DEC – UWA

STRATEGIC DIRECTIONS WORKSHOP

WESTERN AUSTRALIAN CONSERVATION SCIENCE CENTRE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
KENSINGTON

Friday 17 February 2012

Department of Environment and Conservation

THE UNIVERSITY OF WESTERN AUSTRALIA
FACULTY OF Natural and Agricultural Sciences

AGENDA

DEC – UWA Strategic Directions Workshop

Date: Friday 17th February 2012

Time: 9 am to 5 pm

Venue: Western Australian Conservation Science Centre (WACSC)
17 Dick Perry Road, Kensington

Program:

09.00 – 10.30 Welcome and outline of the workshop
Areas of research focus for DEC and UWA
Brief summary/update on existing projects

10.30 – 10.50 Morning tea

10.50 – 12.30 Group discussion:
- identification of strengths of each group/ key areas for collaboration

12.30 – 01.15 Lunch

01.15 – 04.00 Group discussion:
- opportunities for capitalising on existing partnerships
- new initiatives / opportunities for new synergies
- workshop outcomes and strategy for implementation

04.15 – 05.00 Drinks

DEC – UWA

List of Attendees at
STRATEGIC DIRECTIONS WORKSHOP

Name	Affiliation	Email Contact Details
Dr Liz Barbour	UWA	liz.barbour@uwa.edu.au
Prof Roberta Benchini	UWA	roberta.benchini@uwa.edu.au
Dr Margaret Byrne	DEC	margaret.byrne@dec.wa.gov.au
Prof Brian Chambers	UWA	brian.chambers@uwa.edu.au
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Winthrop Prof Timothy Colmer	UWA	timothy.colmer@uwa.edu.au
Prof Peter Davies	UWA	peter.davies@uwa.edu.au
Prof Pauline Grierson	UWA	pauline.grierson@uwa.edu.au
Ass Prof Jason Kennington	UWA	jason.kennington@uwa.edu.au
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Ass Prof Harriet Mills	UWA	harriet.mills@uwa.edu.au
Ass Prof Nicola Mitchell	UWA	nicola.mitchell@uwa.edu.au
Mr Keith Morris	DEC	keith.morris@dec.wa.gov.au
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Ass Prof Pieter Poot	UWA/DEC	pieter.poot@uwa.edu.au
Winthrop Prof Dale Roberts	UWA	dale.roberts@uwa.edu.au
Dr Kelly Shepherd	DEC	kelly.shepherd@dec.wa.gov.au
Ass Prof Rachael Standish	UWA	rachael.standish@uwa.edu.au
Dr Kevin Thiele	DEC	kevin.thiele@dec.wa.gov.au
Prof Erik Veneklaas	UWA	erik.veneklaas.uwa.edu.au
Dr Stephen Van Leeuwen	DEC	stephen.vanleeuwen@dec.wa.gov.au
Prof Kimberley Van Niel	UWA	kimberley.vanniel@uwa.edu.au
Dr Adrian Wayne	DEC	adrian.wayne@dec.wa.gov.au
Dr Colin Yates	DEC	colin.yates@dec.wa.gov.au

DEC – UWA WORKSHOP

Western Australian Conservation Science Centre, Kensington

Index of Projects

No.	Title	Key Staff
1	Biogeography and dendrochronology of *Callitris* in Western Australia	DEC - L McCaw UWA - P Grierson
2	Fire management of complex rehabilitated forests- quantifying and understanding spatial variability of forest structure and fuel loads	DEC - L McCaw UWA - P Grierson, M Boer, R Sadler
3	Ecological pattern and process in fire-prone forests of south-west Western Australia	DEC - L McCaw, R Wittkuhn UWA - P Grierson, R Sadler, M Boer, B Pekin, J Norris
4	Fox predation threatens urban populations of western ringtail possums	DEC - K Morris UWA - R Bencini, B Chambers
5	Susceptibility to *Phytophthora cinnamomi* and sensitivity to phosphorus in native Australian plants- why are they linked?	DEC - C Dunne, B Shearer UWA - H Lambers, P Finnegan, G Yan, S Pearse, X MA , R Jost
6	Ecophysiology of stem succulent halophytes subject to changes in salinity and water availability – distinguishing natural dynamics from potential mine related impacts.	DEC - K Shepherd UWA - T Colmer, E Veneklass, L Moir-Barneston
7	Protecting the safe havens: will granite outcrop environments serve as refuges for flora threatened by anthropogenic climate change?	DEC - C Yates, M Byrne UWA - K Van Niel, S Hopper
8	Adapting to climate change: a risk assessment and decision framework for managing groundwater dependent ecosystems with declining water levels	DEC - A Pinder, S Appleyard UWA - P Close, P Speldewinde
9	Managing genetic diversity and evolutionary processes in foundation species for landscape restoration in the Midwest of Western Australia	DEC - D Coates, M Byrne UWA - D Roberts DEC/UWA - M Millar
10	Defining ecological and evolutionary significant units in spinifex (*Triodia* spp) for improved ecological restoration in arid Australia	DEC - K Thiele UWA - P Grierson
11	Spatio-temporal patterns of fire in the Lake Johnston region of southern Western Australia	Student - A O'Donnell DEC - L McCaw UWA - P Grierson, M Boer

No.	Title	Key Staff
12	Ancient, terrestrial islands in a semi-arid landscape: Patterns of genetic diversity in regional endemics of the Yilgarn Banded Ironstone Formations	Student - H Nistleberger DEC - D Coates, M Byrne UWA - D Roberts
13	Factors that affect seedling establishment and the implications for the translocation of species at risk of extinction	Student - C Allen DEC - D Coates UWA - P Poot, R Standish, M Moody
14	Genetic diversity, chemical composition and biosynthesis of terpenes in Western Australia (*Santalum spicatum*) sandalwood oil for conservation and plantation improvement	Student - J Moniodis DEC - M Byrne UWA - J Plummer, E Ghisalberti, C Jones, L Barbour
15	Ecological study of the quokka (*Setonix brachyurus)* in the southern forests of south-west WA	Student - K Bain DEC - A Wayne UWA - R Bencini
16	Attributes of remnant habitat patches supporting populations of the western ringtail possum	Student - E Malloch DEC - K Morris UWA - R Bencini, B Chambers
17	The efficacy of rope bridges in mitigating negative effects of roads on populations of possums in southwest Western Australia	Student - K Yokochi DEC - K Morris UWA - R Bencini, J Kennington
18	Ecology and population dynamics of the quokka	Student - V Phillips DEC - K Morris UWA - R Bencini, B Chambers
19	Habitat use and home range of the northern quoll, Dasyurus hallucatus: effects of fire	Student - H Mills DEC - I Radford UWA - R Bencini, A Cook
20	Shedding light on Rakali: Ecology and taxonomic differentiation in the Australian water rat (*Hydromys chrysogaster* Geoffroy, 1804) and implications for its conservation status in WA	Student - K Bettink DEC - K Morris UWA - H Mills
21	Can mosaic burning protect northern quolls from severe wildfires in the north Kimberley?	Student - A Cook DEC - I Radford UWA - R Bencini, H Mills
22	Wildlife ecology in the Perup Sanctuary	Student - G Yeatman DEC - A Wayne UWA - H Mills
23	Optimisation of camera traps for animal monitoring on the south coast of Western Australia	Student – J Ashburner DEC - C Tiller UWA - B Cook, P Speldewinde

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Biogeography and dendrochronology of *Callitris* in Western Australia?

Key staff:
DEC – Dr Lachie McCaw
UWA – Dr Pauline Grierson

Project investment and timeframe:
Collaboration undertaken as part of CERF Significant Project led by Professor David Bowman, University of Tasmania: *Using tree rings of an Australian conifer as a bio-indicator of decadal-scale environmental change.*

Current status:
Ecological responses to climate change remain very uncertain, especially in outback Australia. This project is studying the population growth of an Australia-wide native conifer (*Callitris columellaris*). Field surveys, tree ring measurements and stable isotopic analyses are being used to chronicle historical patterns of landscape change; (ii) rank the importance of land-use and climate in driving these changes.
For this project, we:

- Measured size class distributions of a total of 97 stands of Callitris columellaris from 17 regions across the continent
- Measured size classes of 70 additional stands in the Top End to compare areas under Aboriginal management in Arnhem Land with those in remote parts of Kakadu NP. The fire management of land under these two tenures is very different, and this is reflected in their stand structures.
- Sampled cores from 15 trees per site at a total of 85 sites, and measured ring widths of each core (details in Table 1). These data are currently being analysed for publication.
- Sampled and analysed soil from 85 sites for pH, C, N, P (Table 1). These results have been summarized in a manuscript (below)
- Sampled and analysed foliage samples from 85 sites for C, N, P, δ13C and δ18O
- Maintained a research collaboration with Professor Yuji Isagi, Kyoto University, who is undertaking a molecular analysis of foliage from all populations we sampled (Table 1). To date we have sent him over 2500 samples of Callitris foliage from around Australia. Prof Mike Crisp (ANU) has also joined this collaboration on the evolutionary history of Callitris in Australia.

Field work and data analysis are completed.

Journal publications with joint UWA and DEC authorship:
Prior, L.D., McCaw, L., Grierson, P.F., Murphy, B.P. and Bowman, D.M.J.S. (2011). Population structures of the widespread Australian conifer are a bio-indicator of continental environmental change. *Forest Ecology and Management* **262:** 252-262 doi:10.1016/j.foreco.2011.03.030.
Prior, L.D., Grierson, P.F., McCaw, W.L., Tng, D.Y.P., Nichols, S.C. and Bowman, D.M.J.S. (in press) Variation in stem radial growth of the Australian conifer, *Callitris columellaris*, across the worlds driest and least fertile vegetated continent. *Trees – Structure and Function.*

Future directions:
There is scope to build develop further projects suitable for post-graduate research with potential topics:
- re-constructing climate from tree rings in semi-arid southern WA to cover a broader range of sites;
- recruitment and population dynamics in relation to climate and grazing;

Outcomes and management implications:
Improved understanding of the long term population dynamics of woody vegetation in the semi-arid zone.
Improved understanding of climate variability in south-west WA during the past 300 years.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Fire management of complex rehabilitated forests - quantifying and understanding spatial variability of forest structure and fuel loads.

Key staff:
DEC – Dr Lachlan McCaw
UWA – Dr Pauline Grierson, Dr Matthias Boer, Dr Rohan Sadler
CSIRO – Dr Craig Macfarlane

Project investment and timeframe:
Project fully funded through an ARC-Linkage in collaboration with Worsley Alumina (BHP Billiton). No cash contributions from DEC.

Current status:
Three major reports have been presented to Worsley summarizing distribution of fuels and aboveground biomass across a mosaic of forest ages. Experimental burns on the bauxite mine site were undertaken in May 2010 with direct data capture - Lidar and infrared data are now being processed to assess fire behaviour in relation to distribution of fuel loads.

Future directions:
Limited immediate direction. May proceed with studies of fire on rehabilitation and post-fire recruitment patterns. Possibilities to examine recovery of fuel loads.

Outcomes and management implications:
Documentation of the relationship between planned burning and fuel load structures in highly complex and modified forest landscapes.
Unique high-resolution assessment of 3D distribution of fuel loads for validating remote-sesnsed data
Validation of fuel load estimates against "Red Book" data
Findings have direct application to fire management planning for south-west forests.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Ecological pattern and process in fire-prone forests of south-west Western Australia

Key staff:
DEC - Dr Lachlan McCaw, Dr Roy Wittkuhn Bushfire CRC
UWA - Dr Pauline Grierson, Dr Rohan Sadler, Dr Matthias Boer, Dr Burak Pekin, Jaymie Norris,
Others - Dr Nicolas Faivre, Dr Philip Roche CEMAGREF France

Project investment and timeframe:
Projects B1.1 and B1.4 conducted as part of the Bushfire CRC Program B (2003-2010)

Current status:
Journal publications with joint UWA and DEC authorship:

Boer, M.M., Sadler, R.J., Wittkuhn, R.S., McCaw, L. and Grierson, P.F. (2009). Long-term impacts of prescribed burning on regional extent and incidence of wildfires – evidence from 50 years of active fire management in SW Australian forests. *Forest Ecology and Management* **259**: 132-142.

Faivre, N., Boer, M., McCaw, L. and Grierson, P. (2011). Characterisation of landscape pyrodiversity in Mediterranean ecosystems – contrasts and similarities between south-western Australia and south-eastern France. *Landscape Ecology* 26, 557-571.

Pekin BK, Wittkuhn R, Boer MM, Macfarlane C, and Grierson PF (2011). Plant functional traits in relation to fire, aridity, and soil nutrients. *Journal of Vegetation Science* 22, 1009-1020.

Pekin BK, Wittkuhn R, Boer MM, Macfarlane C, and Grierson PF (2012) Response of plant species and life form diversity to variable fire histories and biomass in jarrah forest of southwest Australia. *Austral Ecology* doi:10.1111/j.1442-9993.2011.02280.x

Pekin BK, Wittkuhn R, Boer MM, Macfarlane C, and Grierson PF. (2012) Plant diversity is linked to nutrient-limitation of dominant species in a world biodiversity hotspot. *Journal of Vegetation Science* (accepted Dec 2012)

Other papers currently in preparation

Future directions:
There is considerable scope to build develop further projects suitable for post-graduate research. Potential topics include:
- extending analysis of relationship between planned burning and the occurrence and scale of unplanned fires to the broader forested region;
- structural and floristic changes in response to fire regimes, particularly fire return intervals;
- fire regimes and soil carbon;
- comparison of ecological process in mature and recently harvested forests using a chronosequence Bushfire CRC and FORESTCHECK sites.

Outcomes and management implications:
Documentation of the relationship between planned burning and the occurrence and scale of unplanned fires in the Warren Region landscape over 5 decades. This has become a widely cited paper and is one of only few regional scale investigations into the effectiveness of prescribed fire.
Collaborative research into the effects of different fire regimes on biota and ecosystem processes at matched study sites of known fire history.
Characterisation and comparison of fire regimes in mediterranean ecosystems in south-west Western Australia and south-east France.
Findings have direct application to fire management planning for south-west forests.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Fox predation threatens urban populations of western ringtail possums

Key staff:
DEC - Keith Morris
UWA - Associate Professor Roberta Bencini, Dr Brian Chambers

Project investment and timeframe:
Satterley Property Group, The University of Western Australia, DEC
2011-2014

Current status:
The project is in early stages of development. The student is currently liaising with natural resource community groups that have been conducting their own invasive species control programs in the Busselton region. In collaboration with these groups and DEC, we will design a PhD project that will increase our awareness of what resources are important for foxes to survive in the urban environment and establish if foxes are an important threat for urban populations of western ringtail possums (*Pseudocheirus occidentalis*).

Future directions:
Foxes will be fitted with combination GPS/VHF collars. The aim of this will be to gain some awareness of how foxes use the urban environment in time and space. Once patterns of habitat use have been determined it will be possible to build on this by asking more detailed questions about the diet, mortality and sociality of foxes, and how such behaviours may have been influenced by anthropogenic factors of the urban environment.
This project will run concurrently with another study on the urban ecology of the threatened western ringtail possum in Busselton (Emma Malloch, UWA PhD student). The combination of the detailed study of a predator with its potential prey is important because foxes have been identified as a significant threat to the western ringtail possum, and fox control is likely to be a major component of management recommendations for the possum.

Anticipated outcomes and management implications:
This project will increase our knowledge of the resources required by foxes to survive and reproduce in the urban environment. Urban environments are becoming increasingly important refuges for native fauna and Busselton is home to a significant population of the threatened western ringtail possum. Busselton has a high rate of population growth, and is representative of many rapidly urbanising areas in Australia. How assemblages of native and non-native animals respond to such rapid urbanisation is of importance for scientific interest and management procedures.
By understanding the resource use of the foxes we may be in a better position to attempt to reduce their density in urban areas. This has proven challenging in the past, because conventional techniques such as shooting, broad scale baiting and trapping are largely not viable in the urban environments. Ecologically based, creative methods for controlling foxes would benefit both humans and native fauna living in urban environments.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Susceptibility to *Phytophthora cinnamomi* and sensitivity to phosphorus in native Australian plants: why are they linked?

Key staff:
DEC – C Dunne, B Shearer
UWA - H Lambers, P Finnegan, G Yan, S Pearse, X Ma and R Jost

Project investment and timeframe:
ARC Linkage, 2007- 2012.
$1,500,000 total application including ARC, University, Industry and *in kind.*

Current status:
The approach taken in this project towards understanding the impact(s) and mode of action of phosphite is to investigate its effects on the growth, physiology and biochemistry of *Arabidopsis thaliana* and the Australian native *Hakea prostrata* R. Br. as model species. The working hypothesis is that genetic changes that allow native plants to continually take phosphate from the soil have weakened defence against *P. cinnamomi.* A thorough understanding of the interactions between phosphite and plant P nutrition in determining the susceptibility to *P. cinnamomi* will lead toward new strategies to combat this devastating phytopathogen. The project is expected to be completed by early 2013 but may continue depending on further funding options.

Future directions:
Understanding the risk of on-going phosphite treatment within native plant communities where the risk of adding phosphorous to ecosystems with low phosphorous soils could have long term deleterious consequences.
Advancing the understanding of how phosphite treatment controls *Phytophthora cinnamomi* within WA native plant species to thereby develop new fungicides that could be superior to phosphite.

Anticipated outcomes and management implications:
Improved knowledge about the mechanisms of how phosphite works to control *P. cinnamomi* infection within native plant species. This will allow for improved application methods, a greater understanding of the risks and benefits of phosphite treatment and further insight into how phosphite treatment creates increased resistance to *P. cinnamomi* within susceptible plant species.
New tools for investigating pathogen resistance, plant-pathogen interactions and phosphite control mechanisms at a biochemical and molecular level. This will allow for development of tools to screen intra-specific resistance to use susceptible plant species within revegetation/restoration projects. Furthermore this should allow for better determination about the long terms impacts of *P. cinnamomi* within WA ecosystems and lead to improved plant control techniques.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Ecophysiology of stem succulent halophytes subject to changes in salinity and water availability – distinguishing natural dynamics from potential mine related impacts.

Key staff:
DEC – Kelly Shepherd
UWA - Tim Colmer, Erik Veneklaas and Louis Moir-Barneston (PhD Student)

Project investment and timeframe:
ARC Linkage APA(I) $312K (2008–2010).

Current status:
Linkage grant completed. Project still ongoing with continued support from Industry Partner Fortescue Metals Group (FMG).

Future directions:
Tim Colmer & Erik Veneklaas with FMG applied for an ARC linkage in 2011 but were unsuccessful. Erik Veneklaas and Kelly Shepherd have discussed future ARC linkage applications.

Anticipated outcomes and management implications:
Western Australian samphires (stem succulent halophytes) usually comprise the dominant vegetation in saline habitats. Ongoing collaboration between UWA and DEC to understand the ecophysiology and taxonomy of this important group will provide significant outcomes for improved management of saline areas.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Protecting the safe havens: will granite outcrop environments serve as refuges for flora threatened by anthropogenic climate change?

Key staff:
DEC - Colin Yates, Margaret Byrne
UWA - Kimberly Van Niel, Steve Hopper
Others - Tom Schut (Curtin), Grant Wardell-Johnson (Curtin), Gunnar Keppel (Curtin), Steve Franklin (AAMHatch), Laco Mucina (Curtin)

Project investment and timeframe:
ARC Linkage 2009 to 2011, $330k

Current status:
Dr Peggy Fiedler completed the databasing of Stephen Hopper's notebook vouchers in early 2011. Several workshops have been completed and the first two years fieldwork has been completed (a floristic and environmental survey of fifteen granite outcrops in association with climate stations and ibuttons to record micro-climate data). A total of 461 plots were assessed, and databasing is well advanced. LiDAR and multispectral scanner imagery has been flown for 28 outcrops. Planning is well-advanced towards this season's field-work program, analysis and publication. Two PhD students are enrolled in the project (Goran Alibegovic and Gianluigi Ottaviani).

Several publications and conference presentations have come out of the project so far.

Future directions:
A number of key projects are planned for this year:

- A study on the microhabitats preferences of *Ornduffia marchantii* in the Porongurups, including distribution modelling and an assessment how the species may respond t reduced rainfall and increasing temperatures.
- Habitat partitioning of congeneric herbaceous species at Boyagin Rock, an investigation of co-existence and niche separation.
- Kunzia genetics and micro distribution on outcrops, using cracks as the presence region. (Boyagin, Humps, Chiddarcooping King Rock, Kokerbin).
- Microclimatic habitats on granite outcrops and the impacts of climate change.
- Invasive species on granite outcrops: the role of microclimate and soil depth.

Anticipated outcomes and management implications:
We investigate the biophysical mechanisms facilitating the persistence of species and ecological communities in granite outcrop climate refuges by asking the following questions:

1. How do topographic and micro-habitat features of GOs designate them as refugia?
2. Do phylogeographic patterns demonstrate that GOs have acted as refuges in the past and are important reservoirs of genetic diversity?
3. Are particular environments at the base of GOs more productive, and are individual plants in these environments under less stress than those in the intervening matrix?
4. Are the plant communities of GOs more resilient to anthropogenic climate change disturbances than the communities of the surrounding landscape matrix?

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Adapting to climate change: a risk assessment and decision framework for managing groundwater dependent ecosystems with declining water levels

Key staff:
DEC - Adrian Pinder, Steve Appleyard
UWA - Paul Close, Peter Speldewinde
Others - Jane Chambers (Murdoch University), Stephen Beatty (Murdoch University), Frances D'Souza (Dept Water), Stefan Eberhard (Subterranean Ecology), Ray Froend and Bea Sommer (ECU), Olga Barron (CSIRO), Simon D'Neville (Ecotones)

Project investment and timeframe:
NCCARF project with Jane Chambers of Murdoch University as chief investigator. Funding cash $325000 over 15 months (to March 2013), including $310000 from ARGP. $5000 to DEC, $30000 to UWA.

In-kind contributions from DEC = $67000 (mostly data), UWA = $220000 (mostly data).

Current status:
Project commenced late 2011. Spatial datasets accumulated from various data sources. Initial planning meeting held. 2nd meeting on 21st Feb. Stakeholder engagement meeting on 22nd Feb. Stakeholder engagement plan submitted. Data analysis commenced

Future directions:
The focus of the project is development of a method for producing risk analysis frameworks to guide water management in the face of climate-change. This will be a very preliminary method with plenty of scope for enhancement and refinement.

Anticipated outcomes and management implications:
A detailed methodology for use by managers of water resources and freshwater biodiversity that assesses risk of declining water levels to groundwater dependent ecosystems. The framework will be developed and tested for wetland and subterranean ecosystems, using data-rich and data–poor scenarios. Case studies for the three ecosystems will be provided. Information will be published as peer-reviewed papers, on a website and presented in workshops after completing the project.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Managing genetic diversity and evolutionary processes in foundation species for landscape restoration in the Midwest of Western Australia

Key staff:
DEC - D Coates, M Byrne
UWA - D Roberts
DEC/UWA - M Millar

Project investment and timeframe:
ARC Linkage, The University of Western Australia, DEC, Karara Mining - $300k 2012-2014

Current status:
Due to commence March 2012

Future directions:
Field work will commence in March 2012 with the selection of 4 foundation species that occur across the operations site of the Karara Iron Ore Project and elsewhere in the Midwest region. The work on these 4 species will be focussed around the following objectives

1: Evaluate the historical phylogeographic structure of foundation species of Midwest W.A.
2: Evaluate the contemporary spatial genetic structure of foundation species of Midwest W.A.
3: Establish suitable genetic guidelines and regimes for the appropriate selection of source material for restoration of altered post-mining landscapes that maximise the success of restoration and the potential for long term future ecosystem persistence.

Anticipated outcomes and management implications:
The development of an integrated approach to inform appropriate seed sourcing regimes that provide for resilient restored plant populations that can persist in altered environments. Although the focus of this work is the mid-west banded ironstone ranges and post-mining landscapes it has broad applicability to seed sourcing across a range of semi arid and Mediterranean landscapes.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Defining ecological and evolutionary significant units in spinifex (*Triodia* spp.) for improved ecological restoration in arid Australia

Key staff:
DEC - K Thiele
UWA - P Grierson
BGPA - S Krauss, K Dixon

Project investment and timeframe:
ARC Linkage, $500k 2012 - 2015

Current status:
Funded, not yet commenced

Future directions:
This project will address knowledge gaps currently limiting restoration success of spinifex (*Triodia* spp.) in northwest Australia. Specifically, it aims to delineate evolutionary units (taxa) and local seed transfer zones within *Triodia* and compare the ecophysiological performance of species/genotypes from different niches through field and glasshouse trials.

Anticipated outcomes and management implications:
Findings from this project help:

- Understand the biodiversity and taxonomy of Spinifex in Western Australia
- Enhance restoration of spinifex grasslands at resource hubs in Western Australia
- Provide knowledge that helps the conservation of spinifex biodiversity

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Spatio-temporal patterns of fire in the Lake Johnston region of southern Western Australia

Key staff:
STUDENT - Alison O Donnell (PhD awarded 2011),
DEC - Dr Lachlan McCaw
UWA - Dr Pauline Grierson, Dr Matthias Boer

Project investment and timeframe:
PhD scholarship support from the Bushfire CRC (2006-2009)
6 month scholarship extension jointly funded by UWA and DEC

Current status:
PhD awarded 2011.
Journal publications:
O' Donnell, A. J., Cullen, L.E., McCaw, W.L., Boer, M. M. and Grierson, P.F. (2010). Dendroecological potential of *Callitris preissii* for dating historical fires in semi-arid shrublands of southern Western Australia. *Dendrochronologia* **28**: *37–48.*
O' Donnell, A. J., Boer, M. M., McCaw, W.L., and Grierson, P.F. (2010). Vegetation and landscape connectivity control wildfire intervals in unmanaged semi-arid shrublands and woodlands in Australia. *Journal of Biogeography*, **38**, 112-124, doi:10.1111/j.1365-2699.2010.02381.x
O' Donnell, A. J., Boer, M. M., McCaw, W.L., and Grierson, P.F. (2010). Climatic anomalies drive wildfire occurrence and extent in semi-arid shrublands and woodlands of southwest Australia. *Ecosphere*

Future directions:
There is considerable scope to build on the knowledge base developed through Alison's PhD project through further post-graduate research. Potential topics include:
- fuel dynamics and the relationship between fuel continuity and climate patterns;
- structural and floristic changes in response to fire regimes, particularly fire return intervals;
- regeneration ecology and ecosystem dynamics following extensive high intensity fires;
- relationships between lightning fire ignition and climate in the Great Western Woodlands.

Anticipated outcomes and management implications:
Development of a high resolution fire history database for the Lake Johnson study area (1.15 M ha) for the period 1930-2000.
Improved understanding of links between climate and fire activity in semi-arid landscapes of southern WA.
Validation of dendrochronological techniques for dating past fire events.
Improved knowledge of fire intervals and probability of burning for shrubland, mallee and woodland ecosystems.
Findings have direct application to fire management planning for the Great Western Woodlands.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Ancient, terrestrial islands in a semi-arid landscape: Patterns of genetic diversity in regional endemics of the Yilgarn Banded Ironstone Formations

Key staff:
STUDENT - Heidi Nistleberger
DEC - David Coates, Margaret Byrne
UWA - Dale Roberts

Project investment and timeframe:
3yrs starting March 2010 - UWA $10,000, Cliffs Resources $30,000, DEC $5,000

Current status:
This project investigates evolutionary processes shaping species distributions by assessing phylogeographic patterns and population genetic structure in four species (two millipedes, two plants) endemic to The Yilgarn Banded Ironstone Formations (BIFs). Current studies are focussing on:

- Quantifying haplotype diversity within and between BIF populations and determining whether diversity is geographically structured;
- Estimating the time since divergence (or colonisation) of BIF populations and migration rates (if any) between BIFs;
- Identify any historical bottlenecks and range expansions or contractions.
- Determining whether there are any congruent phylogeographic patterns between taxa that could indicate a shared historical event such as divergence or colonisation events coinciding with a known period of increasing aridity?

Future directions:
This is expected to be the start of a series of studies on a range of BIF endemic plant and animal taxa involving comparative phylogeographic assessment to establish whether common historical forces have led to their congruent distributions. In conjunction with these studies an analysis of fine scale genetic structure on each species will also enable a better understanding of more recent dispersal events and gene flow distributions. These comparative studies should significantly improve our understanding of evolutionary forces driving species richness and endemism, and assist in the development of conservation priorities and strategies across this unique landscape.

Anticipated outcomes and management implications:
The project as a whole will provide a better understanding of biodiversity conservation issues and priorities in this region and more specifically lead to the development of predictive hypotheses about the potential impact of mining and other activities on endemic species in the Yilgarn Banded Ironstone Formations.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Factors that affect seedling establishment and the implications for the translocation of species at risk of extinction

Key staff:
STUDENT - C. Allen
DEC - D Coates
UWA - P. Poot, R. Standish, M. Moody (ex UWA)

Project investment and timeframe:
PhD - 3 years starting March 2010, UWA $10,000, DEC $15,000

Current status:
This project links ecological theory with conservation practice to increase knowledge about factors involved in successful seedling establishment in south west Australia. It is investigates species niche requirements at establishment coupled with data on stress tolerance at the seedling stage. The aims are to answer the following questions:

1. What makes a good seedling microhabitat and does this vary across species?
2. Is it possible to manipulate abiotic and biotic factors to improve survival and growth of translocated seedlings? Are there differences among species in response to these manipulations that can be explained by seedling strategies?
3. Do widely and narrowly distributed species display dissimilar morphological and physiological responses to drought and heat stress at the seedling stage?
4. Does the fitness of translocated and stressed seedlings, measured in terms of survival and growth, correspond with their stress response?

Future directions:
It is anticipated that this work will provide a baseline for future studies leading to a more comprehensive understanding of seedling microhabitat requirements for rare and threatened species. Part of the project will also investigate potential plasticity to abiotic stress in a changing climate which would form a basis for further investigations of seedling establishment and survival, . in translocation or restoration projects, under various climate change scenarios.

Anticipated outcomes and management implications:

- Improved conservation status of Critically Endangered *Banksia ionthocarpa subsp. ionthocarpa* and *Acacia awestoniana* through a series of experimental translocations
- The development of improved scientific principals and methodologies for threatened flora management and translocations, particularly in the context of fire and climate change.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
ARC LP 0882690 Elucidation of genetic and physiological factors controlling biosynthesis of sesquiterpenoids in sandalwood, *Santalum* spp.

Genetic diversity, chemical composition and biosynthesis of terpenes in Western Australian (*Santalum spicatum)* sandalwood oil for conservation and plantation improvement.

Key staff:
STUDENT - Jess Moniodis
DEC - Dr Margaret Byrne
UWA - Prof Julie Plummer, A/Prof Emilio Ghisalberti, Dr Chris Jones, Dr Liz Barbour,
UBC - Prof Joerg Bohlmann

Project investment and timeframe:
Three year time frame: Sept 2009 - Dec 2012

Current status:
Four terpene synthesis genes have been identified and characterised from *S. spicatum*. Three of these have been compared with other sandalwood species.

A collection of *S. spicatum* growing across WA has been undertaken. DNA has been extracted, and molecular genetic analysis has commenced using microsatellites. Oil analysis has been undertaken from wood samples where possible.

Variation in the active sites of genes has been undertaken on a subset of trees to see if this determines oil profiles, but all genes so far examined have been identical.

Future directions:
Correlations between genetic and phenotypic diversity of the *S. spicatum* collection will be carried out.

Environmental parameters were measured when samples were taken for the WA collection. Correlations will be undertaken to determine if any of these factors is related to oil profiles.

Two potential P450s responsible for the hydroxylation of santalenes to santalols have been identified. Work in on going to characterise these enzymes.

Anticipated outcomes and management implications:
The genetic and phenotypic variation present in the remaining WA sandalwood populations will be determined. This will identify superior genotypes for selection.

The biosynthetic pathway for synthesis of key oil components has been identified. Factors which influence oil profiles may be identified and if so this would have implications for management.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Ecological study of the quokka (*Setonix brachyurus*) in the southern forests of south-west WA

Key staff:
STUDENT - Karlene Bain
DEC - Dr Adrian Wayne
UWA - Associate Professor Roberta Bencini

Project investment and timeframe:
2006-2013 (Part-time PhD)

Current status:
- A reliable estimate of quokka abundance using indirect survey methods (principally fresh scat surveys) has been developed and calibrated against the mark – recapture method (Bain et al., in review).
- 327 habitats between Manjimup and Walpole were surveyed for presence/absence of *S. brachyurus* in 2010. Stepwise logistic regression models were generated to select a subset of variables that best predicted occupancy. The strongest model identified the density of the near-surface fuel layer (trash), vegetation structure and proximity to a different fuel age as the subset of variables that best predict the probability of occupancy of *S. brachyurus*.
- Quokka responses to fire are being investigated at 10 sites in the Frankland District.
- Microhabitat use and movement patterns by quokka have been investigated using radio-telemetry. The risk to animal welfare and changed behaviour due to collars was investigated prior to the field study and was found not to pose a tangible risk. Subsequent observations in the field have resulted in the collars being removed as a precautionary measure.

Future directions:
The effect of prescribed fire and wildfire on quokkas in the southern forests is being evaluated by estimating changes in abundance for two years before and after fire. 6 of 12 surveyed habitats have been burnt between 2009 and 2011. Logistic regression will be used to examine the effects of fire season, intensity, patchiness etc on abundance. Field work will be completed by Autumn 2013 and write up will be completed by August 2013

Anticipated outcomes and management implications:
- Development of a more rigorous and practical method of assessing population density of quokkas for population assessment, monitoring and management.
- Identification of the preferred habitat of quokkas in southern forests in relation to factors such as vegetation structure and floristics, position in the landscape, landform systems and geomorphology;
- Quantification of the distribution and abundance of quokkas in the southern forests (Warren Region)
- An improved understanding of the response of quokka to the influence of fire
- An understanding of the mobility, activity patterns and population structure of quokkas in the broader landscape directly relevant to species conservation and management

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Attributes of remnant habitat patches supporting populations of the western ringtail possum

Key staff:
STUDENT - Emma Malloch
DEC - Keith Morris
UWA - Assoc/Prof. Roberta Bencini, Dr. Brian Chambers

Project investment and timeframe:
$128K ($100K from Satterley, $18K from DEC, $10K from UWA) 2011-2014.

Current status:
The student has only just started her fieldwork by selecting habitat patches and installing transects in Busselton to assess the population density of possums in the selected patches using distance sampling.

Future directions:
Once population densities are assessed we will capture and radio collar possums to study their habitat use, movement and survivorship. We will then be able to relate these to characteristics of the patches such as area, vegetation type, canopy density and cover, understorey characteristics, etc.

Anticipated outcomes and management implications:
The results of this project will help us clarify attributes of habitat patches that maintain sustainable populations of western ringtail possums.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title: The efficacy of rope bridges in mitigating negative effects of roads on populations of possums in southwest Western Australia

Key staff:
STUDENT - Kaori Yokochi
DEC - Keith Morris
UWA - Assoc/Prof. Roberta Bencini, Dr. Jason Kennington

Project investment and timeframe:
$228K ($100K from Main Roads, $100K from Satterley, $18K from DEC, $10K from UWA) 2009-2013.

Current status:
Ongoing project examining the efficacy of rope bridges in mitigating the negative influences of roads on the populations of the western ringtail possum (*Pseudocheirus occidentalis*) and the common brushtail possum (*Trichosurus vulpecula*) in Busselton. Genetic, ecological and radiotelemetry data are being collected in the field at the moment. Rope bridges are to be constructed in February/March 2012, and the monitoring of the bridges and possum populations will be continued for a year after the construction.

Future directions:
Two rope bridges will be constructed in February or March 2012, and the monitoring of these bridges using motion activated cameras and microchip readers will commence at the same time. Monitoring of the survival and movement of radio-collared possums will be continued after the construction, and the data will be compared to those before the construction of rope bridges to examine the effects that the bridges have on possum populations. Collection of genetic data from the same populations will be conducted after the construction of the bridges to conduct paternity testings on pouch young born after the construction of the bridges. Paternity testing analyses will demonstrate whether the rope bridges restore gene flow between the groups of possums previously separated by the road or artificial waterway.

Anticipated outcomes and management implications:
The results of this project will establish for the first time whether rope bridges are truly effective in mitigating both genetic and ecological impacts of roads on arboreal animals. From this outcome, road authorities (and possibly other development authorities) worldwide will be able to make confident decisions on whether rope bridges should be incorporated in their development plans to minimise the negative impacts of development on arboreal wildlife.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Ecology and population dynamics of the quokka

Key staff:
STUDENT - Veronica Phillips (PhD Student),
DEC - Keith Morris
UWA - Roberta Bencini, Brian Chambers
Others - Helen Shortland Jones, Shane Kearney (RIA)

Project investment and timeframe:
$88K ($60K from the RIA, $18K from DEC, $10K from UWA) to support a PhD student, 2012-2016

Current status:
A collaborative research agreement between the RIA, DEC and UWA was signed last year. The student has been offered a PhD scholarship and will enrol in July, after completing a Masters in Environmental planning at Macquarie University.

Future directions:
Through this project we will derive robust, quantitative estimates of the size of the quokka population and various subpopulations on Rottnest Island and understand seasonal fluctuations in quokka numbers. We will also develop reliable methods to estimate the body condition of quokkas.
The student will elucidate the ecology of the quokka on Rottnest Island including home range, movements and the fate of animals relocated to different parts of the island for management purposes (e.g. nuisance animals relocated from the Settlement, animals dislocated by re-vegetation programs).
We will also compare the genetic variability of quokka subpopulations living in different parts of the Island and ascertain the extent of gene flow and the levels of inbreeding, genetic divergence between populations and effective population size.

Anticipated outcomes and management implications:
The findings of this project will assist the RIA in making informed decisions on the management of the island's quokkas.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Shedding light on Rakali: Ecology and taxonomic differentiation in the Australian water rat (*Hydromys chrysogaster* Geoffroy,1804) and implications for its conservation status in WA.

Key staff:
STUDENT - Karen Bettink
DEC - Keith Morris
UWA - Dr Harriet Mills

Project investment and timeframe:
2010-2013
$5000 (UWA School of Animal Biology)
$7000 (DEC)

Current status:
Remote camera and trapping data collected from Barrow Island, Murray River and Northcliffe.

Tissue samples sourced from southwest WA and Barrow Island, and additional samples are being sourced from the WAM and Museum of South Australia (including samples from PNG).

Future directions:
Genetic and morphological study to investigate taxonomic variation across Australia and New Guinea.

Anticipated outcomes and management implications:
The project aims to address the following questions:
1. What is the relationship between Rakali populations in Australia? What is the degree of genetic and morphological differentiation across states/territories, regions, ecotypes and geographically isolated populations?
2. What is the current distribution, abundance and ecology of *H. chrysogaster* in two different Western Australia ecotypes, Barrow Island and the Murray River?
3. How do the food resources of Rakali vary? What are the most effective baits to use in trapping programs?
4. What are the implications of this study for the conservation status and management of Rakali particularly in Western Australia?

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title: Can mosaic burning protect northern quolls from severe wildfires in the north Kimberley?

Key staff:
STUDENT - Annette Cook
DEC - Dr Ian Radford
UWA - Dr Roberta Bencini, Dr Harriet Mills

Project investment and timeframe:

Field work conducted at Mitchell Plateau 2008-2009 integrated with DEC fire research projects.

Current status:

MSc thesis awarded March 2011

Future directions:

There is scope to build develop further projects suitable for post-graduate research through the Kimberley Science and Conservation Strategy. Potential topics include:
- structural and floristic changes in response to fire regimes, particularly fire season and return interval;
- interaction between fire regimes, predators and fauna in the northern Kimberley;

Outcomes and management implications:

Improved understanding of the relationship between home range size, fire and seasonal climate variables.
Improved basis for planning fire regimes to conserve vertebrate fauna in fire prone habitats in the north Kimberley.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Wildlife ecology in the Perup Sanctuary

Key staff:
STUDENT - Georgina Yeatman
DEC - Adrian Wayne
UWA - Dr Harriet Mills

Project investment and timeframe:
2011-2013
$60,000 (operating budget) plus $130,000 (DEC in kind)

Current status:
- Baseline surveys of small terrestrial vertebrates are underway inside and adjacent to the Perup Sanctuary.
- The collection of radio-telemetry data to investigate the home range of the woylie (*Bettongia penicillata*) inside and outside Perup Sanctuary has been completed

Future directions:
- The baseline small vertebrate surveys will be complete in 2012.
- An analysis of temporal and spatial patterns in the distribution of small to medium vertebrate species in the Upper Warren will begin based on existing DEC fauna data. This will be related to vegetation and other habitat factors to be compiled and collected.
- Investigate habitat level correlates with woylie population decline

Anticipated outcomes and management implications:
- The establishment of baseline information for Perup Sanctuary that will be necessary for measuring the impact of the sanctuary on the flora and fauna within the fenced area.
- An understanding of the relationships between the distribution of small vertebrates in relation to vegetation type
- Insights into the movement patterns and behaviour of the woylie. Among other things this will assist in the assessment of whether the spread of a disease may account for the 95% decline in woylies in the region in <10 years
- An understanding of temporal and spatial patterns in the distribution of woylies in the Upper Warren and habitat factors related to their distribution and abundance. The differences between pre and post declines will provide important evidence regarding the possible factors associated with the declines and all results from this study will be directly relevant to the recovery of the woylie, prospective translocations and future monitoring designs.

DEC – UWA COLLABORATION
PROJECT STATEMENT

Project title:
Optimisation of camera traps for animal monitoring on the South Coast of Western Australia

Key staff:
STUDENT - Jessica Ashburner
DEC - Dr Cameron Tiller (Albany)
UWA - Dr Barbara Cook, Dr Peter Speldewinde

Project investment and timeframe:
$1,000 – consumables, cameras
Plus in-kind time from all involved

Current status:

Completed

Future directions:

Develop new honours and postgraduate projects to answer questions which have arisen as a result of the work

Anticipated outcomes and management implications:

Assist DEC with improving their efficiency in the use of camera trapping for monitoring threatened species and feral animals