Volume 37 August 2016

CONSULTING ECOLOGY

www.ecansw.org.au

ISSN 1836 – 6813

Newsletter of the Ecological Consultants Association of NSW

ECA
ECOLOGICAL
CONSULTANTS
ASSOCIATION
of NSW Inc

VOLUME 37 AUGUST 2016

INSIDE THIS ISSUE!

1 ECA Office Bearers 2016-2017

1 Message from the President

2 Photo Competition

3 Euroky - Yet More taxonomic changes to the reptiles of nsw

4 Euroky - Underwater 3D Maps: New Technologies are Precise, Cost-Effective and Openly Available

5 Euroky - Biodiversity Conservation Bill 2016

5 Advertising Opportunities with the ECA

7 ECA Submision for the Biodiversity Conservation Bill 2016

24 Conference 2016 abstracts

29 Upcoming Events in 2017

29 February 2016 ECA Membership Report

30 Experimental Design and Statistics Workshop

31 Recent Literature and New Publications

32 What's in a trap: An evaluation of various detection methods for terrestrial vertebrate fauna and implications for Environmental Impact Assessments

39 Relevance to Environmental Assessment of the NSW Vegetation Classification and Assessment Project and Comments on Mapping

44 Contributions to the Newsletter, Volume 38

Back cover ECA Photo Gallery

Editors: ***Martin Denny*** **and** ***Brian Wilson***

Design and Layout: ***Amy Rowles***

Front Cover Photo: *Acacia* in Sturt National Park. Photo Courtesy of Amy Rowles

ECA Office Bearers 2015-2016

President:
Martin Denny
president@eca.org.au

1st Vice-President:
Belinda Pellow
belindap@ambs.consulting

2nd Vice-President:
Mia Dalby-Ball
ecologicalca@outlook.com

Secretary:
Adam Greenhalgh
secretary@ecansw.org.au

Treasurer:
Andrew Lothian
treasurer@ecansw.org.au

Councillors:
Toby Lambert
tobylambert@enviroproperty.com.au
John Travers
info@traversecology.com.au
Isaac Mamott
isaac.mamott@sclerophyll.com.au
Jane Raithby-Veall
JRaithby-Veall@biosis.com.au
Alison Hunt
alison@ahecology.com
Brian Wilson
bwilson452@gmail.com
Nathan Garvey
ngarvey@biosis.com.au
Veronica Silver
veronica@geolink.net.au
Chantelle Doyle
chantelle@ambs.com.au

Administration Assistant:
Membership Officer:
Amy Rowles
admin@ecansw.org.au
39 Platt St, Waratah, NSW, 2298

Message from the President

Dear members,

Most of us are dictated by the passage of years as defined by our society. We work within the calendar year and/or the financial year. Other societies use different time scales such as the year of the Emperor (I would not like to start thinking that we are in the second year of Turnbull). However, to me, the years are measured by the annual ECA forum and AGM, which were held in July at Bowral. Consequently, it is worthwhile to look back over the 'year' and see what has happened within the ecological consultant's world.

First, the Conference this year focused on New Insights in Ecology and featured 10 speakers (including a recipient of the ECA Research Grant) presenting a variety of papers on ecological issues including coastal developments, fire management, offsetting, vegetation condition and tree hollow estimation. Two of the speakers presented an overview of the current development of vegetation mapping being undertaken with the OEH. This is a new approach using pattern recognition and, to date, there has been some criticism of the results. As the mapping is planned to be used in the conjunction with the new Biodiversity Conservation Act, we ecological consultants will be dependent upon its reliability. An article describing an alternative system of vegetation mapping is in this issue.

It has been quite a year for the ECA, with a lot of energy being put into responding to the introduction of the Biodiversity Conservation Bill and our Certification Scheme. Both have resulted in a higher profile for the Association and we have become a stakeholder in our own right, to be approached for consultation and advice. To give an example, as part of the introduction of Biodiversity Conservation Bill the ECA were requested to send representatives to a series of workshops, forums and face-to-face meetings with the OEH. These included an introduction to the new Bill as well as an assessment of the Biometric calculator and an offset payment calculator developed by Deloittes. The Greater Sydney Landcare Network invited the ECA to be part of a panel discussing the new Bill at a forum titled "Maintaining Biodiversity & Land Reform Management Law Reform", with representatives from the Environmental Defenders Office, NSW Farmers, Local Land Services and Western Sydney University as other members of the panel.

The introduction of the Certified Practising Ecological Consultant (CPEC) Scheme has finally arrived, after a 10 year gestation. It has started with five applicants, which is sufficient for the scheme to iron out any irregularities and introduce improvements. I look

forward to the next input of applicants. Although the new Act will force consultants undertaking Biobanking assessments (now called BAM) to be accredited, there will be a large amount of work associated with smaller projects e.g. residential developments, as well as Assessments of Significance ("7-Part Tests") that will still require consultants that should be certified. So, think seriously of becoming a CPEC, as it will be important in future dealings with councils, small developers and OEH.

Probably not many of our members will remember the TV series, The Bill. This was a series shown on the ABC from the 1980's to 2010. The Bill centred round Sun Hill police station and the episodes dwelt on murder, theft, rape and violence, and this was just within the staff at the station. Now we have a new Bill, the Biodiversity Conservation Bill, which will, sometime in the future, be enacted. The new Act will have a profound influence on the workings of ecological consultants.

As you all will know, there are many criticisms of the Bill in terms of its long-term improvements to biodiversity conservation and these are the focus of many of the protests by different groups. Although the ECA agrees and supports such criticism and will continue to push for the re-write of much of the Bill, our main concern must be towards our membership. How will the introduction of the Biodiversity Conservation Act affect our ability to reliably assess impacts from developments and to work with any offset strategy? Some of the points set out in the ECA submission to the Bill (you can read the full submission on the ECA website) are concerning the controlling of consultant's fees, no accreditation of persons undertaking Assessments of Significance or small area developments, lack of data in Threatened Species Profile Database, lessening of reliance on field surveys for Threatened Species, loss of paddock trees, weakening of offset requirements and like-for-like assessments, less credits allocated under the new BAM calculator and the streamlining of assessment only using vegetation maps without any field surveys.

This is quite a list and is only part of the many faults to be found within the Bill, hopefully OEH will take the many submissions seriously and have a look at how the new Act can be improved with the help of outside stakeholders, particularly the ECA.

Martin Denny

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 10th of October and the next meeting is planned for the 8th of February 2017. 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

PHOTO COMPETITION

Due to the lack of entries for this edition, volume 37 will feature photos from the Rowles and Wilson family holiday to the very wet arid zone.

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

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.

YET MORE TAXONOMIC CHANGES TO THE REPTILES OF NSW

Gerry Swan

It has been about three years since I last put together a list of changes that had occurred to the New South Wales reptiles, so now seems like a good time to provide a further update. These comments only apply to reptiles known from NSW, there are many more changes happening interstate. We are probably fortunate in that our reptile diversity is poor when compared to say Queensland or WA but if you do work interstate then keep on top of it. The genetic jockeys are sequencing anything they can get their hands on. Several more papers are being prepared and will hit the world later this year.

In the gecko family the Fat-tailed Gecko (*Diplodactylus conspicillatus*) got carved up into 7 species. The NSW resident started off as *Diplodactylus platyurus* but that didn't last too long and it is now *Diplodactylus ameyi*, the Eastern Deserts Fat-tailed Gecko.

Then the widespread Variegated Dtella (*Gehyra variegata*) was banished from NSW and replaced by *Gehyra versicolor*, the Variable Dtella.

The Marbled Velvet Gecko (*Oedura marmorata*) has been split into 4 species and the NSW version is *Oedura cincta* the Inland Marbled Velvet Gecko.

Moving on to the dragons the genus *Hypsilurus* has been found not to occur in Australia so the Southern Angle-headed Dragon, previously *Hypsilurus spinipes*, is now *Lophosaurus spinipes*.

In the skink family Coventry's Skink (*Niveoscincus coventryi*) is now *Carinascincus coventryi*.

The genus *Eulamprus* has been carved up with *Eulamprus martini* and *Eulamprus tenuis* now in a new genus *Concinnia*, while *Eulamprus murrayi* and *Eulamprus tryoni* are also in a new genus, *Karma* (Murray's Skink *Karma murrayi* and Tryon's Skink *Karma tryoni*).

The Narrow-banded Sand-swimmer (*Eremiascincus fasciolatus*) is now the Ghost Skink (*Eremiascincus phantasmus*).

Nothing much in the snake area except that the Blind Snakes are no longer in the genus *Ramphotyphlops* but instead are now in the genus *Anilios*.

But don't despair, the 3rd edition of A Field Guide to Reptiles of New South Wales is now with the publisher and will be released at the end of 2016.

References.

Couper, P.J. & Oliver, P.M. 2016. A new species of gecko from arid inland regions of eastern Australia (*Diplodactylus*; Diplodactylidae). Zootaxa 4093(4):525-538.

Denzer, W. & Manthey, U. 2016. Remarks on the taxonomy and nomenclature of the genus *Hypsilurus* peters 1867 (reptilian, Agamidae, Amphibolurinae). Zoosyst. Evol. 92(1):103-110.

Hedges, B. Maron, A.B., Lipp, K.M., Marin, J. & Vidal, N. 2014. A taxonomic framework for Typhlopid snakes from the Caribbean and other regions (Reptilia, Squamata). Caribbean Herpetology 49:1-61.

Mecke, S. Doughty, P. & Donnellan, S.C. 2013. Redescription of *Eremiascincus fasciolatus* (Gunther, 1867) (Reptilia:Squamata: Scincidae) with clarification of its synonyms and the description of a new species. Zootaxa 3701 (5): 470-517.

Oliver, P.M., Couper, P.J. & Pepper, M. 2014. Independent Transitions between Monsoonal and Arid Biomes Revealed by Systematic Revision of a Complex of Australian Geckos (*Diplodactylus*, Diplodactylidae). PLoS ONE 9(12).

Oliver, P.M. & Doughty, P. 2016. Systematic revision of the marbled velvet gecko (*Oedura marmorata* species complex, Diplodactylidae) from the Australian arid and semi-arid areas. Zootaxa 4088(2):151-176.

Sistrom, M.J., Hutchinson, M.N., Hutchinson, R.G. & Donnellan, S.C. 2009. Molecular phylogeny of Australian *Gehyra* (Squamata: Gekkonidae) and the taxonomic revision of *Gehyra variegata* in south-eastern Australia. Zootaxa 2277:14-32.

UNDERWATER 3D MAPS: NEW TECHNOLOGIES ARE PRECISE, COST-EFFECTIVE AND OPENLY AVAILABLE

Augustine Porter

Images and research from Augustine (Gus) Porter, Will Figueira and Renata Ferrari of the University of Sydney, School of Life and Environmental Sciences.

For marine ecologists and consultants there is demand for a simple, reliable and precise way to measure 3D structural complexity in marine environments. The team at the University of Sydney Marine Ecology Lab endeavored to create a tool fit for this purpose. The resulting Underwater Mapping Platform (UMP) uses off-the-shelf action cameras and a foldable frame to capture 3 x 12mp wide-angle photos every second. These are processed using the Photogrammetry software Photoscan from Agisoft to generate 3D models of reef patches (see Fig 1). These models are highly accurate and precise (see Figueira, Ferrari et al. 2015 for methods and precision).

We have deployed the UMP at sites from Port Kembla NSW to Lizard Island, QLD over transects ranging from 100 – 1000 m2. With the exception of visibility less than 3m and large macro algae cover greater than 60%, the platform produced high-resolution, complete-coverage 3D models over all substrate types. At these scales, model resolutions are roughly 20-30mm. This allows assessment of changes in complexity over time, assessment of infrastructure, or habitat as an explanatory variable in ecological studies.

These tools are currently being used to map the effects of stressors such as bleaching and cyclone damage on

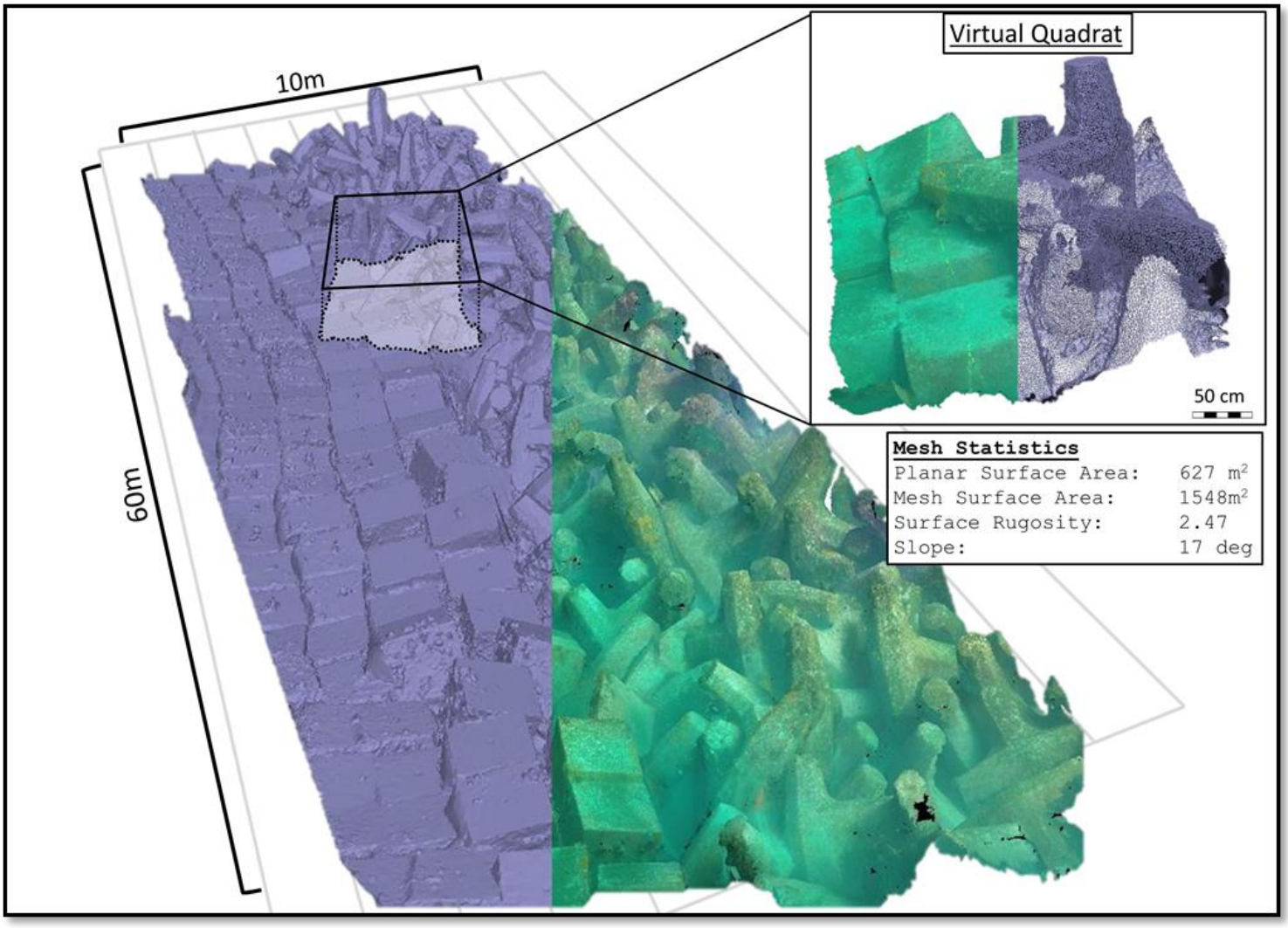


Fig. 1. 3D mesh with image overlay covering 627m2 of submerged Industrial Breakwater. This transect has ~2.5cm mesh resolution and was mapped in under 20 minutes with an openly available tool made from inexpensive, off-the-shelf components. 3D mapping is rapidly becoming a tool that scientists and consultants can deploy without specialist training or a large budget.

the Great Barrier Reef. Methods and components for mapping at both colony and patch extents are available to all scientists and managers who wish to include metrics of 3D structure in their studies (Figueira et al. 2015).

We encourage the community to take advantage of this exciting and accessible new approach to incorporate an important biological and ecological factor into their work to better describe marine processes.

To view 3D meshes, visit https://sketchfab.com/models/8a30c66f8c2e4f0eb35243b4f8e150ed

Gus Porter is a PhD student at the University of Sydney. He has worked in ecological consulting and government roles in the USA and Australia and is currently studying the effects of novel 3D structures such as breakwaters on fish assemblages.

References

Figueira W, Ferrari R, Weatherby E, Porter A, Hawes S and Byrne M (2015) Accuracy and Precision of Habitat Structural Complexity Metrics Derived from Underwater Photogrammetry. *Remote Sensing* 7:15859

BIODIVERSITY CONSERVATION BILL 2016

The ECA formed a sub-committee to make a formal submission on the proposed Biodiversity Conservation Bill 2016. This submission included comments directly relating to the Ecological Consulting industry. A copy of this submission has been included in this edition of Consulting Ecology.

Individual submissions and a summary document of key issues raised in the submissions are now loaded on the government website https://www.landmanagement.nsw.gov.au/

The bill has now been passed and may be accessed via the following website: https://www.parliament.nsw.gov.au/bills/Pages/bill-details.aspx?pk=3357

"Non-ECA promotional material presented in the ECA Newsletter does not necessarily represent the views of the ECA or its members."

If you have 2nd hand ecological equipment that you would like to sell or would like to purchase you can place an ad in this newsletter. Free for members or $40 for non -members. Contact admin@ecansw.org.au.

WILDLIFE SCHOOLS

Practical ecology training courses, delivered by experts.

Wildlife Schools are specialist training courses designed by ecologists, for ecologists.

Expand your knowledge and get up to date information on specific requirements and best practice techniques for the survey, identification and management of south eastern Australian wildlife. Threatened species are especially targeted.

Courses run regularly during spring, or contact us to arrange a training program tailored to your organisation's specific needs.

This event will count as 2 points per hour towards your Certified Environmental Practitioner CPD Log.

Six great reasons to attend:

- Discover and experience wildlife and habitats first hand
- Learn from and be guided by recognised experts in Australian flora and fauna
- Develop your skills and build your confidence in field work and practical ecology
- Gain a better understanding of biodiversity and environmental assessment
- See how environmental compliance is practically applied in the field
- Meet and network with environmental professionals from a range of organisations

More info and course dates:
Join our mailing list to receive updates on future courses and priority notification of early bird registration discount offers. Sign up online at **www.wildlifeschools.com.au**

Registration enquiries:
Deretta Brown
0488 774 107
dbrown@niche-eh.com

General course enquiries:
Dr Frank Lemckert
0425 249 026
flemckert@niche-eh.com

niche Environment and Heritage

27 June 2016

Biodiversity Reforms - Have Your Say PO
Box A290

SYDNEY SOUTH NSW 1232

Dear Sir

Re: Draft Biodiversity Conservation Bill, draft Local Land Services (Amendment) Bill and supporting products

The *Ecological Consultants Association of NSW* (ECA) formed in 1999 to promote and enhance best practice in ecological assessment, planning and management in accordance with the principles of Ecologically Sustainable Development. It is the leading industry-based organisation for ecological consultants in NSW.

The ECA provides essential professional development services for its members, including young ecologists starting their careers. Along with our mentoring, conferences, publications and annual grants the ECA provides an effective link between environmental and planning law, government agencies and consultants with expert and specialist ecological knowledge.

The ECA strongly believes that the draft *Biodiversity Conservation Bill 2016* is regressive and will not protect or slow the rate of biodiversity loss in NSW. Rather it will create a pathway for biodiversity decline. Specifically it;

1. Will lead to a reduction in the protection of biodiversity.
2. Will be more complicated to interpret and implement because it combines Act and Policy within the one document.
3. Does not conform to the NSW Office of Environment (OEH) Scientific Rigour Statement.
4. Is contrary to evidence-based policy because it significantly reduces requirements for field survey and other essential data collection.
5. Is based on a system to determine the values of biodiversity (credits) that has been shown to be inaccurate, bases calculation of credits on cursory and at worst inaccurate ecological information, relies on maps compiled on broad based data and modelling to provide fine scale assessment.
6. Is missing important information that underpins it, in particular the Land Category Maps, threshold values maps, method to assess habitat suitability, assessment thresholds and sensitivity classes. There is a real risk of the preparation of these documents being rushed to meet government requirements reducing the reliability of the data they contain.
7. Will not '*slow the rate of biodiversity loss'* (Purpose (a) of the new Act). There is no procedure to measure biodiversity loss. Monitoring of species, their populations and factors that affect their status is the only way of measuring rates of biodiversity loss.

The provisions of the proposed biodiversity conservation strategy are inadequate for this purpose.

8. Provides weaker protection for biodiversity than its predecessors because the majority of its protective measures are overridden by allowable activities under the proposed Local Land Service Act (LLS Act). From the outset, the powers being bestowed upon three Ministers of different departments to enable carriage of development consents appears to be a significant dictum that development will go ahead no matter what.

9. The new legislation does not provide direction on how the *NSW Office of Water Controlled Activity Guidelines* will be affected by these changes; and similarly for the matters raised by OEH in their 'Wetlands' policy. Will these need to be rewritten to deal with the provisions of the new legislation? Similarly the new legislation fails to recognise the local government sector as a key element in the determination of ecological conservation strategies in the form of Local environmental plans, area plans or special plans such as riparian management plans and or special area plans

e.g. Wyong and Lake Macquarie LGS's with their Squirrel Glider management plans; or The Hills Council with its Yellow-belied Glider population strategy.

Therefore the ECA does not support the enactment of the Biodiversity Conservation Bill in its current form.

The ECA believes that at the heart of these laws is an apparent philosophy by the NSW Government that some biodiversity just cannot be conserved. The greatest biodiversity losses in NSW currently occur in agricultural regions. The ECA is of the very strong opinion that these losses will be increased and accelerated in agricultural landscapes, where sensitivity maps will classify vast areas of NSW as no longer subject to vegetation clearing controls.

Currently, our native grass/shrub lands cannot be reliably mapped by the OEH using the sensitivity mapping methodology. Thus exposing important habitats and associated species to being lost through ignorance.

Gone will be the old paddock trees with hollows relied upon by woodland birds, arboreal mammals (e.g. gliders) and micro-chiropteran bats. The knock-on effects of the loss of insectivores and pollinators from the rural landscape is an obvious ecological impact.

The ECA believes that the proposed laws place a misguided confidence in vegetation mapping. Indeed the system proposes a greater reliance on mapped vegetation types with a computer modelling approach to threatened species protection, rather than using real data collected by experienced field ecologists.

Recent validation analysis shows that the majority of the Plant Community Types in the Upper Hunter (as one example) were mapped with an accuracy of less than 30%. This level of inaccuracy is likely to extend across the whole of NSW. This is inadequate for critical land use decisions being proposed by the new legislation.

The ECA has prepared a submission which raises 25 issues in respect of the matters brought forward within the legislation – see submission attached.

These fundamental issues all have a distinct bearing on the future of our biodiversity and the way we, as a society, are addressing biodiversity conservation for our future. They also address potential detrimental impacts that the new legislation would have on the ecological consulting industry, a significant group of practitioners that help manage and protect the natural environment.

It is the ECA's strong and considered opinion that the legislation as it is currently drafted will lead to biodiversity decline, affect the livelihoods of existing ecological consultants, and potentially deter large numbers of suitably-qualified university graduates from choosing a career in ecological consultancy.

Given the significance and importance of this matter the ECA believes that the draft bill and associated documents should be rewritten, in consultation with relevant environmental experts outside government, and ecological industry groups, to better protect NSW biodiversity.

Yours faithfully

Martin Denny
President ECA of NSW

Submission by the Ecological Consultants Association of NSW on the Draft Biodiversity Conservation Bill, draft Local Land Services (Amendment) Bill and supporting products

1. Preamble

The Ecological Consultants Association of NSW (ECA) was initiated to promote and enhance best practice in ecological assessment, planning and management in accordance with the principles of Ecologically Sustainable Development.

The ECA was formed in 1999 and our members include ecologists, regulators and land managers. Ecological consultants in NSW are professionals with a vast amount of experience in biodiversity assessment across a wide range of disciplines. Consequently, the profession is strongly associated and guided by the two draft bills.

One of our main aims has been to develop a certification scheme for consultants, which was launched in January 2016. This scheme was developed with financial support and peer review from OEH. The scheme and its goals are detailed further below at Appendix 1.

2. Suitability of the new Biodiversity Act as a replacement for the current Acts

The ECA NSW believes that a change in legislation is an opportunity to take a step forward in biodiversity conservation. However, we strongly believe that the draft Biodiversity Conservation Bill 2016 (the draft bill) is regressive and will accelerate, not protect or slow, the rate of biodiversity loss in NSW.

ECA does not support the introduction of this draft bill and it needs to be rewritten in consultation with relevant environmental experts from outside government. ECA members have a detailed knowledge of the current Acts and assessment processes required by them and we believe that the draft bill, if enacted in its current form:

1. Will lead to a reduction in the protection of biodiversity.

2. Will be far more complicated to interpret and implement because it combines Act and Policy within the one document.

3. Does not conform with the NSW Office of Environment and Heritage (OEH) Scientific Rigour Statement. While stating that the BAM is a scientifically robust method to assess biodiversity impacts, few scientific publications can be found that support the previous forms of the BAM or the results of biodiversity offsetting to date.

4. Is contrary to evidence-based policy because it significantly reduces requirements for field survey and other essential data collection.

5. Is based on a system to determine the values of biodiversity (credits) that has been shown to be inaccurate, bases calculation of credits on cursory and at worst inaccurate ecological information, relies on maps compiled on broad based data and modelling to provide fine scale assessment.

6. Is missing important information that underpins it, in particular the Land Category Maps, threshold values maps, method to assess habitat suitability, assessment thresholds and sensitivity classes. There is a real risk of the preparation of these documents being rushed to meet government requirements reducing the reliability of the data they contain, and

7. Will not '*slow the rate of biodiversity loss'* (Purpose (a) of the new Act). There is no procedure to measure biodiversity loss. Monitoring of species, their populations and factors that affect their status is the only way of measuring rates of biodiversity loss. The provisions of the proposed biodiversity conservation strategy are inadequate for this purpose.

8. Provides weaker protection for biodiversity than its predecessors because the majority of its protective measures are overridden by allowable activities under the proposed Local Land Service Act (LLS Act).

9. The new legislation does not provide direction on how the *NSW Office of Water Controlled Activity Guidelines* will be affected by these changes; and similarly for the matters raised by OEH in their 'Wetlands' policy. Will these need to be rewritten to deal with the provisions of the new legislation? Similarly the new legislation fails to recognise the local government sector as a key element in the determination of ecological conservation strategies in the form of Local environmental plans, area plans or special plans such as riparian management plans and or special area plans e.g. Wyong and Lake Macquarie LGS's with their Squirrel Glider management plans; or The Hills Council with its Yellow-belied Glider population strategy.

3. Biodiversity

A widely-accepted definition of the term biodiversity is - the diversity of life at the levels of genes, species and ecosystems.

The OEH defines biodiversity as follows:

Biodiversity' or 'biological diversity' is the variety of life on earth and can be thought of in terms of genetic diversity, species diversity and ecosystem diversity. Biodiversity includes all the different plants (from lichen and mosses to shrubs and trees), animals (invertebrates, frogs, reptiles, birds and mammals) and micro-organisms such as bacteria.

The term Biodiversity is the basis for the draft bill, which states that it ONLY *applies in relation to animals and plants.*

OEH should clarify that the draft bill applies to biodiversity as it is defined on the OEH webpage.

The draft bill states that - *For the purposes of this Act, biodiversity values are the following terrestrial biodiversity values:*

a) *vegetation integrity—being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state,*

b) *habitat suitability—being the degree to which the habitat needs of threatened species are present at a particular site,*

c) *biodiversity values, or biodiversity-related values, prescribed by the regulations.*

The ECA requests OEH provide clarification that the draft bill applies to living animals, plants, fungi and other organisms and that these are explicitly recognised as biodiversity values in their own right, not just the integrity of vegetation in which they occur or suitability of the habitat on which they depend.

4. Slowing the rate of biodiversity loss

OEH State Land and Tree Study (SLATS) data from 1988-2013 shows that more than 1 million ha of woody vegetation (i.e. >20% projected foliage cover) was cleared in NSW in 24 years. Clearing in open woodlands, shrublands and grasslands has not been reported.

OEH must report on clearing rates for non-woody vegetation in order to provide evidence to assess rates of biodiversity loss.

How will the draft bill, and the Land Category Map, facilitate the slowing of biodiversity loss?

5. Control of consulting fees

The new Act has a clause that seeks to control the rate that can be charged for a Biodiversity Assessment.

(j)) states that, *the maximum amount that accredited assessors may charge for preparing biodiversity assessment reports at the request of any person, may be set by the Environment Agency Head.*

The clause seeks to dictate the maximum BAM assessors can charge for their services. This should be influenced by market forces, supply and demand, quality of service, cost of time and materials etc, rather than arbitrary decisions of a single department.

The clause is contradictory to the Government's agenda of encouraging agencies to design policies or regulatory proposals that deliver improved outcomes for Australian small business. This proposal is prohibitively restrictive to business, particularly small-medium enterprises.

In the BAM section 5.4.3 consultation note for plot and transect surveys, there is a request for consultants to provide information on survey time and costs. This should not be requested as it is impossible to say how long an assessment will take as each assessment is different. Also, cost and time should not be a parameter for determining an assessment method to adequately assess biodiversity.

The ECA requests that Section 6.10.4 (j) of the new Act and any request for business information in the BAM methodology be removed.

6. Conflict of interest

How does the draft bill ensure that unfair advantage is avoided in the BAM certification process?

The certification training of ecological consultants for BioBanking assessment has been undertaken on behalf of the OEH by the environmental consultancy EcoLogical Australia (ELA).

The ECA has maintained for some time (and submitted to OEH in writing) that certification training must be delivered by an independent educational institution, such as TAFE or University.

We would like to recommend that to maintain transparency and impartiality the OEH ensure that BAM certification training is undertaken by an independent education institution that does not have ties with the environmental consultancy industry.

ECA believes that ELA's participation in the certification process may provide the company with an unfair advantage when competing for work within our industry.

7. Ecological assessments outside of the BAM

ECA is concerned that the standard of ecological assessment is highly variable in quality.

This is apparent in court challenges and the fact that some assessments are even carried out by unqualified persons without formal scientific training. Although the BAM has a certification process ECA is concerned that the standards are inefficient and that certification does not extend to other assessment tasks other than BAM required under the new Act.

Examples of these tasks are:

- flora and fauna surveys
- vegetation assessment and mapping
- habitat tree assessment, marking and mapping

- nest box programs
- pre-clearance surveys
- biodiversity monitoring
- ecological impact assessments
- species impact statements
- due diligence
- opportunities and constraints assessments
- threatened species management plans
- flora and fauna management plans
- habitat rehabilitation advice
- peer review
- interpretation of environmental laws.

Under the draft legislation, there is no provision for the accreditation of ecological consultants outside of the BAM process. Clause 7.21 states that the Environment Agency Head may accredit persons to prepare Species Impact Statements.

The new Act does not require an accreditation process for undertaking one of the steps that determines if the BAM is implemented i.e. BAM will be triggered if an assessment of significance finds that the development will have a significant impact on listed species/ communities. This important step in the process that arises prior to the need for a Species Impact Statement must be undertaken by and accredited ecologist.

Clause 7.21 of the new Act should be altered to read that *the Environment Agency Head may accredit persons to prepare Assessments of Significance and Species Impact Statements.*

ECA NSW has established a rigorous accreditation process, Certified Practicing Ecological Consultant (CPEC) that could be endorsed by OEH to address those areas not covered by the BAM. The scheme establishes a high standard of practicing ecological assessment in NSW; and provides planning authorities and communities with a high level of confidence in ecological assessments prepared by CPEC. See Appendix 1 for more details on the ECA CPEC Scheme.

The OEH should endorse the ECA NSW Scheme for certifying ecological consultants to ensure a high standard of ecological assessment and providing planning authorities and communities with a high level of confidence in ecological assessments.

8. Data underpinning the draft bill

ECA is seriously concerned about the inadequacy of the data that is provided in the Threatened Species Profile Database and currently available mapping.

The ECA knows from experience that these data are not complete, in some instances incorrect and yet the data underpins the whole BAM process.

The ability to confirm, edit and add to data to inform the preparation of the BAM report and associated impact assessments will be impaired by the reduction in field survey and the reliance on the use of inadequate data for desktop assessment.

The draft bill needs to be strengthened to ensure that adequate data will be collected as a result of additional field monitoring and reporting to enable confidence in the BAM assessment process.

The draft bill legislates for the preparation of a Biodiversity Conservation Investment Strategy. However, the Strategy is unable to be prepared in the absence of adequate field data sets. The new Act must ensure that adequate data will be used to prepare the investment strategies.

Who will sit on the Biodiversity Data Governance Board, the vehicle responsible for overseeing the Threatened Species Profile Database?

9. Threatened species survey

The BAM states in clause 6.5.1.8 that - *Where a development site or land to be biodiversity certified is within any of the specified geographic limitations of a species and contains any of the habitat features or habitat components associated with a species that is on the list of candidate species for assessment at Step 3, an assessor may opt to assume the species or breeding habitat component is present on the subject land, instead of undertaking a threatened species survey or obtaining an expert report.*

Collecting data to determine species presence, its habitat and population size prior to native vegetation clearing will allow OEH to compile and make available important information for the Threatened Species Profile Database as well as ensure reliable biodiversity assessment.

Money invested in threatened species surveys by the developer at this point would be more cost-effective than if the developer paid into a fund that then sponsors research. Under this new model any opportunity to learn about species habitat requirements and ecology to inform future decision making under the new Act will have been lost.

Biodiversity monitoring is an important step in biodiversity protection, and a crucial step in halting biodiversity loss. It would be more cost-effective and of greater value to biodiversity protection if there is a requirement to undertake surveys prior to development.

The Act should ensure that crucial data to inform the Threatened Species Profile Database is collected prior to native vegetation clearing and development.

Field surveys for threatened species not only identify the presence of a species but also the location. In terms of the concept of *avoid or mitigate*, knowledge to avoid is not possible without knowing where the threatened species occur within a development site. To assume the species is present in a polygon means that the whole polygon will need to be avoided or the whole polygon will have to be offset when only a small area within the polygon supports the threatened species and habitat. Ultimately a larger area than needed could be offset.

The new BAM will not be able to ensure that the 'avoid and mitigate' rule can be properly applied if field assessment of threatened species is not required.

A species listed as being threatened can no longer also be listed as an endangered population.

Does this apply within a listing category or across all categories e.g. critically endangered, endangered, vulnerable?

10. Fauna assessment

It is noted that the requirement for fauna assessment has been significantly reduced in the draft bill.

There is now a heavy reliance on habitat as a surrogate for determining the presence of fauna. Maps of Plant Community Types and vegetation condition, for the most part, do not lead to accurate predictions of the presence of fauna species, including threatened species, the structure of the fauna communities, and the environmental processes that are acting upon them.

The new Act can only protect fauna if it ensures that adequate field surveys are a part of the assessment process. Detection of change in a species population such that it requires protection under the new Act will only be possible if fauna ecologists are regularly collecting data for addition to the NSW Wildlife Atlas.

11. Paddock tree assessment

Paddock trees in Category 1 land will be able to be cleared without assessment.

There are large amounts of published, scientific information that support the crucial importance of these trees as habitat for fauna and as avenues to allow movement of fauna across vast, partially-cleared landscapes. It is on this basis that they have been protected in the past.

What evidence has been obtained that shows paddock trees in Category 1 land do not support biodiversity?

How does the draft bill ensure that biodiversity loss would be slowed if paddock trees in Category 1 land are not assessable?

Under the proposed LLS Act the impacts of the removal of paddock trees can be self-assessed by a landholder under a self-assessable code. There is no requirement for an ecological consultant to undertake assessments. ECA is concerned that:

1. Some threatened species that use paddock trees have cryptic behaviour (e.g. hollow-dependent microbats) and are not likely to be detected by a landholder who does not have expertise in fauna surveys.

2. A landholder involved in the self-assessment of the importance of paddock trees may not be aware of their episodic importance as threatened species habitat, especially if the self-assessment is conducted in between peak flowering periods e.g. many paddock trees are crucial food refuges for threatened species (e.g. threatened parrots and the critically-endangered regent honeyeater) when in flower, especially at times when flowering in other parts of these species' ranges does not occur (e.g. in drought

periods). Paddock trees can act as drought refuges for nectivorous threatened species and are crucial to their long-term survival.

3. The removal of paddock trees has the potential to create a barrier to the movements of threatened bird species, and to gene flow within and between populations. Other threatened species use paddock trees to disperse through the landscape. For instance, a recent CSIRO radio-telemetry study demonstrated that young Brown Treecreepers can disperse from their natal territories across open paddocks provided that the distances between paddock trees are no more than 80-100 m.

4. We are still learning how to manage the requirements of many taxa. Much of our fauna biodiversity is cryptic and not easily observed. Birds are not the only form of biodiversity and untrained observers are not always aware of the changing state of biodiversity.

Self-assessment of paddock trees by individuals who have no formal training in science will result in a loss of Biodiversity in NSW.

Given the risk to biodiversity as a result of loss of paddock trees there must be a requirement for a landscape assessment of paddock trees and hollow availability in the new BAM.

12. Offsets

The internationally-accepted principles of offsetting include the use of like-for-like, additionality and restorability to offset the loss of biodiversity.

The draft bill has discarded these principles by redefining the term 'like for like' in its variation rules, weakening the requirements for additionality and allowing biodiversity lost through native vegetation clearing to be paid for in lieu of an offset.

It also fails to recognise the evidence on the limited restorability of native vegetation.

The draft bill defines suitable offset for impacted species to be another species from the same taxonomic order or another species that has the same life form. This shows a lack of understanding of the differences between these organisms and the specialised requirements of many threatened species.

It is clear to the ECA that, in reality, this is not an offset policy and that the diversity of living organisms would be significantly reduced by a policy that does not ensure like-for- like at species level.

The modified 'like for like' rule in the new offset policy will not protect Biodiversity but will facilitate its loss.

Variation rules should be re-written and based on expert, scientific advice to ensures that like for like, additionality and restorability to offset the loss of biodiversity, is the outcome of the new Act and BAM.

Restoration has been used to offset the loss of biodiversity. Increasingly, scientific publications of monitoring research are showing that restored areas do not result in the restoration of cleared vegetation communities or formations. The draft bill has ignored this scientific evidence and needs

to be taken into account by the draft bill. The new Act should not endorse restoration as a suitable offset to biodiversity loss when there is no evidence to support this assumption.

13. Credit calculation

Investigations by the ECA have found that the proposed BAM does not allocate as many credits for the same assessment as does the current BioBanking method. For both developments and offsets, the number of ecosystem credits is significantly decreased.

The BAM also decreases the credit ratio between development and offset, meaning that it is less effective than the BioBanking Method in compensating for biodiversity loss.

The new BAM, that should lead to better protection of biodiversity, will result in a reduction of overall credits at a native vegetation clearing site.

The draft bill must deal with discrepancies between current and new credit calculator values in terms of biodiversity and value.

14. Assessment of significance and BAM thresholds

The draft bill requires the BAM to be used to assess a development if any of the BAM thresholds are met.

In addition, the BAM will also apply to any developments that will have a significant effect on biodiversity based on the existing assessment of significance (formerly known as the seven-part test) under the EP&A Act.

The new assessment will be *a Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats.*

The OEH should endorse the ECA NSW Scheme for certifying ecological consultants to ensure the assessment of significance is undertaken by suitably qualified and experienced persons thus providing planning authorities and communities with a high level of confidence in the assessment.

The test for determining whether proposed development or activity are likely to significantly affect threatened species or ecological communities, or their habitats does not include evaluation of listed Key Threatening Process's.

However, a KTP determined by the Scientific Committee is defined as a mechanism that

adversely affects threatened species or ecological communities.

To ensure the protection of biodiversity, the assessment of significance must include a question to evaluate the potential for developments to facilitate a KTP.

For the purposes of Part 5 of the Planning Act, an activity is to be regarded as an activity likely to significantly affect the environment if it is likely to significantly affect threatened species, populations or ecological communities.

15. Clearing Codes

Clearing codes underpin native vegetation clearing in the LLS Act.

The LLS Act provides that certain 'allowable activities' and activities undertaken in accordance with a code can be undertaken on category 2 land. Allowable activities can be undertaken on category 2 land without approval or notification. Code-compliant clearing requires either notification or certification depending on the type of clearing proposed. Clearing that requires certification may also require set-asides. Additionally, clearing on Category 2 land outside of the clearing codes can be allowed by the local land service on application by the landowner.

These codes and their exemptions are too broad and they will accelerate rather than stop biodiversity loss contrary to the stated purpose of the new Act.

16. Urban vegetation

There is no reference to urban vegetation or the proposed SEPP in the new Act. The following has been taken for the LLS Act.:

The proposed SEPP will replace Standard Instrument LEP provisions relating to tree removal permits in urban council areas and in urban zones. It will define the urban area of the State and make provision for the removal of native and other declared species of trees or other vegetation under the authority of a permit granted by the local council or other nominated authority. If the removal is above the biodiversity offset scheme (or BAM) threshold, the SEPP will make provision for the removal under the authority of an approval of the Minister for Primary Industries of the kind provided under this Part for clearing in rural areas that is not Schedule 5A allowable or clearing authorised by a land management (native vegetation) code. LLS Act.

The proposed SEPP will also provide that development consent under the Environmental Planning and Assessment Act 1979 is not required for removing non declared species of trees or other vegetation in urban areas and deal with the clearing of non-native vegetation in non-urban areas. The Environmental Planning and Assessment Act 1979 and the Biodiversity Conservation Act 2016 will deal with the clearing of native vegetation from any area for the purpose of carrying out development that requires development consent. LLS Act.

It appears that the removal of trees and native vegetation in urban areas has been taken from the Minister of the Environment and it is proposed to now rest with the Minister for Primary Industries. The ECA strongly oppose this measure and question how urban bushland is related to the Primary Industries portfolio.

17. Set Asides

The proposed LLS Act allows areas of land to be set aside.

The LLS Act states that:

Where NSW listed EEC vegetation is proposed to be cleared under a code and the code imposes a set-aside requirement for the clearing, an area of land containing the same EEC must be set aside. Revegetation is not available for EEC clearing. A 50% loading is applied to the relevant set-aside ratio for EEC clearing unless the area proposed to be cleared is less than the threshold area set out in the table below and not contiguous with any other area containing the same EEC, in which case the set-aside is required at the otherwise applicable ratio (i.e. without the 50% loading).

Specialist ecological advice must be required to determine the presence of EEC's on category 2 land proposed to be cleared under clearing codes or the suitability of set asides or significance areas of Biodiversity may be lost.

18. Species impact statements

In relation to species impact assessments, the new Act states:

Despite anything to the contrary in this Part (Part 7), *the Environment Agency Head may:*

a) vary the matters otherwise required to be included in a species impact statement in a particular case, or

b) dispense with the requirement of a species impact statement to assess the impact on biodiversity values that are required to be assessed in a biodiversity development assessment report submitted with the species impact statement, or

C) dispense with the requirement for a species impact statement in particular case if the Agency Head is satisfied that the impact of the action concerned will be trivial or negligible.

The new Act must ensure that the Agency Head is adequately informed to make such a decision.

19. Streamline assessment

Streamline assessment does not require field survey if vegetation maps are available for the particular location.

ECA members are very aware of the fact that current maps compiled on broad based data and modelling are not reliable for fine scale assessment. A number of Threatened Ecological Communities (TECs) are often located in small pockets in the landscape such as Dry Rainforest or as small wetlands which are not picked up in the broader-scale mapping. Consultants upgrade information about TEC boundaries regularly in their assessment reports and alter the attribution of plant community types based on their field surveys to ensure an accurate assessment.

The new Act must ensure that streamline assessment methods include field confirmation of vegetation types to prevent increased biodiversity loss in these circumstances.

Streamline assessment relies on threshold values provided in the BAM.

Clarification of this in the method is needed to determine if the current mapping was adequate and whether a full field survey was required.

20. Category maps

The land Category mapping method document lacks some specific details that are needed to evaluate the efficacy of the method. For example, it does not explain how the seasonal cover disturbance image has been used to modify or augment the land use mapping.

Furthermore, it is apparent that some areas mapped as land use 3.2 grazing modified pastures, could include substantial areas of native vegetation which should be classified as Category 2 but is actually classified as Category 1.

OEH must ensure that accurate assessment of the current state of vegetation underpins the land Category map.

21. Threshold based on size of area to be cleared

In the BAM, both the streamline assessment and the full assessment are determined by thresholds based on the size of the area to be cleared in relation to the total size of the property.

Scientific publications have shown that very small patches of vegetation can have very high biodiversity values. One minimum size threshold should be set for all areas to be cleared regardless of the total area of the lot.

22. Role of the Minister for the Environment

The following clauses are found in the Local Land Services Act.

The Minister for Primary Industries may make a land management (native vegetation) code only with the concurrence of the Minister for the Environment.

However, a land management (native vegetation) code may be amended without public consultation or the concurrence of the Minister for the Environment if the Minister for Primary Industries is satisfied the amendment merely corrects an error or makes a minor change to the code.

The new Act should ensure that the Minister for Primary Industries is accountable when he or she makes changes to land management codes.

Within the new Act the Minister of Planning has been given authority over the Minister for the Environment in some key areas, notably where state significance and infrastructure are involved. These projects have the potential to have the greatest biodiversity impact and should not be exempt from regular standards of environmental assessment and decision making.

The new Act should ensure that the interests of large developers including the State, do not take precedence over the interests of the public in the environment.

23. Areas of outstanding Biodiversity value

What process will be used to determine areas of outstanding biodiversity?

ECA believe that the process should be independent and listing determined by the Scientific Committee.

ECA believes that the Scientific Committee should be the authority that determines Areas of Outstanding Biodiversity in a similar way that KTP's are determined.

Placing the determination of these areas outside of the Scientific Committee reduces the strength of this part of the Act to maintain, conserve and restore areas of 'special biodiversity importance'.

Using the same process to list key threatening processes (Division 3 of the Act) will strengthen the current ability of critical habitat (areas of outstanding biodiversity) to maintain, conserve and restore areas of 'special biodiversity importance'.

The new Act should designate a method for determining Areas of Outstanding Biodiversity Value that is the same as for a Key Threatening Process.

24. Licencing

Currently, licensing does not specifically require plot based data to be entered into the VIS. Therefore, clients can request consultants to withhold this information.

ECA would like to see the requirement for all quantitative, plot based data, collected under licence (particularly now that the 20 x20 requires the collection of quantitative scores) to be supplied to the VIS.

What is the status of a Scientific Licence (now to be called biodiversity conservation licence) for consultants undertaking surveys i.e. what level of risk (Tier) is applied under the new Act?

Ecological consultants will hopefully still undertake surveys for flora and fauna under the new Act. Will consultants still require a licence and what will be the status and requirements of such a licence?

25. Corruption

The draft bill allows (under some undefined circumstances) for the offsetting of fewer biodiversity credits than those stipulated by a BAM.

The draft bill allows for those regulating the development offsets to personally invest in the same offsets they approve.

The draft bill allows the Biodiversity Trust to provide loans to planning authorities to undertake Bio certification.

How does the draft bill protect against the possibility of corruption?

Appendix 1

CERTIFIED PRACTISING ECOLOGICAL CONSULTANT

The primary objectives of the ECA Certified Practicing Ecological Consultant (CPEC) scheme are:

1. facilitate professional recognition for those involved in ecological assessment;
2. Establish a high standard of practicing ecological assessment in NSW;
3. Provide planning authorities and communities with a high level of confidence in ecological assessments prepared by CPEC; and
4. Promote the development of a viable ecological survey and assessment industry.

A CPEC will be recognised by the industry, government authorities and the community as

ethical, experienced, respected within the industry, licenced and insured.

To qualify to become a CPEC the requisite competency criteria need to be met:

- Have at least five years of consulting experience in a relevant ecological field during the past 10 years.
- Commit to ongoing professional development and demonstrate commitment to maintaining an appropriate understanding of current and scientifically robust ecological assessment methodologies.
- Demonstrate that you are respected by peers within the ecological consulting industry by the provision of two recommendations from full members of the ECA NSW, and two from within the applicant's area(s) of particular interest.
- Provide a written statement of 500 words outlining your career achievements and particular ecological interests. (Attendance at a meeting with the review panel maybe requested on a case by case basis).
- Provide evidence of appropriate licences and approvals to undertake ecological work in NSW and carry Professional Indemnity Insurance applicable for your area of consulting.
- Be willing to Sign the ECA (NSW) Code of Business Practice, Professional Conduct and Ethics and to uphold the beliefs as set out in these documents.

Guarantee of quality of a CPEC.

1. A CPEC is required to submit documents to an independent committee of experts who will recommend certification. The committee can request interview or further information from the applicant if required.
2. The CPEC committee follows a set of requirements to ensure the applicant is qualified for certification.
3. A CPEC will pay a biannual fee
4. A prospective CPEC will be listed for 30 days on the ECA website to invite community input prior to awarding of the certification.
5. A CPEC will be required to renew their certification every two years supported by a log of professional development activities undertaken in the preceding 2 years.
6. A CPEC can be reported to the ECA for discipline if they do not meet the standard required by the certification.
7. The ECA has Articles that support the disciplining of a CPEC.
8. The ECA has the relevant insurance required.

Abstracts

Ecological applications of time series satellite data

Dr Adam Roff

(Senior Spatial Analyst, Native Vegetation Information Science, NSW OEH)

Plant functional types represent a classification scheme based on plant responses to resources or environmental conditions. The theory is that the functional role of vegetation can be identified by linked sets of morphological and physiological traits constrained by resources, based on the hypothesis of functional convergence. Remote sensing is in a unique position to observe plant functional types at different spatial and temporal scales. The increased availability of remote sensing data, coupled with high performance computing and storage, has allowed for the creation of large-area, gap-free, surface reflectance data products. Introducing a time series of these data provides information on class stability and informs on logical transitions between classes. We review some novel applications in NSW, Australia that have harnessed remote sensing data in a time series to: (1) create a large area assessment of tree cover, (2) delineate wetland extent based on inundation history and (3) create a high spatial resolution image of western NSW to help identify plant functional types.

Assessing tree hollows in woodlands

Dr Jennifer Taylor[1] and Dr Murray Ellis[2]

([1]Catholic University School of Science ACU, [2] NSW Office of Environment and Heritage)

For many species of woodland fauna conservation relies on our ability to protect and restore hollow trees within highly degraded landscapes. To do this we need to understand key factors determining hollow presence in the landscape and time-lags to production of new hollows following planting or natural regeneration.

Eucalypts provide the vast majority of hollows in Australian woodlands. The probability of hollows being present and abundance of hollows varies among Eucalyptus species and sites, but increases with tree size and stage of senescence. Ground-based surveys can provide a reliable means of assessing whether individual trees possess hollows. However, this is time consuming if assessing large numbers of trees across larger areas. At a landscape-scale in woodlands, it is likely to be more efficient to assess abundance of hollows using satellite-derived information on foliage cover. Improved accuracy of satellite assessments can be obtained with use of rapid ground assessments.

Predicting the future abundance of hollows within woodland landscapes depends on an understanding of tree growth rates. Combining data on tree growth, mortality and recruitment with data on characteristics of hollow-bearing trees improves our ability to forecast when hollows will re-appear in the landscape following planting or natural recruitment.

Authors: Jennifer E. Taylor[1], Murray Ellis[2] and Laura Rayner[1,3]

[1]School of Science, Australian Catholic University

[2]NSW Office of Environment and Heritage

[3]Australian National University

Impacts of coastal developments on marine environments and mitigation through solutions-based strategies

Dr Katherine Dafforn

(Senior Research Associate, University of New South Wales and Institute of Marine Science)

Estuaries are among the most highly disturbed of all aquatic environments due to their proximity to urban areas and the impacts from agricultural and industrial activities. Apart from physical modification to these systems (e.g. addition of artificial structures and loss of important habitat), important chemical stressors include toxic contaminants (e.g. metals and polycyclic aromatic hydrocarbons), enriching contaminants (e.g. fertilisers), emerging contaminants (e.g. microplastics), and changes to environmental conditions such as salinity and turbidity that are outside the natural range of variation. The communities living in estuaries are exposed to multiple stressors and it is crucial that the ecological consequences are investigated to develop adaptable solutions.

In urban seascapes, the practice of "eco-engineering" is gaining momentum and driving innovative strategies to manage marine infrastructure. Similar to "green roofs", adding native vegetation or fauna to marine infrastructure via seeding or transplants can aid in the restoration of degraded habitats, and also minimise the colonisation of unwanted species, such as non-indigenous species. Eco-engineering has the potential to design structures that not only serve their primary function of foreshore stabilisation and infrastructure protection, but also mitigate impacts and support biodiversity and ecosystem services that benefit coastal dwellers.

I will discuss the potential for physical modifications such as artificial structures to promote the establishment of nonindigenous species, and eco-engineering design solutions that can mitigate the impacts of marine infrastructure. I will discuss the potential for novel molecular tools to assess ecological impacts of nutrients from land-based run-off and legacy contamination from industrial practices. My work uses experiments in the field and lab to investigate multiple stressors and furthers our understanding of their impacts so they can be better managed.

Optimisation of prescribed burning regimes for fuel reduction, carbon, water and vegetation

Associate Professor Tina Bell

(Faculty of Agriculture and Environment, University of Sydney)

Fire plays a critical role in biodiversity and conservation, carbon balances and nutrient cycling, soil erosion and hydrological outcomes. Fire management operations such as low-intensity prescribed burning are used to mitigate the risk of bushfires by altering fire behaviour with temporary removal of accumulating fuel. While empirical evidence shows that prescribed burning can reduce the incident and extent of unplanned fires in Australia, the incorporation of some environmental values such as those relating to carbon and water into fire management operations is not as well integrated as others such as maintenance of biodiversity. The overall aim of our research is to examine the trade-offs between prescribed burning and ecological management objectives to provide approaches for optimising prescribed burning for environmental outcomes. Empirical field measurements are commonly used by land managers to assess the effectiveness of prescribed burning. The general, but untested, assumption is that variability in soil and fuel properties increases from small (e.g. 1 m) to large spatial scales (e.g. 10–100 km). In our current research we are endeavouring to determine how much environmental variability is captured in measurements collected at different spatial scales to find an appropriate balance between resource expenditure and confidence in observations.

Plant community-based conservation and underlying species assemblages: Does protecting 'endangered ecological communities' represent ant species across the landscape?

James Schlunke

(Ecological Consultant)

Community or ecosystem-based conservation strategies are often considered the best approach for representing cryptic or poorly known diversity such as invertebrates. Communities are typically defined in terms of plant community composition, and plant communities that are rare or have suffered historically high rates of loss are given legal protection under biodiversity conservation legislation. This strategy assumes a strong correlation between plant community composition and composition patterns of all other taxa, however this assumption is rarely tested. Alternatively, species composition of other groups may be driven by processes besides those driving plant community composition, including inter-specific competition or stochastic processes such as dispersal limitation.

To test the congruence between plant and ant assemblages across the landscape I sampled ant and plant assemblage composition, and also structural attributes of vegetation across 40 sites from five distinct plant communities within the Sydney region, including four listed as Endangered or Critically Endangered under state and national legislation. I found a weak association of ant assemblages with plant community composition, with only broadly different vegetation classes supporting unique assemblages. Broadly, spatial turnover of ants was low, however within-community turnover patterns varied greatly between community types. I then investigated the relative importance of plant community, habitat structure and spatial drivers of ant assemblage composition at fine scales in the NSW South-east Slopes region. Spatial turnover was the strongest predictor of ant assemblage composition, with assemblages also showing some association with habitat structure. Plant community composition alone showed weak association with ant assemblages, and this association was driven entirely by spatial autocorrelation of habitat structure. Habitat complexity was found to influence assemblages by reducing the fine-scale abundances of highly aggressive competitively dominant species.

In conclusion, I found that plant community surrogacy provided only weak representation of ant assemblages, and only at course scales when comparing broadly different plant community classes. Within communities, and amongst structurally similar plant communities, spatial turnover in assemblages was strong and resulted in highly spatially structured ant communities. These finding are especially important to the implementation of biodiversity offsetting strategies, as ant assemblages represented in compensatory habitat would likely be compositionally distinct from those lost through development if offsets are located large distances from lost habitat.

Mammals, the missing seed predators in arid Australia.

Charlotte Mills

(PhD candidate UNSW)

Authors: Charlotte Mills, Mike Letnic and David Roshier

Woody weed encroachment in arid and semi-arid Australia has increased dramatically over the past century. Although there are a number of hypotheses for this increase, none can adequately explain all facets of the phenomenon. Not yet considered is the role of declining native mammals in woody weed encroachment, despite knowledge that native mammals consume woody weed vegetation. Increases in woody weed cover have coincided with the decline of native mammal populations, particularly small arid species. These native mammal population declines preceded any understanding of their inter-specific interactions, especially of their role in vegetation dynamics.

Our research explores the relationship between woody weed shrub species and Australia's declining mammal species. We used foraging tray experiments inside and outside fenced reserves to compare seed predation levels in areas with and without small native mammals. We found that native mammals such as hopping mice (*Notomys*

spp.) and the burrowing bettong (*Bettongia lesueur)* are important predators of woody weed seeds in Australian arid environments. The decline of these mammals across Australia may have facilitated increases in shrub abundance. This research can inform land managers addressing issues of woody weed encroachment and land degradation, ecosystem health in conservation reserves, and provides economic incentives for native mammal conservation.

Vegetation classification and mapping in NSW: strengths and weaknesses of contemporary methods

Dr Mark Tozer

(NSW OEH)

Over the past three decades, the classification and mapping of native vegetation communities in NSW has undergone a methodological evolution driven by the steady accumulation of point-specific species inventory data. The primary change has been in the method of deriving units of classification. The demarcation of type based on structure and dominant species (alliances) has been supplanted, in many quarters, by the use of clustering algorithms to identify compositional types (assemblages of vascular plant species), which may differ from alliances by virtue of the weight afforded to sub-dominant species. The advent of Geographic Information Systems (GIS) has similarly expanded the range of tools available for mapping vegetation, including high-resolution digital imagery for interpreting aerial photo-pattern and a range of sophisticated terrain and climate models. These developments have stimulated debate concerning the most accurate or cost effective approach for mapping vegetation. The debate has largely centred on the respective benefits of interpreting aerial photo-pattern versus statistical distribution models. However, in practise, the distinction is artificial at all but the most restricted scales of interpretation. By either process, the purpose is to predict which of the many vegetation types observed at a sample of field sites are likely to occur in areas that were not directly observed. Whether the map-maker considers aerial photo-pattern alone or in combination with environmental variables is immaterial, provided a pattern is demonstrated in advance of compiling a map. Nevertheless, aerial photo-pattern is first and foremost an expression of patterns in the dominant species. Such patterns have a logical application in the mapping of vegetation alliances, but patterns in the distribution of assemblages of species may or may not correlate with patterns in dominant species. Conversely, many parts of NSW have insufficient point-samples to permit either numerical clustering or formal vegetation modelling. The implications of this state of affairs for vegetation mappers and map users are discussed.

The pros and cons of 'strategic offsets'

Associate Professor Brendan Wintle

(Faculty of Science, School of Botany, University of Melbourne)

Governments and industries increasingly use offsets to compensate for the unavoidable impacts of development on biodiversity. However, high uncertainty about the biodiversity outcomes of offsetting strategies has led to significant criticism in the academic and policy literature, while the ad-hoc application of offset rules within a region may lead to offsets favouring some species and communities at the expense of others. We have explored opportunities to improve offsetting outcomes through strategic regional offset approaches, underpinned by concepts of complementarity and irreplaceability from the conservation planning literature. Compared to like-for-like approaches, strategic approaches, based on conservation planning principles can lead to enhanced understanding of regional-scale impacts, more efficient identification of offset sites and improved biodiversity outcomes. Strategic approaches may also encourage forward thinking about impending threats to, and opportunities for, biodiversity conservation. However, strategic approaches throw up significant ethical and social questions and pose significant governance risks. I'll characterise some of the pros and cons of strategic offsetting approaches using a case study from the Hunter Valley and let you decide whether its a good idea or not.

Uncertainty in vegetation condition assessments

Dr Emma Gorrod

(Principal Scientist – Adaptive Management Science, NSW Office of Environment and Heritage)

There are numerous sources of uncertainty in vegetation assessments, including epistemic (uncertainty about knowledge) and linguistic (language) uncertainties. One type of epistemic uncertainty is observer error in field assessments of vegetation. A recent international review of observer error revealed consistently substantial magnitudes of observer error in: estimates of species richness; visual estimates of plant abundance; and visual estimates of plant cover. Recent research has shown that precision of estimates may be improved by training (giving observers feedback about group averages), but more work needs to be done on other methods of reducing observer error. Uncertainty due to observer error can be characterised, and it is critical to quantify uncertainty where it may lead to a different decision or outcome. Examples include decisions that relate to thresholds and the evaluation of change over time.

Restoring ecological communities: what's really possible and how long does it take?

Professor David Keith

(School of BEES, The University of New South Wales)

Ecological restoration is widely seen as an imperative to conserve biological diversity and improve the function of ecosystems and the services that they provide. As scientists, regulators and practitioners, we are often asked for advice on how to go about it and to oversee its implementation. In Australia, restoration of particular communities is often required as a condition of development approval, as an offset to impacts that involve unavoidable loss or as a contribution to a biobank. It is also a key part of the recovery strategies for threatened ecological communities and habitat of threatened fauna. The goal in such cases, explicitly or implicitly, is to develop a self-sustaining assemblage that closely resembles some specified target community. In this talk, I examine five empirical case studies that attempt to quantify the success of efforts to restore ecological communities and broad habitat types for fauna from substantially disturbed initial states on retired agricultural or mining land. I first ask what measurements and experimental designs are needed to evaluate progress of restored communities towards their targets. I then examine the evidence for success, the rates of ecological change, compare differences between community types and attempt to diagnose reasons for progress or lack of it. It's taken a while for science to catch up with demand, expectations and practice, and it still lags. But the accumulating case studies place us in a better position to recommend what is feasible and what is not, estimate how long it takes to reach specified goals and design projects and monitor them in ways that improve chances of success. Improved capacity to advise on these questions is critical to environmental consulting, regulatory policy, impact assessment, and conditions attached to development approvals.

Photo Courtesy of Toby Lambert.

UPCOMING ECA EVENTS IN 2017

ECA ANNUAL CONFERENCE

Date: July 2017 TBC

Proposed theme: Maximising the effect of environmental studies and reports in planning and environmental care.

Location: Central Coast

ECA WORKSHOPS 2017

- **Experimental Design**

Date: 5th February 2017
Location: Hurstville
(See page 16 for details)

- **Statistics for Ecological Consultants**

Date: **4-**5th March 2017
Location: Hurstville
(See page 16 for details)

- **Invertebrates**

Date: May 2017,
Location: Wetlands Centre, Shortland, Newcastle

- **Soils for Ecologists**

Date: Late 2017
Location: Sydney

The dates and venues for some of 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

- **Ecological Society of Australia 2016 Conference**

Date: 28th November - 3rd December 2016
Location: Fremantle, WA
Details: www.esa2016.org.au

- **Ecosystems and Landscapes in a Changing World**

Date: 5th—9th February 2017
Location: UNE, Armidale, NSW
Details: http://conferencecompany.com.au/revegconf2017/.

- **The 12th International Mammalogical Congress**

Date: 9th-14th July 2017
Location: Perth, WA
Details: http://www.promaco.com.au/IMC12/

- **2017 Australasian Bird Fair and Wildlife Expo**

Date: 3rd—5th November 2017
Location: Sydney Olympic Park, Sydney
Details: birdfair.com.au
Contact: admin@birdfair.com.au

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

2017 fees due December.

Look for your renewal in the mail

August 2016 ECA Membership Report

Amy Rowles
ECA administrative assistant

In total we have 188 members, comprised of 140 Practising Ecological Consultants, 6 Associate (Consultants), 22 Associate (Government Ecological/ Environment Officer), 8 Associate (Non-practising), 2 Associate (Subscriber) and 10 Students. We have had 11 new members and they are introduced below:

- Hayden Beck (Practising Member)
- Julia Ryeland (Student Member)
- Jenni Kremer (Student Member)
- Mathew Misdale (Practising Member)
- Annette McKinley (Practising Member)
- Abraham Mijares (Associate Consultant Member)
- Chantelle Doyle (Associate Consultant Member)
- Jessie Bear (Student Member)
- Kiarrah Smith (Associate Consultant Member)
- Travis Peake (Practising Member)
- Greg Little (Practising Member)

WORKSHOPS!

EXPERIMENTAL DESIGN Saturday 4th February 2017

Presenter—Gordana Popovic

This course will examine the underlying principles of experimental design with a focus on data collection and analyses to explore questions and hypotheses in research.

OVERVIEW

- Introduction to experimental design- Asking well-defined research questions and understanding biologically meaningful changes
- Properties of the data collected - Variability of data in space and time affects experimental design and analysis
- Randomisation – How to collect data for valid inference
- Control – Importance of comparing to a control group
- Sample size – Determining whether there is enough data to answer the question, is our sampling scheme concentrating data collection in the right places
- Pilot study – Do you need to test your methods in a pilot study

PRACTICAL COMPONENT (using free online tools and Excel)

- How to randomise – Create a sampling scheme
- Simple power analysis – How much data do we need to answer the question ?

STATISTICS USING 'R' Saturday 4th and Sunday 5th of March 2017

Presenter—Gordana Popovic

This course will introduce participants to the R language and R Studio environment.

Day One

- Introduction to R - how to open R and import data,
  - basic data handling
  - plotting.
- Manipulation of Data - convert between formats (long and wide),
  - subset data
  - calculate summary statistics (to make tables for reports and manuscripts).
- Create publication ready plots for all data types in R

REGISTRATION OPENS 15 DECEMBER

Day Two

The second day will showcase R's statistical capabilities. We will

- Revise some basics, like data types, p-vaues, confidence intervals, and tests like the t-test and chi-square test.
- Introduce linear models. These form the basis of all statistical modelling and can be extended to cover discrete data types (generalised linear models) and more complex experimental designs (mixed models) as well as multivariate models for multi species data.
- Introduce the lm() function in R, and focus on how to check model assumptions, test a range of hypotheses and understand model outputs.

Recent Literature and New Publications

Recent Journal Articles / Literature

Phillips S. (2016) **Aversive behaviour by koalas (*Phascolarctos cinereus*) during the course of a music festival in northern New South Wales, Australia.** *Australian Journal of Mammalogy* **38** (2): 158-163.

Clews L. (2016) **Observations on roost use by the yellow-bellied sheathtail-bat (*Saccolaimus flaviventris)* in northern New South Wales, Australia.** *Australian Mammalogy* - http://dx.doi.org/10.1071/AM15048

Stevens K. et al (2016) **Genetic structure and sex-biased dispersal of a declining cooperative-breeder, the Grey-crowned Babbler, *Pomatostomus temporalis*, at the southern edge of its range.** *Emu* - http://dx.doi.org/10.1071/MU15096

Sanders D. et al (2016) **Responses of Critically Endangered migratory Swift Parrots to variable winter drought.** *Emu* - http://dx.doi.org/10.1071/MU15126

Austin V., Ribot R. and Bennet A. (2016) If waterbirds are nocturnal are we conserving the right habitats. *Emu* - http://dx.doi.org/10.1071/MU15106

Lintermans M. (2016) **Finding the needle in the haystack: comparing sampling methods for detecting an endangered freshwater fish.** *Marine and Freshwater Research* - http://dx.doi.org/10.1071/MF14346

Tonkin Z. et al (2016) Spatio-temporal spawning patterns of two riverine populations of the threatened Macquarie perch (*Macquaria australasica). Marine and Freshwater Research* - http://dx.doi.org/10.1071/MF15319

Descovich K. et al (2016) **The eastern grey kangaroo: current management and future directions**. *Wildlife Research* - http://dx.doi.org/10.1071/WR16027

Abstracts

Sex and ontogenetic dietary shift in *Pogona barbata*, the Australian eastern bearded dragon.

Wotherspoon, D and Burgin, S (2016)

Australian Journal of Zoology (early online)

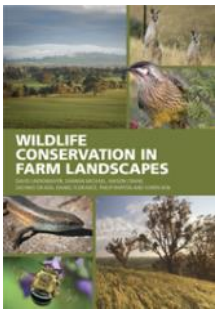
Differences may occur in the carnivore–omnivore–herbivore spectrum over the lifespan of a reptilian species, but it seldom occurs between adult males and females. Information regarding the dietary habits of Australian eastern bearded dragon (Pogona barbata) is also limited. We dissected museum specimens and road kills of the Australian eastern bearded dragon to compare ontogenetic shift in diet. Juveniles were insectivorous. They typically consumed larger, more active, arthropod prey than mature individuals – they are active predators. Adults were omnivorous and typically consumed small arthropod prey, and tended to be sit-and-wait predators. Mature males, particularly larger males, were primarily herbivorous. Such divergence in adult reptilian diet has rarely been reported. We suggest that the dietary switches observed are consistent with the Optimum Foraging Model. Juveniles require a high protein diet to maximise growth from juvenile to maturity. Beyond maturity females continue to require higher levels of protein for reproduction than males. At least in part, this is because males rely on sham aggression to defend territory during the reproductive season rather than resorting to aggressive behaviour. This results in a lesser requirement for protein for adult males than is required for juveniles and adult females. Males have the advantage of not being as dependent on protein, and thus are able to rely more heavily on vegetation.

You can view the paper online from the journal website www.publish.csiro.au/journals/ajz

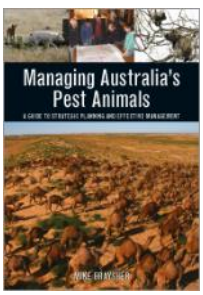
Photo courtesy of Danny Wotherspoon

Recent Book Releases

Information Source: CSIRO Publishing Website http://www.publish.csiro.au



Title: Wildlife Conservation in Farm Landscapes
Author: D. Lindenmayer et al.
RRP: $49.95
No. Pages: 232
Publisher: CSIRO Publishing
Date: August 2016



Title: Managing Australias Pest Animals: A Guide to Strategic Planning and Effective Management
Author: Mike Braysher
RRP: $49.95
No. Pages: 216
Publisher: CSIRO Publishing
Date: February 2017

WHAT'S IN A TRAP: An evaluation of various detection methods for terrestrial vertebrate fauna and implications for Environmental Impact Assessments

Steve Sass[1,4], Gerry Swan[2], Catherine Sullivan[3] & Samantha Parsell[1]

[1] EnviroKey, PO Box 7231, Tathra NSW 2550
[2] Cygnet Surveys & Consultancy , 2 Acron Road, St. Ives NSW 2075
[3] Tritton Resources Pty. Ltd., PO Box 386, Nyngan NSW 2825
[4] Email: steve@envirokey.com.au

Introduction

Assessing biodiversity during the environmental impact assessment (EIA) process requires a comprehensive knowledge of the assemblage of species within habitats of interest. Fauna surveys of species occurrence and abundance have long been used to acquire this knowledge. Pitfall buckets have been the preferred trapping method for many fauna surveys in arid and semi-arid areas due to their ability to catch a wide range of small terrestrial vertebrate fauna (Bos *et al*. 2002; DEC 2004; Swan and Foster 2005). However, it has been demonstrated that pitfall buckets may have a trapping bias for some species (Thompson *et al*. 2005). For species such as large and medium-sized snakes, goannas and some mammals, individuals can easily escape these traps (NPWS 2002). Given this, the ability of workers to detect species may be limited by the choice of trapping method.

Previous studies comparing the effectiveness of various trapping methods with the results suggest that no single approach accurately samples all species within a community and that in some instances, results may be influenced by survey timing and have the potential to be idiosyncratic to geographic region (Friend *et al.* 1989; Garden et al. 2007; Sass 2009; Thompson *et al*. 2005).

This manuscript provides the results of a study conducted in the Cobar Peneplain Bioregion, a mineral rich area of central-west NSW characterised by extensive areas of existing mining operations and exploration leases. This study evaluates a variety of trapping/detection methods commonly used for sampling terrestrial vertebrate fauna. The key question arising from this research is whether a single method, or a combination of methods, should be incorporated into future fauna surveys associated with EIA.

Methods

Study Area

The study area was located approximately 15 kilometres north of Hermidale in the Bogan local government area and the Cobar Peneplain Bioregion of western NSW. It is characterised by an ecotonal occurrence of two vegetation communities being *'Green Mallee – Cypress Pine very tall Mallee Woodland on gravel rises mainly in the Cobar Peneplain Bioregion'* (Benson ID 176) and *'Poplar Box Grassy Woodland on flats mainly in the Cobar Peneplain and Murray – Darling Depression Bioregions'* (Benson ID 105) (Figure 1 provides examples). Benson ID 176 is dominated by Green Mallee (*Eucalyptus viridis*) with the occasional White Cypress Pine (*Callitris glaucophylla*), Currawang (*Acacia doratoxylon*) and Gum Coolabah (*Eucalyptus intertexta*) while Benson ID 105 is dominated by Poplar Box (*Eucalyptus populnea subsp. bimbil*), Kurrajong (*Brachychiton populneus subsp. populneus*), White Cypress Pine (*Callitris glaucophylla*) and scattered Gum Coolibah (*Eucalyptus intertexta*). Both vegetation communities are widespread across the Cobar Peneplain Bioregion (Benson *et al.* 2006).

Survey Design

The survey design comprised a trap array at six sites, active searches and night spotlighting.

Each trap array comprised a 24m long x 0.23m high PVC drift fence. Along this fence, two pitfall buckets, two PVC tubes and two pair of funnel traps were established to divert fauna into the traps (Figure 2). At right angles to the drift fence, three 'A' size Elliot traps and three 'handi-glaze' type hair tubes were established. For a schematic view of the trap array see Figure 3.

Six trap arrays were activated over two survey periods in February 2010: the first being 4 consecutive nights;

the second being two consecutive nights. This resulted in a total of 432 trap nights (pitfall buckets 72 trap nights, PVC tubes 72 trap nights, funnel traps 72 trap nights, Elliot traps 108 trap nights, hair tubes 108 traps nights). Trap positions along the drift fence were shifted one space to the right at each survey site to avoid any potential trap design bias.

Active searches were carried out at 17 sites by one person for 30 minutes at each site. Logs, rocks and other material on the ground were turned, Leaf litter at the base of trees and beneath shrubs was raked, trees were checked for active animals, hollows and cracks checked and loose bark removed. Following heavy overnight rain flooded trenches were checked for frogs as well as calls being identified.

Spotlighting was carried out on two nights for a total of 4 person hours. This was carried out on foot and by vehicle.

Results

Using seven different methods (Pitfall buckets; Pitfall PVC tubes; Funnel traps; Elliot traps; Hair tubes; Spotlighting and Active search), a total of 34 vertebrate fauna species were recorded. These comprised four mammal species, eight frog species and 22 reptile species. Pooling the data from the six trap sites, the active search sites and spotlighting provides an overview of the species detected and their method of detection (Table 1). The number of individuals within each fauna group for each trapping/detection method is also provided (Figure 4).

The data revealed that active searching was the most successful detection method with 18 species and 68 individuals recorded. Fourteen of the 18 species were not recorded by any other method. Spotlighting detected six species and 22 individuals, the majority being frogs brought out by rain, although a Murray/ Darling Carpet Python (*Morelia spilota metcalfei*) was a notable find on a road. Funnel traps were the most successful of the trapping detection methods accounting for 11 species and 28 individuals. The PVC tubes detected four species and six individuals. Pitfall buckets only detected 3 species and 4 individuals although several rain events filled the buckets. Enge (1997) commented that funnel traps could be used in wetlands where pitfalls are precluded, and also observed that, unlike pitfalls, funnel traps can continue to function during high water levels. Two species comprising two individuals were detected using hair tubes. Elliot traps were the least successful method with no animals detected.

Pitfall Traps

The Pitfall trapping technique captured one species of gecko (Eastern Beaked Gecko), one species of blind snake (Brown-snouted Blind Snake) and one species of frog (Red Tree Frog). Pitfall traps were the only method to detect *Ramphotyphlops wiedii*., but one other blind snake was also detected within the funnel traps. The gecko and frog were also detected in the funnel traps. The capture rate for the pitfall technique was 5.52 individuals per 100 trap-nights.

Funnel Traps

Funnel traps were the most successful trapping method during this study. Funnel traps captured four species of gecko, four species of skink, two species of snake, and one species of frog (see Table 1). The capture rate using the funnel trap technique was 38.64 per 100 trap-nights which is significantly greater than previous studies such as Thompson & Thompson (2007) (10.19 per 100 trap-nights).

PVC Tubes

PVC tubes captured one species of gecko, one species of snake, one species of frog and one species of mammal. Two species (*Diplodactylus steindachneri* and *Sminthopsis murina*) were only detected using PVC tubes. The capture rate for PVC tubes was higher than pitfall traps during this study (8.28 individuals per 100 trap-nights).

Discussion

The selection of the fauna survey methods employed during a study will ultimately depend on the species or taxa of interest, the habitat of the survey site and for EIA, often the scope of works defined by clients. However, given the level of fauna survey work

conducted for EIA in the Cobar Peneplain Bioregion and indeed across similar arid and semi-arid landscapes of Australia, there is an obvious benefit for ecological consultants and researchers to have an understanding of the successes and failures of a variety of commonly used trapping and detection methods. This is of particular relevance to EIA where adequacy reviews by government agencies undertake an assessment of the appropriateness of the fauna survey methods employed.

Our study has demonstrated that a variety of trapping/ detection methods must be utilised to obtain site-specific data and not one single method should be relied upon to gather these data. A dependence on traditional methods such as pitfall buckets to trap small terrestrial vertebrate fauna has the potential to result in a large number of false absences. With a number of species only being detected using a single method, it is apparent that ecological consultants must employ a variety of detection methods during a general fauna survey or that specific methods be utilised when targeting specific taxa. While active searching detected more species and individuals than any other method, this method does depend heavily upon the experience and skill of the searchers. However, this study revealed the success of funnel traps in detecting the largest number of species and individuals when compared to other trapping methods. But reptiles can only be caught in traps if they encounter and enter these. Active searching can uncover animals that do not move widely or are inactive because of climatic or other conditions.

There is a possible reason as why the pitfall trapping technique is either unable to trap fauna, or fauna is avoiding the pitfall trap. Considering pitfall buckets are 60cm deep, the drop into the pitfall bucket is a substantial fall for a small animal. This depth could be a deterrent to the animal therefore avoiding the bucket altogether. Field work conducted in western NSW within sand dunes (pers obs.) using the pitfall trapping technique recorded reptile tracks following the drift fencing, stopping at the pitfall bucket and continuing around and away from the pitfall bucket. Other studies such as Thompson & Thompson (2007) have discussed the possibility of larger fauna falling into the bucket but escaping by climbing out. This could explain the captures of only small reptile species within the pitfall traps, as they could not escape the buckets.

Previous studies have also shown a comparative difference in the PVC tubing and funnel trapping techniques. Sass (2009) has recorded a greater number of reptile species in funnel traps than PVC trapping techniques. With a total of 6 species captured in funnel traps compared to 3 species captured within PVC tubes. However, Thompson & Thompson (2007) recorded more reptile species within the pitfall traps than funnel traps. Temperature and shade content could be influencing factors of trapping techniques - the time of day and temperature could influence what trap different reptiles enter. The shade cloth material of the funnel traps produces more shade, attracting reptiles seeking shade and or shelter. Pitfall traps have more direct sunlight and basking opportunities, maybe attracting reptiles early in the day. Further investigation of these factors could possibly provide insight as to why these variations occur.

The failure of the Elliot traps to detect any small, terrestrial fauna was surprising. Other studies conducted by one author (SS) have trapped a number of species in western NSW including the endangered Kultarr (unpubl. data) but in these instances, large numbers of Elliot traps (>200) had been activated during each study. A similar approach is recommended should this method be utilised for fauna surveys in western NSW.

Hair tubes were the only method to record two species of mammal (*Oryctolagus cuniculus*, *Wallabia bicolor*). The capture rate for hair tube technique was very low (1.86 individuals per 100 trap-nights) despite their success in forests in south-eastern Australia (Mills et al. 2002). However, the detection of Swamp Wallaby (*Wallabia bicolor*) by only this method is noteworthy given that the species is regarded as being of conservation concern in western NSW (Dickman et al. 1993).

Figure 1. Vegetation communities of the study area (left to right, Benson ID 176, Benson ID 105)

Implications for future fauna surveys

This study has confirmed that researchers and consultants preparing EIA should not rely on a single trapping/detection method when undertaking fauna surveys in western NSW. On the basis of species detection, active searching and funnel trapping were the most successful techniques for surveying terrestrial fauna within the Cobar Peneplain Bioregion. Recent surveys have also captured large elapid snakes and goannas using funnel traps (unpubl. data) confirming that this method has the ability to detect reptiles across all families. With an absence of mammalian fauna in funnel traps, we suggest trap lines comprise a combination of funnel traps and PVC tubes to detect the greatest number of species and individuals.

With environmental management at existing mines and EIA for exploration and mines reliant on accurate, robust data, this study provides substantial evidence to adopt a multi-method approach. This will also assist in ensuring that the adequacy of future fauna surveys is subject to less criticism during the EIA adequacy review process by government agencies and throughout subsequent public exhibition.

References

Benson J. S., Allen C. B., Togher C. & Lemmon J. (2006) New South Wales Vegetation Classification and Assessment: Part 1 Plant Communities of the NSW Western Plains. *Cunninghamia* **9**, 383-450.

Bos D. G., Carthew S. M. & Lorimer M. F. (2002) Habitat selection by the small dasyurid Ningaui yvonneae (Marsupialia: Dasyuridae) in South Australia. *Austral Ecology* **27**, 103-9.

DEC. (2004) Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft). *NSW Department of Environment & Conservation, Hurstville, NSW.*

Dickman C., Pressey R. L., Lim L. & Parnaby H. E. (1993) Mammals of particular conservation concern in the western division of New South Wales. *Biological Conservation* **65**, 219-48.

Enge, K. M., (1997) Use of Silt Fencing and Funnel Traps for Drift Fences. *Herp. Review* **28 (1),**30-31.

Friend G. R., Smith G. T., Mitchell D. S. & Dickman C. R. (1989) Influence of pitfall and drift fence design on capture rates of small invertebrates in semi-arid habitats of Western Australia. *Australian Wildlife Research* **16**, 1-10.

Garden J. G., McAlpine C. A., Possingham H. P. & Jones D. N. (2007) Using multiple survey methods to detect terrestrial reptiles and mammals: what are the most successful and cost-efficient combinations? *Wildlife Research* **34**, 218-27.

Mills D., Harris B., Claridge A. & Barry S. (2002) Efficacy of hair -sampling techniques for the detection of medium-sized terrestrial mammals. I. A comparison between hair-funnels, hair-tubes and indirect signs. *Wildlife Research* **29**, 379-87.

NPWS. (2002) Kultarr (Antechinomys laniger) Recovery Plan. *NSW National Parks and Wildlife Service, Hurstville*.

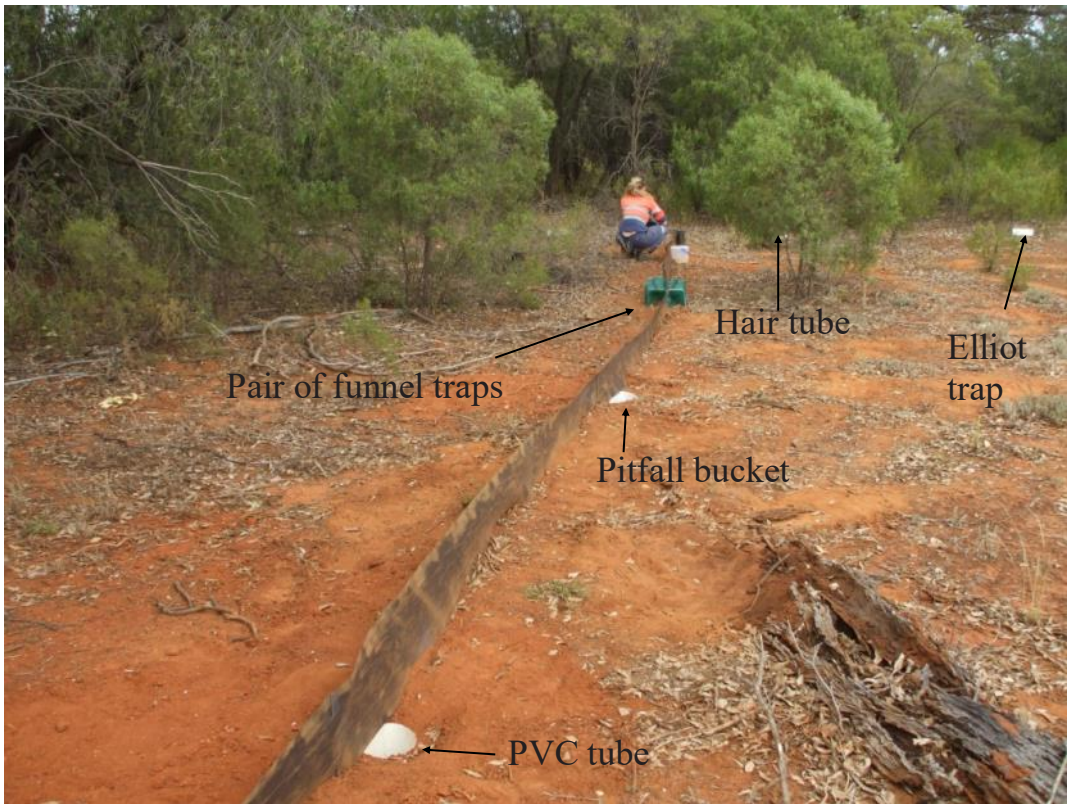
Sass S. (2009) The effectiveness of funnel traps to conduct reptile surveys in the chenopod shrublands of western New South Wales. *Consulting Ecology* **22**, 18-20.

Swan G. & Foster R. (2005) The reptiles and amphibians of Mutawintji National Park, western NSW. *Australian Zoologist* **33**, 39-48.

Thompson, G. G. & Thompson, S. A. (2007) Usefulness of funnel traps in catching small reptiles and mammals, with comments on the effectiveness of the alternatives. *Wildlife Research* **34**: 491-497.

Thompson S. A., Thompson G. G. & Withers P. C. (2005) Influence of pit-trap type on the interpretation of fauna diversity. *Wildlife Research* **32**, 131-7.

Figure 2. Photographic example of a trap array.



Acknowledgements

This study was conducted under the authority of a Scientific Licence issued by the NSW Office of Environment and Heritage and Animal Care and Ethics Approval by Industry & Investment NSW.

We are indebted to Dean Woods and Yvette Smart (Tritton Mine) for providing valuable assistance during the collection of field data.

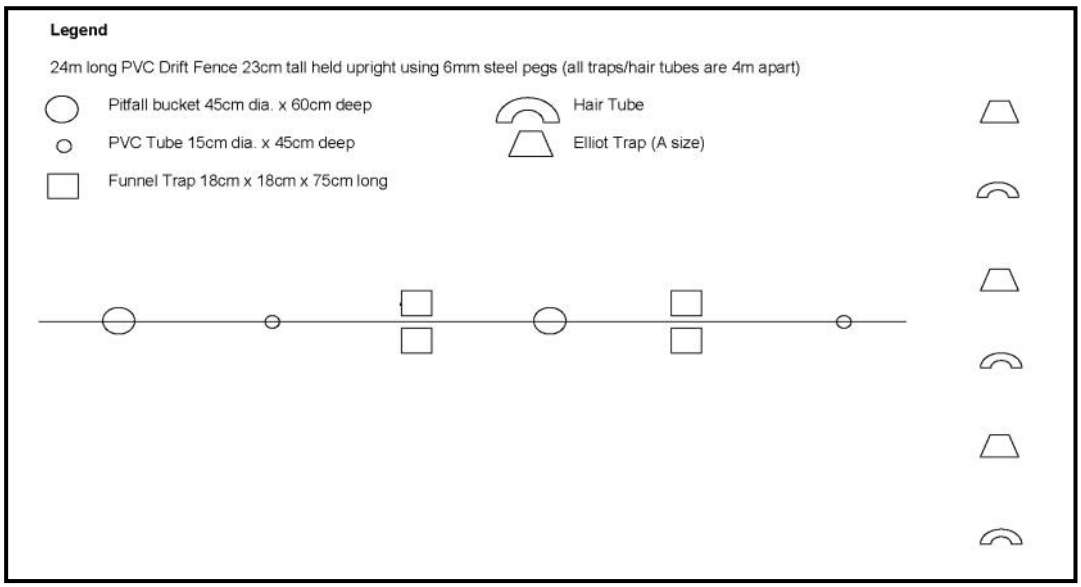


Figure 3. Schematic view of the trap array.

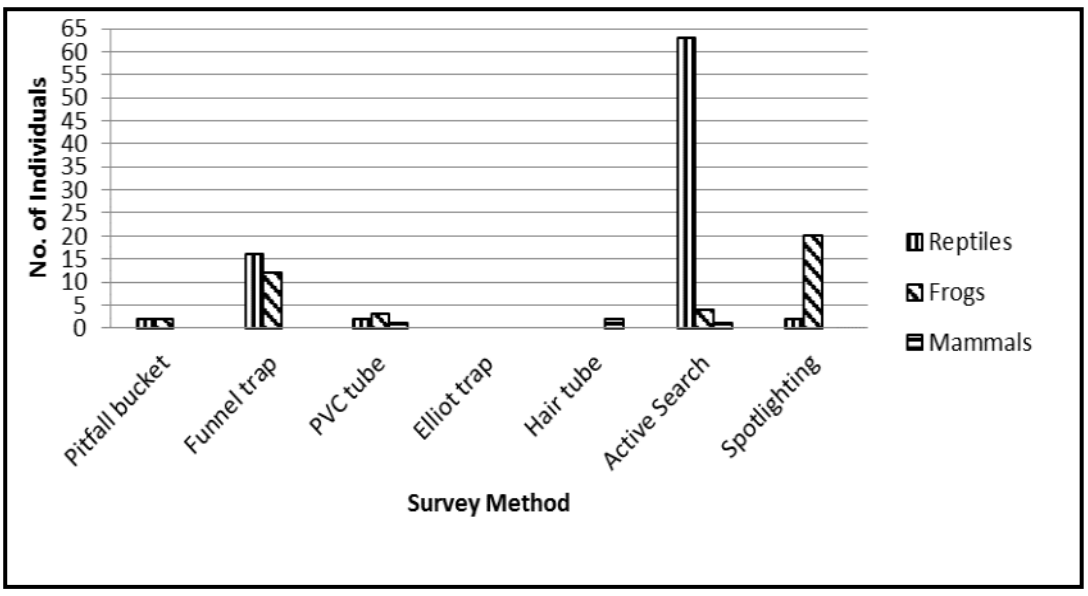


Figure 4. Number of individuals detected using pitfall buckets, funnel traps, PVC tubes, Elliot traps, hair tubes, active search and spotlighting techniques

Table 1. Pooled data detailing species diversity relative to each of the seven trapping/detection methods

Species	Pitfall bucket	Funnel trap	PVC tube	Elliot trap	Hair tube	Active search	Spot lighting
REPTILES							
Diplodactylus vittatus Eastern Stone Gecko	0	2	0	0	0	0	0
Gehyra Versicolor Variable Dtella	0	2	0	0	0	12	0
Heteronotia binoei Prickly Gecko	0	0	0	0	0	9	0
Lucasium steindachneri Box-patterned gecko	0	0	1	0	0	0	0
Rhychoedura ormsbyi Eastern Beaked gecko	1	1	0	0	0	0	1
Strophurus intermedius Southern Spiny-tailed Gecko	0	1	0	0	0	1	0
Amphibolurus burnsi Burns' Dragon	0	0	0	0	0	1	0
Diporiphora nobbi Nobbi Dragon	0	0	0	0	0	2	0
Pogona vitticeps Central Bearded Dragon	0	0	0	0	0	2	0
Varanus varius Lace Monitor	0	0	0	0	0	2	0
Cryptoblepharus pannosus Ragged Snake-eyed Skink	0	0	0	0	0	12	0
Ctenotus allotropis Wedgesnout Ctenotus	0	3	0	0	0	0	0
Egernia striolata Tree Skink	0	0	0	0	0	1	0
Lerista punctatovittata Eastern Robust Slider	0	0	0	0	0	1	0
Lerista timida Dwarf Three-toed Lerista	0	1	0	0	0	4	0
Menetia greyii Dwarf Skink	0	1	0	0	0	0	0
Morethia boulengeri Boulenger's Skink	0	3	0	0	0	15	0
Tiliqua rugosa Shingleback Lizard	0	0	0	0	0	1	0

Species	Pitfall bucket	Funnel trap	PVC tube	Elliot trap	Hair tube	Active search	Spot lighting
Ramphotyphlops bituberculatus Prong-snouted Blind Snake	0	1	1	0	0	0	0
Ramphotyphlops wiedii Brown-snouted Blind Snake	1	0	0	0	0	0	0
Morelia spilota metcalfei Carpet Python	0	0	0	0	0	0	1
Demansia psammophis Yellow-faced Whipsnake	0	1	0	0	0	0	0
FROGS							
Litoria caerulea Green Tree Frog	0	0	0	0	0	1	0
Litoria peronii Peron's Tree Frog	0	0	0	0	0	0	6
Litoria rubella Red Tree Frog	2	12	3	0	0	0	12
Neobatrachus sudelli Painted Burrowing Frog	0	0	0	0	0	1	0
Limnodynastes fletcheri Barking Marsh Frog	0	0	0	0	0	0	1
Limnodynastes interioris Giant Banjo frog	0	0	0	0	0	0	1
Notaden bennetti Holy Cross Toad	0	0	0	0	0	1	0
Uperoleia rugosa Wrinkled Toadlet	0	0	0	0	0	1	0
MAMMALS							
Oryctolagus cuniculus European Rabbit	0	0	0	0	1	0	0
Sminthopsis murina Common Dunnart	0	0	1	0	0	0	0
Tachyglossus aculeatus Echidna	0	0	0	0	0	1	0
Wallabia bicolor Swamp Wallaby	0	0	0	0	1	0	0
Number of species	3	11	4	0	2	18	6
Number of individuals	4	28	6	0	2	68	22

RELEVANCE TO ENVIRONMENTAL ASSESSMENT OF THE NSW VEGETATION CLASSIFICATION AND ASSESSMENT PROJECT AND COMMENTS ON MAPPING

John Benson

When consultants are contracted to assess a site or an area proposed for development, land use change or management action, besides investigating species present, a question that often arises is: How important is the habitat in the context of the region, the state or the continent? A means of answering that question is to compare the habitat at the site with a jurisdictional-wide ecological classification (typology) that contains information on the threat status and adequacy of representation in protected areas. Achieving that was a primary aim of the NSW Vegetation Classification and Assessment database project (NSWVCA) conducted between 1999 and 2013 by the Ecology Section of the Royal Botanic Gardens Sydney. This article describes that project in the context of current classification and mapping programs.

At the outset it is important to understand that a classification is a non-spatial typology that can be made spatial through mapping. For a number of reasons, it has been difficult to reliably map finely classified vegetation types whether they are defined quantitatively or qualitatively. While new technologies and imagery have improved the capacity to achieve more reliable maps, the results of using automated mapping technologies are limited.

The NSWVCA Project

The NSWVCA collated disparate data and knowledge into a single rational vegetation information database system. Prior to it, NSW lacked a State-wide plant community vegetation classification system to act as a conservative surrogate for terrestrial biodiversity. A key aim was to produce a consistent assessment of the threat status and protected area status of each defined vegetation type to guide conservation and management action. Because the NSWVCA database assimilates knowledge on 90 fields of information such as listing characteristic species, vegetation structure, threats, areas in protected areas, attributes such as soils, substrate and landscape position; disturbance regimes; coupled with professional photography, it also provides a basis for education about the natural world in NSW.

The targeted classification thematic level of NSWVCA is the "plant association" (Braun Banquet 1932, Beadle and Costin 1952), although in data-poor regions a coarser level was applied. In NSW regulations these vegetation units are referred to as Plant Communities Types (PCTs). The NSWVCA did not come out of the blue! It built on previous ecological studies, in particular, the insightful classifications and descriptions in Beadle (1981) *The Vegetation of Australia*. Beadle started out as a soil conservationist and understood not just plant species and assemblages, but also soils and landscapes. Likewise the NSWVCA descriptions place defined plant communities into landscapes. In order to mesh with other States the NSWVCA applied the structural definitions in the Australian Field Survey Yellow Book by Walker and Hopkins (1990) and compared a NSW classified PCT with classified units in adjoining states (South Australia, Queensland, Victoria) and the ACT. More than 30 Federal and NSW Threatened Ecological Communities (TECs) are primarily derived from the NSWVCA.

Due to the scope of the project (think of classifying in a 90 field database 1500 PCTs), NSW was divided into four sections. The work commenced with the semi-arid and arid NSW Western Plains progressing to the dry temperate Western Slopes then onto the cool temperate NSW Tablelands (that latter is incomplete). A primary concern was to complete all regions west of the Great Dividing Range which includes 58% of the Murray Darling Basin and 85% of NSW. It was anticipated that the biologically complex east coast and eastern escarpment section would be classified by other experts through projects analysing the rich plot data accrued there over the last 30 years and linking that to the NSWVCA west of the Great Dividing Range.

The first step in 1999 – 2000 was to develop a prototype database. This was constructed in MS Access containing 90 fields, numerous tables and capacities to produce both MS Word and PDF reports on

combinations of fields including listing PCTs for geographical areas. Up to three images of each plant community were linked to the database. The database format provides users with a capacity to query combinations of the 90 information fields. So, for example, if a consultant wished to know where all listed threatened ecological communities (TECs) were by a geographic region such as bioregions, sub-regions, catchments, local government areas or conservation reserves, they could retrieve this information readily. Over the course of the next 10 years the NSWVCA database was refined and published three times.

More than 600 sources including papers, reports, vegetation maps and floristic data analyses were used to develop the NSWVCA vegetation classification from South Australia to the western NSW Tablelands. Inland NSW is devoid of well-structured, consistent floristic plot data and there is significant climatic variability that makes combining existing datasets, sampled in different seasons, perilous for classification. In vegetation classification, it is important to segregate temporal disturbance classes from the more consistent ecological assemblages: something not done when inexperienced ecologists simply run data analyses without knowing the landscapes.

Irrespective of the pitfalls highlighted above, the NSWVCA classification preferentially adopted results of quantitative floristic analyses if sound data existed (e.g. regional surveys, surveys of conservation reserves etc.) but all of these were field checked. To develop vegetation classifications in regions with little or no quantitative data other information was interrogated such as vegetation map unit descriptions, descriptive reports and species lists. 2000 new sites were sampled and extensive notes were taken during 70,000 km of field traverses: numerous roads were driven, including minor and farm roads. Over 20,000 photographs were taken during these traverses, all GPSed. A classification gap on the western side of the New England Bioregion was filled through extra sampling and an analysis of 1400 plots delivering >40 PCTs. This was completed via a consultancy with the consulting firm Ecological Australia who held expertise in that region. All sources supporting a classified PCT are cited in the Reference field in the database. Confidence levels are attached to the degree of certainty of a classified type, existing extent, pre-European extent and extend recorded in protected areas.

Details about the NSWVCA project, its rules, the MS Access database itself and the classification results and descriptions are contained in four published papers and their complementary journal CDs/DVDS:

1. Introduction and description of the project and database: https://d1nu2wha2fqaui.cloudfront.net//RoyalBotanicGarden/media/RBG/Science/Cunninghamia/Volume%209%20-%202005/Cun9Ben331.pdf

2. Plant communities of the NSW Western Plains Classification: https://d1nu2wha2fqaui.cloudfront.net//RoyalBotanicGarden/media/RBG/Science/Cunninghamia/Volume%209%20-%202005/Cun9Ben383.pdf

3. Plant communities of the NSW South Western Slopes Bioregion: https://d1nu2wha2fqaui.cloudfront.net//RoyalBotanicGarden/media/RBG/Science/Cunninghamia/Volume%2010%20-%202009/Cun104599Ben.pdf

4. Plant communities of the Brigalow Belt South, Nandewar and west New England Bioregions: https://d1nu2wha2fqaui.cloudfront.net//RoyalBotanicGarden/media/RBG/Science/Cunninghamia/Volume%2011%20-%202010/Cun114457Ben.pdf

By the publication of version 3 the NSWVCA in 2011, 590 plant communities over 11.5 of the 18 Bioregions of NSW (being 78% of the State) were incorporated into the database system and soon after used in assessment tools. By 2013, a further 160 plant communities were in the process of being classified and databased covering another two bioregions (South Eastern Highlands and Australian Alps). Unfortunately, this work remains incomplete. It was involving key experts in these regions.

In 2011/12 the MS Access database and its data were

converted by NSW OEH into a corporate SQL platform titled the OEH VIS Classification Database found at:

http://www.environment.nsw.gov.au/research/Visclassification.htm

OEH added fields in their VIS version to provide linkages to outputs from numerical analysis and to cater for fields in the regulatory BIOMETRIC Tool database (that may be replaced or altered under the new NSW Biodiversity Act regulations). The inland NSWVCA types were combined with a batch of eastern NSW types that were hurriedly classified in 2005 to form the list of PCTs currently in use. These eastern types are gradually being updated with a major eastern NSW circa 40,000 plot analysis underway within OEH: a technical challenge to say the least.

No classification scheme is perfect as nature is infinitely variable. Improvements are made with better data. The NSWVCA inland NSW classification has stood testing and use over 10 years and a number of projects have successfully mapped its units in wetlands, on floodplains, in reserves and over larger regions. Its PCTs have been mapped with digital API using ADS-40 digital imagery and ground checking. This has included poorly-plot sampled types that are generally left out of modelled maps because modelling requires a minimum number of samples. This last point raises questions about the philosophy of model-mapping demonstrated when distinct PCTs, well described by experts but lightly sampled, are left out of maps and therefore environmental assessment. Some examples are provided in Figures 1-3.

The NSWVCA was never meant to be an ecological functional classification, although combining similar types into a broader thematic classification could deliver that in some regions.

Vegetation mapping

To cover the history and various methods of vegetation mapping is beyond the scope of this article. ECA members will be aware the topic has become controversial in NSW with different methods advocated by different experts. The history of vegetation mapping up to 2006 is summarised in the NSWVCA Introduction paper (Benson 2006). Since then additional methods and products have emerged. The two most topical are discussed below.

The current debate on vegetation mapping is between two methods. Firstly, data-driven scientists advocate what they consider is a "scientifically repeatable approach" of using site data to model PCTs combined with auto-pattern recognition of patterns (using various imagery) to deliver computer-generated vegetation maps. Secondly, more traditional mappers advocate using human digital aerial photographic interpretation (DAPI) of high resolution ADS-40 digital airborne imagery (or equivalent) in 3-D space. This new imagery is an order of magnitude better than previous wet film aerial photographs used in past vegetation mapping. The capacity to view this new imagery in 3-D space significantly improves capability to detect differences in floristic assemblages and condition attributes. Therefore, it is now possible to more confidently identify canopy species and understorey and ground structure – particularly in vegetation with open canopies.

The evidence suggests digital API is delivering more reliable PCT maps and has a capacity to map poorly sampled PCTs thus completing a more comprehensive coverage of variability: important for biodiversity conservation. Feedback also suggests that the so-called repeatable aspect of the automated pattern recognition modelled mapping is compromised by numerous manual changes to improve poor accuracy. Some may suggest that modelling x pattern recognition method is better suited for coarse thematic level mapping or detecting structural, growth or condition changes with repeated runs of imagery. Others were likely attracted to it because it promised rapid production of a PCT map of NSW at what appeared to be a cheap price but has turned out to be >$10 million. Demand for such a map was possibly driven by proposed changes to regulations that rely more than the past on maps. However, the cost-effective claims are contentious given the combined costs of fixing mistakes and future remapping.

The modelling x pattern recognition method struggles to attain reasonable accuracy for mapping PCTs as revealed in Upper Hunter validation paper by John Hunter (2016), which is supported by other checking. The inaccuracies may be explained by a lack of site

data to constrain the model, poorly mapped environmental variables and limited DEMs. The method is also limited because pattern recognition software detects and maps disturbance patterns, that may vary within PCTs caused by variable management histories (e.g. grazing intensity, cutting timber etc.), or, natural events such as inundation and fire. Well-trained expert Human DAPI in 3-D can "weed out" these vagaries especially if complemented with extensive field checking. Pattern recognition results would also improve with more extensive field checking.

A major concern about the modelling x pattern recognition method is not just the inaccuracy of PCTs mapped but a reductionist approach that overlooks distinct but poorly-sampled vegetation types that exist in nature. Those types are left out because of rules set about the amount of site data required for modelling. This approach could eliminate >50% of PCTs in inland NSW and quite a few in eastern NSW (see examples in Figures 1-3).

A breakthrough for API methodology to accurately map finely classified PCTs came with the acquisition of high resolution ADS-40 airborne imagery flown over NSW by the NSW Lands Department from 2007 onwards. This imagery can be interpreted for each map polygon through digital API in 3-Dimensional space to detect key canopy species, vegetation strata structure and aspects of disturbance or condition. The mapping goes straight into GIS so is much more efficient than previous wet film API. The benefits are illustrated in the independently validated mapping of 100 NSWVCA types, to >80% accuracy, over 2.2 million hectares in the mid-Murrumbidgee catchment published in Maguire et al. (2012):

https://www.rbgsyd.nsw.gov.au/RoyalBotanicGarden/media/RBG/Science/Cunninghamia/Volume%2012%20-%202012/Cun124mag247.pdf

The NSW NPWS, EPA and consultants and others are increasingly using DAPI with high resolution imagery in vegetation mapping.

Given the above, it is surprising that in a talk on vegetation classification and mapping at the recent ECA Conference, an OEH researcher stated it was not possible to use API to map "plant associations", including those derived from cluster analysis of plot data. As demonstrated by recent DAPI mapping projects across NSW, it is possible to use DAPI to map PCTs even with similar structural canopies, although detection of PCTs improves by using the imagery in 3-D. Some recent DAPI projects with ADS-40 imagery include: mapping PCTs in the Coffs Harbour, Bellingen and Nambucca Shires on the NSW North Coast; threatened ecological communities in eastern NSW State Forests; PCTs in numerous conservation reserves; PCTs in inland wetlands; PCTs on floodplains; PCTs across the National Parks in the Blue Mountains and other parts of the Sydney region. DAPI mapping does not preclude the use of modelling to indicate areas for more detailed DAPI mapping. This was done with the TEC mapping in State Forests.

Even before the advent of this extraordinary ADS-40 digital imagery, Benson and Ashby (2000) mapped 24 mainly numerically-derived finely classified plant communities in the Guyra region on the New England Tablelands to over 90% accuracy, using API with standard wet film 1:25,000 colour imagery and extensive ground checking.

For the auto-modelling x pattern recognition mapping method to improve at the PCT level of classification, disturbance classes will need to be eliminated or reduced from the maps; but there remains the limitation that pattern recognition struggles to distinguish between different floristic assemblages with similar canopy structures (density and height of tree crowns for example). The method is best suited to mapping change in patterns and perhaps condition classes. Even in Europe where floristic site data are abundant (>2 million plots), API remains the main means of mapping finely classified vegetation types. Also, since a floristic plot costs between $200-$1000, depending on the number of attributes recorded, one could argue that, in order to attain high map accuracy (>70 or 80% to PCT), it may be less costly to run well-organised 3-D digital API projects across bioregions - standardised to reduce observer bias. And given the continuum concept of species distributions, it may be too ambitious to expect vegetation classification and mapping to be a purely quantitative process. Such

zealotry becomes serious if the cost is a failure to recognise and protect the full range of habitats that exist in the wild (Figures 1-3).

Ultimately, a vegetation classification and map is best judged by what users think of it. Does it make sense on the ground? Are the main habitats included? Is the map line-work reliable? Personally, I would prefer it if environmental regulations avoided relying too much on maps because any spatial layer contains error. To ensure reliability in decisions, it is best to check sites on the ground – the exception may be when there is available demonstrable excellent mapping of very high standard (>80-90% accuracy to the PCT level of classification). Benson and Ashby (2000) attempted to set that standard nearly 20 years ago.

Figure 1: NSWVCA ID132 *Eremophila freelingii - Acacia aneura - Senna* spp. shrubland on scarp, Sturt NP, NSW-NFWP, [AGD66 29°16'31"S 141° 40'53"E], This is an example of a poorly sampled but distinct type of vegetation that could be mapped with digital API but could be left out of modelled mapping due to lack of site data. Photo: 24/8/03, Jaime Plaza.

Figure 2: NSWVCA ID611 *Xanthorrhoea glauca* subsp. *glauca* tall grasstree shrubland on a basalt rock scree on Heavens Ridge Fire Trail in the northern part of Towarri National Park [AGD66 31°51'51.9"S 150° 46'5.9"E]. This is an example of a highly distinct vegetation type left out in the Upper Hunter modelled x pattern recognition vegetation mapping probably because of rules about numbers of plots required for modelling. This type can easily be mapped by API, even using satellite imagery. Photo: 10/5/09, Jaime Plaza.

References

Beadle, N.C.W. (1981) *The vegetation of Australia.* (Cambridge University Press: Cambridge).

Beadle, N.C.W. & Costin, A.B. (1952) Ecological classification and nomenclature. Proc. Linn. Soc. New South Wales LXVII 61-82

Benson, J.S. (2006) New South Wales Vegetation Classification and Assessment: Introduction - the classification, database, assessment of protected areas and threat status of plant communities. *Cunninghamia* 9(3): 331-382

Benson, J.S. & Ashby, E.M. (2000) Vegetation of the Guyra 1:100 000 map sheet New England Bioregion, New South Wales. *Cunninghamia* 6(3):747-872

Braun-Blanquet, J. (1932) (Translated, revised and edited by Fuller, G.D. & Conrad, H.S. in 1983) *Plant sociology: the study of plant communities* (Koeltz Scientific Books: Germany).

Hunter, J.T. (2016) Validation of the Greater Hunter Native Vegetation
Mapping as it pertains to the Upper Hunter region of New South Wales. *Ecological Management & Restoration* 17(1)

Maguire, O., R.C. Armstrong, R.C., Benson, J.S., Streeter, R., Patterson, C., McDonald, P., Salter, N., East, E., Webster, M., Sheahan, M. & Young, D. (2012) Using high resolution digital aerial imagery interpreted in a 3-D digital GIS environment to map plant communities in central-southern New South Wales. *Cunninghamia* 12(4): 247-266.

Walker, J., and Hopkins, M.S. (1990) Vegetation. In: McDonald, R.E., Isbell, R.F., Speight, J.R., Walker, J. & Hopkins, M.S. eds. (1990) Australian Soil and Land Survey Field Handbook, 2nd edition, pp. 58-77. Inkata Press, Melbourne and Sydney.

Figure 3: Alpine lakes ecosystem: Cootapatamba Lake in Kosciuszko National Park are included in the incomplete NSWVCA classification of the Australian Alps Bioregion. This ecosystem cannot be described by vascular plant species but can be by microscopic zoo and phytoplankton which was the approach of the NSWVCA project. This highlights that not all terrestrial ecological communities can or should be described through analysis of floristic plots and that some ecological communities should be added to any floristic classification if the aim is a complete habitat typology. Photo: John Benson.

**Dr John Benson is an ECA Member. He previously worked with the NSW NPWS and as an ecologist at the Royal Botanic Gardens Trust Sydney. John is an expert in native vegetation across much of NSW. In the 1980s and 90s he helped establish numerous NSW conservation reserves and initiated threatened plant species research, survey and recovery programmes. Subsequently he influenced ecosystem risk assessments schemes nationally and internationally and contributed to NSW government species and plant community type information systems. He has been an advisor to various governments on environmental policy.*

Contributions to the Newsletter, Volume 38

Contributions to the next newsletter should be forwarded to the administration assistant Amy Rowles admin@ecansw.org.au by the **15th of January 2017.**

- 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 generalise 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

ECA Photo Gallery

Photos courtesy of Amy & Richard Rowles and Brian Wilson

Sand dune in flower near Innamincka

Lunch in the dunes, the best we could do with all the road closures—the Simpson will have to wait until next time.

Sturt NP after a thunderstorm

The crew standing on three states at Camerons Corner: left to right: Brian Wilson, River, Jasmine, India, Richard, Kacia and Amy Rowles

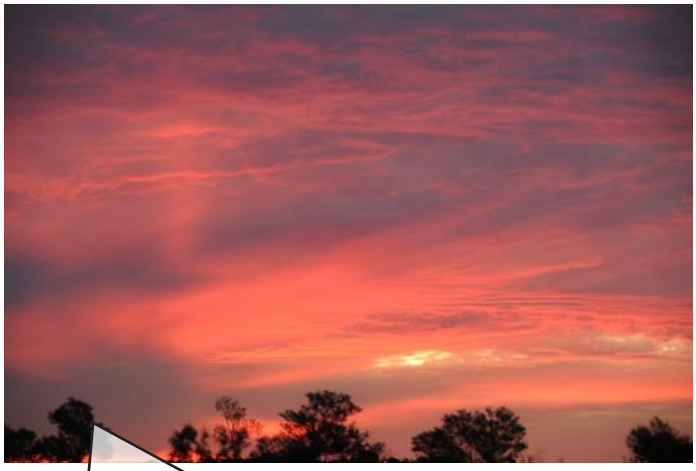
More Water! Mmm.... is this really the arid zone.

Mud

ECA Photo Gallery

No trip out west is complete without seeing some Sturt 's Desert Peas

A familiar site for the trip, the bonus was not many other people were silly enough to be out there in the rain, so we had some camp sites to ourselves

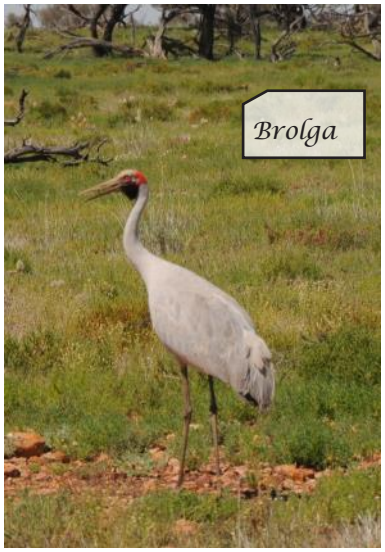


A beautiful sunset to make up for the fierce mozzies at Noccundra

Another wet camp at Yowah

Damp creek bed at an Aboriginal Reserve at Tibooburra

Another beaut sunset, Sturt National Park.



Holy Cross Toad , Yowah. This frog has an amazing call that was travelling over hundreds of metres and was deafening as I got close.