and Swamp Walla-by (*Wallabia bicolor*). **Rodentia:** Bush Rat (*Rattus fuscipes*).
Life Cycle	Not studied, but likely to be similar to *E. sarcina.*	Not studied, but likely to be similar to *E. sarcina.*

Table 9 Summary Information about *Leptotrombidium deliense* and *House-dust Mite* (*Dermatophagoides pteronyssoides*)

	***Leptotrombidium deliense* Walch 1922**	***House-dust Mite* *Dermatophagoides pteronyssoides* Trouessart 1897**
Distribution	Coastal northern Queensland (Ingham-Cape York, including Atherton Tableland, and coastal areas of the Gulf of Carpentaria) and northern Western Australia (The Kimberley Region).	Worldwide, including throughout Australia.
Habitat	Host species and their nest, burrows and resting areas.	Associated with house dust and bird nests.
Host Species in Australia	**MAMMALS** **Marsupialia:** Musky Rat-kangaroo (*Hypsiprymnodon moschatus*), Northern Brown Bandicoot (*Isoodon macrourus*), Long-nosed Bandicoot (*Perameles nasuta*), Red-cheeked Dunnart (*Sminthopsis virginiae*). **Rodentia**: False Water-rat (*Hydromys chrysogaster*), Fawn-footed Melomys (*Melomys cervinipes*), Grassland Mosaic-tailed Rat (*Melomys lutillus*), Bush Rat (*Rattus fuscipes*), Cape York Rat (*Rattus leucopus*), Black Rat (*Rattus rattus*), Dusky Field Rat (*Rattus sordidus*), Giant White-tailed Rat (*Uromys caudimaculatus*).	Free-living. However, Domrow (1992) documents incidences of D. *pteronyssoides* occurring in a person's scalp that had a fungal infection and another person's scalp that had alopecia.
Life Cycle	Larvae in soil climb onto hosts, or climb onto vegetation and then attach to host mammals. The larva feeds on tissue fluids, engorges on these, and then drops off the host. the larva enters the soil, and emerges from the moult as a deutonymph. The protonymph stage is vestigial. The deutonymph feeds on detritus or soft-bodied invertebrates and after engorging, emerges from the molt as an adult male or female. Adults also feed similarly to the deutonymphs. Males deposit spermatophores, which are picked up by females. The females deposit eggs in the soil, which hatch and release larvae.	The life stages of *D. pteronyssoides* are the egg, active larva, resting larva (pharate tritonymph), active tritonymph, resting tritonymph (pharate adult), and active adult stages. Between 19 and 30 days are needed to complete a life cycle depending upon the temperature and humidity (Furumizo 1973). Mated females live about two months. A male may attach itself to a tritonymph female and mate when she reaches the adult stage. *D. pteronyssinus* lays about 80 eggs over a 45-day period. There is a general agreement that house dust mites in the home feed on shed skin of humans and other mammals. The average individual sheds 0.5 to 1.0 gram of skin daily. Spieksma *et al.* (1971) reported that the mites were sensitive to relative humidity and at 60% or lower the mite population stops growing and dies out.

Table 10 Summary Information about *the Mould or Storage Mite (Tyrophagus putrescentiae*) and Itch Mite (*Sarcoptes scabei*)

	Mould or Storage Mite *Tyrophagus putrescentiae*	**Itch Mite *Sarcoptes scabei* Gerlach 1857**
Distribution	Occurs worldwide. Throughout Australia, including some islands of Bass Strait, but absent from mainland Tasmania.	Found throughout Australia, including Tasmania.
Habitat	Free-living mite that inhabits agricultural food storage depots, cultivated mushrooms, house dusts, greenhouses, soil, mosses, litter and nests of a range of animal species. It is saprophagous and myrcetophagous and is known to feed on decaying organic material in the soil and to damage stored food products (Bahrami *et al*. 2007).	Skin of host species.
Host Species in Australia	Free-living. Have the ability to move onto humans who are in close contact with the species, especially in grain and other fresh food depots. In Australia, this mite has also been found: in nests of the Short-tailed Shearwater (*Puffinus tenuirostris*); on the bill of a duck (species unknown); and in the head hair and faeces of humans. *T. putrescentiae* does not burrow into the skin, but can cause skin allergies in humans.	**Marsupialia:** Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*), Common Wombat (*Vombatus ursinus*), Koala (*Phascolarctos cinereus*), Common Ringtail Possum (*Pseudocheirus peregrinus*). **Carnivora**: Dog (*Canis familiaris*), Dingo (*Canis lupus*), European Fox (*Vulpes vulpes*). **Artiodactyla:** Dromedary Camel (*Camelus dromedarius*). **Perissodactyla:** Horse (*Equus ferus*). **Primates:** Human Being (*Homo sapiens*).
Life Cycle	The life history T. putrescentiae was studied by Bahrami et al. (2007) who reared this species on *Fusarium graminearum* cultures under controlled laboratory conditions. They found the egg incubation, larval and nymphal periods, and adult longevity were 2.22±0.06, 3.46±0.12, 4.84±0.16 and 10.05±0.9 days, respectively at 25 ºC and 60% relative humidity. Pre-oviposition, oviposition and post-oviposition periods were 2.22, 5.77 and 1.4 days, respectively. Gross and net fecundity rates were 76.2 and 23 eggs per female per generation, respectively. The population consisted mainly of eggs and larvae (78%), and nymphs and adults represented only 22%.	Life stages consist of the egg, larva, nymph (protonymph and tritonymph phases) and adult stages. The length of these stages may vary with environmental conditions and host species. Upon infesting a host, the adult female burrows into the stratum corneum (outermost layer of skin), where she deposits two or three eggs per day. A female can lay up to 30 eggs, then dies at end of a burrow. Upon hatching, the six-legged larvae migrate to the skin surface and then burrow into molt pouches, usually into hair follicles, where vesicles form. *In vivo* studies conducted by Arlian & Vyszenski-Moher (1988) of *S. scabei* on dogs showed development from egg to adult required 10.6-13.16 days for the male mite and 9.93-13.03 days for the female. Egg incubation times were 50.1-52.97 hr. Larval duration was between 3.22 and 4.20 days. The durations of the protonymphal stages that were destined to become females and males were 2.40-3.40 days and 2.33-3.33 days, respectively. Tritonymphs destined to become females and males moulted in 2.22-3.22 days and 2.42-3.42 days, respectively. During development, all life stages frequently leave their burrows and wander on the surface of the skin. Adult mites mate when the male penetrates the molting pouch of the female. Mating occurs only once, as that one event leaves the female fertile for the rest of her life (one to two months). The impregnated female then leaves the molting pouch in search of a suitable location for a permanent burrow. Once a site is found, the female creates her characteristic S-shaped burrow, laying eggs in the process. The female will continue lengthening her burrow and laying eggs for the duration of her life.

From the Botany Desk

This issue the Botany Desk has compiled a short list of some of the more interesting botany-related abstracts from ESA 2014 held in Alice Springs, along with a brief commentary following each abstract. The abstracts provide a snapshot of some of the current botanical research being undertaken in Australia and include topics as diverse as seedbank dynamics, rainforest and native grassland restoration, plant root dynamics, orchid fire ecology and genetic diversity.

PATTERNS OF BARK THICKNESS ACROSS A LANDSCAPE-SCALE FIRE AND PRODUCTIVITY GRADIENT IN NORTHERN AUSTRALIA

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Fire resistance traits such as bark thickness have evolved in response to pervasive fire regimes in north Australia. Thicker bark generally indicates that fire is a significant ecosystem driver, and increasing fire is predicted to cause species drift towards communities increasingly dominated by species which can rapidly acquire thick bark. In this study we examine the species composition and bark thicknesses for plant communities across a fire and productivity gradient extending from the northern tropics to arid central Australia. In the north where fire is most prevalent and water is not limiting, thicker barked eucalypts, which are advantaged by their unique epicormic strand structure, are dominant. As rainfall declines southward, with a concomitant decline in fuel loads, the prevalence of species with thinner bark increases. In the southern hummock grasslands, where fire and aridity coincide, life history strategies to cope with fire are more limited: trees have thick bark or are absent, and basally resprouting mallee eucalypts and shrubs with thin bark are the norm. Comparisons of relative bark thickness among different life history strategies and within phylogenies confirm that fire is a key driver of thick bark in northern Australian trees.

Botany Desk Comment: The thick barks of the bloodwoods, stringybarks, ironbarks and wollybutt so ubiquitous across the top end is also likely to help these tropical woodland trees with moisture retention during the dry season and drought periods. It is likely that this bark trait coupled with the eucalypt's resprouting ability through epicormic bud and lignotuber structures will ensure their continued dominance in the fire prone tropical savannas.

ROOT TRAITS MAY LIMIT EUCALYPTUS SPECIES' ABILITY TO SHIFT THEIR DISTRIBUTION RANGES UNDER CLIMATE CHANGE.

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Research into the impacts of climate change on species distributions often considers aboveground traits only. Species endemic to specific edaphic environments are assumed to be adapted to these conditions and to compete poorly with more generalist species in common environments. However, in a changing climate, it is no longer just the specialised species that are threatened, as even common species may be required to migrate and might encounter novel edaphic environments. We hypothesise that both widespread and more specialised species have root traits that result in the filtering of species when climates force migration across the landscape. Nine species from the highly diverse Eucalyptus genus in the South-West Australian biodiversity hotspot were chosen to represent a range of growth habits, soil and climatic preferences. Five replicates of each species were grown in 58 x 36 x 3 cm rhizotrons in a glasshouse environment to study root system growth, architecture and root length distribution in a common soil type. Species' root systems varied with climate zone and/or soil type that they typically inhabit. From drier inland locations, trees tended to have less lateral roots in the top 10 cm of the soil profile and invested more biomass into tap roots, with species in sandy soils from higher rainfall locations having the opposite strategy. These differences have implications for the distribution range and migration potential of these species as differing rooting strategies could affect the survival of seedlings during the first summer drought.

Botany Desk Comment: These findings seem to be consistent with field observations of uprooted trees where coastal eucalypt tap roots generally appear much less extensive than those from trees on the NSW western tablelands, slopes and plains. The tap roots of the drought tolerant savannah bloodwoods are also generally much deeper than those of the more drought sensitive boxes across the top end. On a slight tangent, root architecture of a number of NSW north coast wallum heathland plants is also being studied at UNE Armidale to try and better assess impacts to wallum heathland communities that are subject to water table drawdown impacts associated with borefields on the large coastal sandmasses of the NSW north coast.

EFFECTIVE MONITORING TO SUPPORT THE MANAGEMENT OF GROUNDWATER DEPENDENT VEGETATION

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Conditions for managing the health of groundwater dependent vegetation (GDV) are often attached to approvals for abstraction of groundwater in resource projects. To maintain the health of GDV, managers of these projects require clear information from a monitoring program that is science based, adaptive and efficient. We demonstrate these principles with a case study of riparian woodland situated adjacent to a gas plant on the Pilbara coast of Western Australia. The monitoring program includes quantitative data collected for tree health: measures of water status (water potential) and projected foliar cover as measured by digital photography. Additionally, ratings of tree health are used to compliment these measures. Recently, high resolution satellite imagery has also been incorporated to provide additional monitoring metrics and to detect changes in health at a landscape scale. Monitoring results have indicated that trends in GDV health to date related to seasonal variation in rainfall rather than groundwater drawdown as a result of abstraction. To assist management decision-making at this site, we have developed control charts of vegetation monitoring parameters utilising biological and statistical triggers: examples are presented. We conclude by highlighting additional innovations with the potential to improve the effectiveness of this and other GDV monitoring programs, emphasising the role of monitoring in underpinning the achievement of management goals.

Botany Desk Comment: GDE researchers widely acknowledge that their understanding and mathematical modelling of GDEs has been limited to date by a poor knowledge of GDE species' root systems and root dynamics, and that given the difficulties of accessing the sub-surface (requiring intrusive excavation), little is still known on root adaptability to changes in groundwater levels and associated changes in nutrient availability and soil moisture. As such, detailed monitoring is often used to supplement and validate modelling predictions in relation to changes in GDE as a result of predicted groundwater changes. Typically, GDE monitoring parameters include species (and community) diversity/ abundance/cover/distribution as well as canopy health and regeneration. The study of root architecture and dynamics (eg. water uptake) is in its infancy in Australia, but will no doubt yield valuable information to feed into the mathematical models and ultimately to develop improved predictions to likely changes to GDEs from water table drawdowns, as well as improved early warning indicators and management triggers for GDE protection.

INVESTIGATING NOVEL METHODS FOR RESTORING NATIVE GRASSLAND IN FORMER CROP LAND

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In southeast Australia, ecological barriers to restoring crop land to native grassland include high levels of nitrogen and phosphorus, and a seed bank of exotic weeds. These factors give exotic species a competitive advantage over native species, and prevent the establishment of native species. We will conduct a replicated field experiment in former crop land near Werribee, Victoria, that will address two major objectives: (i) to test some novel approaches for grassland restoration and their cost-effectiveness, and (ii) to determine the individual effects of N, P and the exotic seed bank as barriers to restoration this will

improve our understanding of these barriers, and provide a stronger theoretical framework for grassland restoration research. Each method we trial will address one of the barriers to restoration. To address the exotic seed bank, we will apply large blocks of green waste (from municipal green waste collections), which we predict will generate enough heat to reduce the viability of the exotic seed bank. We will test two methods of reducing soil phosphorus: (i) the application of Phoslock, and (ii) sowing and harvesting native plant species that may accumulate phosphorus (e.g. Ptilotus sp.). We will test the reduction of soil nitrogen via carbon additions to the soil that will increase microbial activity. Scalping (topsoil removal) prior to sowing native seeds addresses all three of these barriers (it removes N, P and the exotic seed bank), and has shown considerable success as a technique for grassland restoration in Victoria.

Botany Desk Comment: On a similar front, research in the restoration of temperate grassy woodlands (essentially a grassy ecosystem) on the NSW tablelands has shown initial success with spring burns combined with carbon (sucrose or sawdust) addition and native grass seeding. The restoration results have partially succeeded in reducing soil nitrate concentrations and replacing exotic (Mediterranean) annuals with native perennial grasses. Interestingly but not surprisingly, the establishment of perennial native grass seedlings in some research trials have shown significant reductions in soil nitrate and thus may be a key factor in restoring ecosystem function in these degraded grassy woodlands to a pre-agricultural, naturally-low nitrate state. This is likely due to the fact that the majority of nitrogen (in undisturbed grasslands) is taken up in the dense root systems and leafy tussocks of the perennial grasses with little becoming available in the topsoil year round. As an alternative to spring fire treatment, some research has also shown success with using pulse grazing, slashing and herbicide application to treat annual exotics, although slashing is often limited by the extensive rocky outcropping associated with many parts of the NSW tablelands and slopes.

KICKSTARTING RAINFOREST SEEDLING REGENERATION IN RETIRED PASTURE: A MANAGEMENT EXPERIMENT WHERE WEEDS MAY BE ALLIES

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In an experimental restoration project we investigated means of overcoming barriers to the re-establishment of woody vegetation in response to release from two widely recognised regeneration barriers - pasture grass competition and poor propagule supply (seed availability) resulting from disruptions to seed-dispersal processes. At three 0.64 ha sites in retired pasture adjacent to rainforest, we quantified how seedling recruitment responded to (1) release from competition with pasture species, and (2) local facilitation of bird-assisted seed dispersal provided by scattered woody plants and artificial bird perches. Twenty months after commencement, pasture grass suppression using repeated herbicide had caused a significant but modest increase in density of native woody seedlings, together with abundant co-recruitment of a bird-dispersed non-native pioneer (wild tobacco *Solanum mauritianum*) . Recruitment of native rainforest species was further enhanced by local structure in herbicide-treated areas, being consistently greater under live trees and dead non-native shrubs (herbicide-treated) than in open areas, and intermediate under bird perches. Distance from the forest edge had no clear role; its influence was highly variable and inconsistent among sites. Native seedling recruitment comprised 28 species across 0.25 ha sampled, and was dominated by two bird dispersed rainforest pioneers (*Homalanthus novoguineensis*, *Polyscias murrayi*). These results both support current ideas about barriers to rainforest regeneration, and highlight potentially useful roles of some woody weeds in accelerating forest succession on retired agricultural land.

Botany Desk Comment: Some of the research literature noted that in the natural regrowth sites, the non-native pioneers produce fleshy fruits which are spread by birds, and their seedlings appear able to compete with pasture grasses and can grow rapidly. Once sufficiently grown, the non-native pioneers provide perches and food for some fruit-eating birds which are then more likely to facilitate recruitment of native rainforest plants through native seed dispersal (although some rainforest birds will not venture away

from the rainforest edge into open areas so this function has its limits). In the youngest regrowth sites, native trees comprised only about 40% of stems and 60% of species in the first five years; and non-native trees dominated. But after several decades, the natives increased to become the majority of trees: around 80% of stems and 90% of species after three decades. As such, the literature showed that passive intervention of retired pasture had the ability to naturally regenerate to a regrowth rainforest, but that the time scale needed to achieve a native dominated stand was measured in decades (as it is for restoring many ecosystems). Active intervention through planting has been shown to markedly hasten the rate of rainforest recovery in retired pasture relative to passive intervention. Some of the literature has indicated that sites replanted at high diversity and density took about 10 years to develop a tree canopy as dense as that seen in mature remnant rainforest, compared with 30-40 years on average for regrowth (passive) sites.

DOES YEAR TO YEAR VARIATION IN SEED PRODUCTION LEAD TO A MORE RESILIENT SEED BANK?

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Bush fires vary in a number of characteristics such as intensity and season. For plant species relying on fire to break seed dormancy (e.g. species with physical dormancy) being able to respond to this variation is critical for ensuring long term population persistence. Development of a seed bank during inter-fire years with seeds requiring a broad range of temperatures to break dormancy would therefore be a good strategy for population persistence. The presence of, and mechanisms for, the development of such a seed bank were investigated using the study species *Acacia suaveolens*. Acacia suaveolens has seeds with physical dormancy which require heat from fire to release dormancy enabling germination. Seeds were bulk collected from 12 sites over 2 successive years, and subjected to one of five fire related heat treatments and monitored for germination. In addition to population level comparison, within site variation was tested using seeds collected from individual plants at 4 of these sites. Climate data were obtained for each site from nearby meteorological stations. Germination responses at the population level differed significantly between years, whilst within sites, response also differed between individuals at high temperature treatments. More than 20% of the variation in germination response between sites was explained by rainfall. These results show that year to year and intra-population variation in dormancy thresholds are important for building up a seed bank able to produce post fire regeneration under varying fire conditions. The implications of this in terms of changing fire regimes and climate are discussed.

Botany Desk Comment: There are at least 2 main types of functional plant traits in relation to seed dormancy in south-east Australian Fabaceae. These being obligate and facultative pyrogenic dormancy species with the former displaying only high temperature dormancy thresholds (>80^{o}C which are only achieved by fire), and the latter showing lower temperature dormancy thresholds not reliant on fire to break dormancy. It is thought that the species in the pyrogenic facultative group may be more at risk from Climate Change (relative to the obligate dormancy species), as predicted elevated soil temperatures may reduce the amount of seed bank that is able to break dormancy and germinate, ultimately impacting on seedbank persistence.

MEANS, OR EXTREMES: WHICH CLIMATE VARIABLES ARE THE STRONGEST PREDICTORS OF PLANT TRAITS?

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The strategies plants use vary hugely across different parts of the world from the lush tall forests of the tropics to the tough little plants of arctic tundra. However, we know surprisingly little about global patterns in fundamental plant traits, and even less about which environmental variables drive these patterns. When ecologists include climatic variables in their analyses, they tend to focus on variables that give information about climate averages, such as mean annual precipitation and mean annual temperature. These variables capture information about the conditions that the plants experience most often. However, it may not be the 'average' days that impose the strongest selection pressure on plant populations, but rather the extreme events such as floods, droughts and heat waves. We tested this idea using data for 21 plant traits from 447961 species-site combinations from around the world, including 25354 species. Our results show that extreme events have a disproportionately strong effect on plant traits. The expected increased

frequency and severity of extreme events under climate change are therefore likely to have a strong impact on plant ecological strategy.

Botany Desk Comment: An additional major theme coming out of current ecological research on climate change impacts on Australian plants is that the ability of species to tolerate future temperature increases and reduced rainfall is, to an extent, limited by genetic constraints imposed by the local native environment to which species are naturally adapted (particularly for arid and semi-arid plants). Experiments have shown that for a range of species, those plants adapted to more readily accessible water had a reduced ability to tolerate temperature increases (ie. lower thermal tolerance thresholds), particularly during summer, than species naturally occurring in local microhabitats where water availability is more restricted or short-lived. As such, a Bluebush chenopod shrubland community may tolerate warming to a greater degree than a Black Box Woodland which naturally occurs amongst and has adapted to an ephemeral surface water or groundwater source. Another climate change theme for Australian trees coming out of the literature is that the predicted warming may be beneficial to a suite of eucalypts in south-east Australia in the cooler winter and spring months (ie. increased tree height and diameter growth), but may be detrimental (reduced photosynthesis and growth) in the summer periods.

IMPACT OF PRESCRIBED BURNS ON EMERGENCE AND REPRODUCTIVE SUCCESS OF TERRESTRIAL ORCHIDS IN SOUTH AUSTRALIA

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Prescribed burning has become an important factor shaping ecosystems across Australia; however, their effects on key ecological interactions, such as pollination, remain poorly understood. Terrestrial orchids are highly sensitive to disturbance and although fire can promote flowering in many species, the effect of managed fire regimes on their reproductive output and hence long-term population viability is unknown. Most orchid species are strongly pollen limited, therefore increased flowering does not necessarily translate into increased seed production. In particular, orchids that depend on specific pollinators may be more susceptible to disturbance regimes, than those utilising a generalist pollination strategy. We are monitoring the emergence of spring-flowering terrestrial orchids within four prescribed burn areas and adjacent control sites in the Mount Lofty Ranges, South Australia. Pollination success, seed release and herbivory effects are being monitored in detail for two generalist (Caladenia rigida, Glossodia major) and two specialist species (C. tentaculata, C. behrii). Surveys carried out 6-12 months post-burn indicate that emergence rates and pollination success of C. rigida and G. major were reduced following an autumn burn compared to nearby control sites. In contrast, a spring burn did not affect emergence of C. tentaculata or G. major. Pollination of C. tentaculata was higher following a spring burn, but was not significantly different for G. major at the same site. Post-burn data from two more spring burns may help to determine whether these differences are related to the season of the burn, differences in pollination strategy, and/or differences in habitat characteristics.

Botany Desk Comment: Another key factor in the equation in fire ecology of terrestrial orchids, is the impact that fire has on mycorrhizal fungi, which many terrestrial orchids are dependent on (fungi in turn are dependent on the development of an organic litter component in the soil). In southern Australia, which bears host to the greatest diversity of terrestrial orchids worldwide (>1000 species), the far majority of these have the following fire responses:

Fire-killed species - includes those species whose tubers occur in the leaf and bark litter or in the first few centimetres of soil, and as such are vulnerable to being burnt and killed in a bushfire (ie. tubers are too shallow in the soil for adequate insulation to the fire heat). The orchids that fall into this category typically flower in late spring or summer (eg. *Cryptostylis, Chiloglottis, some Dipodium*). Typically, only a portion of a given population are killed in any one fire, with those killed generally occurring at or near high fuel loads;

Fire-sensitive species – Includes many autumn and winter flowering species (eg. *Genoplesium/ Corunastylis, Microtis, Acianthus, Corybas,* some *Pterostylis*) which can be inhibited (from flowering) by fires; as opposed to many spring flowering species which are stimulated by fire (see below). Many of these cooler-month

flowering species do not flower for a few seasons following a fire until such time as the bush has at least partially recovered. A number of *Corunastylis* and *Corybas* species that I have seen on the north coast have taken at least 3 seasons (ie. years) to flower following a relatively intense fire. Be warned, however, as there are always exceptions to the general rule of orchid flowering ecology and so do not be surprised if you occasionally see one of these cooler-month flowering species recovering quickly following fire;

Fire-neutral species: Includes those species that survive a fire and their flowering neither increases nor decreases in the years following the fire. That is, they behave as if a fire has not occurred (eg. winter and early spring flowering *Pterostylis*, *Caleana major*, some *Calochilus* taxa, *Spiranthes australis*); and

Fire-stimulated species – Includes those orchid species that flower more abundantly in the years following a summer bushfire (eg. *Caladenia, Diuris, Prasophyllum, Thelymitra,* some *Dipodium, Glossodia major*). These orchids tend to thrive in the post fire conditions (eg. increased light and nutrients, reduced habitat competition). Once the bush recovers some years following fire and a significant ground fuel load is re-established, these species will go dormant to some extent (markedly reduced flowering) until the next fire comes through.

NO DIFFERENCE IN GENETIC DIVERSITY BETWEEN RESPROUTERS AND NONSPROUTERS IN FIRE-PRONE ECOSYSTEMS

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Some plant traits are important in how plants respond strategically to fire. Post-fire regeneration strategies (such as resprouting and nonsprouting) have been proposed as key strategies influencing reproduction and population genetics of plant species in fire-prone environments. Resprouters, generally not being killed by fire, regenerate from lignotubers, epicormic buds, bulbs and rhizomes. In contrast, nonsprouters are killed by fire and rely on seed storage (soil or canopy) for regeneration after fire. How these two traits effect the genetics of these groups has been a point of interest over the last half century. Nonsprouters have been hypothesised to have higher within-population genetic variation and speciation rates compared to resprouters due to frequent recombination via sexual reproduction over short generation times. We conducted a meta-analysis on published studies reporting genetic diversity measures of plant species within five Mediterranean-type ecosystems. Eighty three focal species were identified from studies with clear information on the post-fire regeneration and adequate sample sizes (> 10 per population). These were then categorised according to genetic markers, and comparisons were made of genetic diversity measures (after controlling sample size) between resprouters and nonsprouters. We found no significant difference between genetic diversity of resprouters and nonsprouters across all diversity parameters, regardless of genetic maker categories, taxa groups and geographic regions.

Persistence of multiple generations in the environment may be a mechanism of accumulating genetic variation in repsprotuers. Accumulation of somatic mutations may also contribute to high genetic varaition in resprouters.

Botany Desk Comment: Certainly a surprise result to many on this one – the literature is full of microsatellite marker studies showing greater diversity and speciation of seeder species vs. resprouters such as in the South Africa Cape fynbos ecosystems. Conversely, there is also literature that concludes no differences in genetic differentiation among the Mediterranean-type ecosystems. Consequently, this one got my interest up as I often initially presume resprouters and clonal populations (having longer generation times and lower population turnover) to be less genetically diverse than outcrossing seeder taxa (with relatively short generation times and higher population turnovers). The microsatellite technology which enables a researcher to view the # alleles at any one locus will ensure the debate over genetic differentiation continues.

Contributions to the Newsletter, Volume 35

Contributions to the next newsletter should be forwarded to the administration assistant Amy Rowles admin@ecansw.org.au by the

15th of July 2015.

- Articles may be emailed in WORD, with photos included or referenced in an attached file as a jpg.
- Please keep file size to a minimum, however there is no limit on article size (within reason)
- Ensure all photos are owned by you, or you have permission from the owner
- Ensure that any data presented is yours and you have permission from your client to refer to a specific site (if not please generalize the location).
- All articles will be reviewed by the editorial committee, and we reserve the right to request amendments to submitted articles or not to publish.
- Please avoid inflammatory comments about specific persons or entity

The following contributions are welcome and encouraged:

- ◊ Relevant articles
- ◊ Anecdotal ecological observations
- ◊ Hints and information
- ◊ Upcoming events
- ◊ Recent literature
- ◊ New publications (including reviews)
- ◊ Photographs

Advertising Opportunities with the ECA

Website:

$200 for a banner

$300 for company name with some detail and a link

$500 for company name within box, logo, details and web link

All website packages run for one financial year and include a small ad in any newsletter produced during the financial year.

Newsletter:

$100 for a third of a page

$250 for a half page

$500 for a full page

$1 / insert / pamphlet

Advertising is available to service providers of the Ecological Consulting industry. The ECA will not advertise a consultant or their consulting business.

If you wish to advertise, please contact the ECA administrative assistant on admin@ecansw.org.au.

ECA Photo Gallery

Photo Competition Entries

Left: *Acacia loderi (Photo courtesy of Kath Chesnut)*

Top centre and top right: Major Mitchell's Cockatoo *Lophochroa leadbeateri* taken at Finke Gorge National Park.*(photo courtesy of Ariane Weiss)*

Right: Bearded Orchid *Calochilus paludosus* at Illawong, in Sutherland Shire Council (*Photo courtesy of De-Anne Attard)*

Left: Perons Tree Frog *Litoria peroni* at Chinchilla *(Photo courtesy of De-Anne Attard)*

Below Left: Border Thick-tailed Gecko *Underwoodisaurus sphyrurus,* Nundle, NSW *(Photo Courtesy of Tim Mouton)*

Below centre and below right: Carpet Python, Rankin Springs *(Photo courtesy of Bruce Hansen)*

ECA Photo Gallery

Photo Competition Entries

Left: Pied Oystercatcher

Below: Hooded Plover

Right: *Diurus ochroma*

Centre Left: Major Mitchell Cockatoo

(photos courtesy of Kath Chesnut)

Left: White-bellied Sea Eagle *(Photo courtesy of Tim Johnson*

Left: Ornate Burrowing Frog *Platyplectrum ornatum* at Chinchilla

Right: *Neobatrachus sudelli* at Chinchilla

(Photos courtesy of De-Anne Attard)