Volume 27 Part 1

2009

Conservation Biology Grant Reports:

- Sexual Dimorphism, Demography & Habitat use of the Flinders Ranges Scorpion (*Urodacus elongatus*)

- Knowing our natives: the beautiful fringe lilies

The challenge of species adaptation: Implications of climate change for conservation planning and practice

Road to Extinction?? Ferries-McDonald Road development

NCSSA major concerns include

- **Native vegetation, threatened species and habitats**
- **Protecting all forms of life (biodiversity) on land and in the oceans**
- **Park dedication, management and legislation**
- **Education about biodiversity to all sections of the community**
- **Cooperation with other conservation groups**

Inside this issue:

Around NCSSA

Recent changes

Congratulations to our Scientific Officer Georgina Mollison and her husband Dan on the birth of their beautiful baby daughter, Lily on the 19th January! Georgie has taken 12 months parental leave from her position and Tim Milne and Annie Bond have jointly taken on the Scientific Officer role for that period. See their report on page 5.

Update on NCSSA Project

Defining the efficacy of patch based biodiversity surrogate measures by using a comparison with an existing comprehensive woodland bird dataset

The NCCSA, along with the University of Queensland, has been conducting the Mount Lofty Ranges Woodland Bird Monitoring Program. Since 1999, bird-monitoring experts have systematically surveyed 160 woodland sites across the Mount Lofty Ranges. These sites have been re-surveyed in triplicate annually to allow estimation of factors contributing to errors in calculating changes in the populations of birds. This current project aims to "value add" to this long term monitoring project by collecting site based attribute data which can be used to assess the efficacy of measures currently used, or that could potentially be used, for "significant environmental benefit" calculations for remnant vegetation.

These measures include:

- the current "significant benefit" calculations used by DWLBC to assess remnant vegetation for clearance
- the attributes used in the Bushland Condition Monitoring method and the SABAT tool to score the Biodiversity Significance Index (which have been flagged as potential tools that DWLBC could use for native vegetation assessment.

This project has been supported by the Native Vegetation Research Fund Grant program from 2008 to 2010. Currently Sonia Croft and Bill New are assisting in gathering site data which will be collected by 2009 and analysed in the early part of 2010.

Walks with Nature 2009

The Walks with Nature program this year is being developed in conjunction with the Department of Environment and Heritage's Healthy Parks Healthy People. As well as the Great Australian Bushwalk another walk has been proposed in the Cleland Conservation Park to take place in August. More information on dates and locations will become available once these details are confirmed.

Bushland Condition Monitoring Project

The latest manual in the series has been completed. The Bushland Condition Monitoring Manual: Eyre Peninsula, Vols 1 - 3 has been distributed to all training participants from the region and is now available at the Society's office or you can order it from the web page.

NCSSA people

Management Committee

President Helen Vonow
Vice-President Katie Fels
Secretary Sue Graham
Assistant Secretary Caroline Taylor
Treasurer Richard Winkler

General committee
Ben Taylor, Nicole Lewis, Tina Bentz, Hugh Kneebone, Nerissa Haby and Andrew Crompton

Staff

Scientific Officer Tim Milne and Anthelia Bond
Administrative Manager Elizabeth Lonie
Project Manager Tim Milne
Temperate Woodland Campaigner Penny Paton
Eastern Flanks Grassy Ecosystems Officer Bill New
Threatened Plant Action Group Coordinator Tim Jury
Bushland Condition Monitoring Manual Trainer Janet Pedler
MLR Woodland Bird Survey Coordinator Tina Bentz & Bill New
2007 South East Survey Kerry Gilkes and Georgie Mollison
2008 Tothills Survey Georgie Mollison
Database & Website Project Officer Lesley Parton

A tribute to Yvonne Steed: champion of the natural world

NCSSA members will be saddened to know that Yvonne Steed passed away on the 16th of February.

Yvonne was an esteemed conservationist and champion for South Australia's threatened indigenous flora. She was the founding Coordinator for the Threatened Plant Action Group (TPAG) and with other TPAG members initiated a vast array of active recovery programs for threatened flora. With her expert knowledge and skilful, diligent work, Yvonne brought about great improvements in the conservation management of land throughout South Australia.

A person of substance and vision, Yvonne possessed an inspiring sense of respect for living things. Her empathy and understanding of nature were deep and visceral. She will be remembered as a warm and engaging woman who always endeavoured to see and encourage the best in others.

A heartfelt thanks Yvonne, for having shared a part of your life with us. You leave the earth a better place for your efforts and sacrifices. Though you will be missed, you will continue to live on in our thoughts, in our hearts and in our work. May you rest in peace.

NCSSA Conservation Biology Grant 2009

Attention research students, applications are now open for the Society's 2009 Conservation Biology Grant. The grant aims to assist honours and post-graduate level student research into aspects of conservation biology. Funds are available for research aimed at: improving understanding of the conservation status of species or ecological communities; providing recommendations for improvement of some aspect of biodiversity conservation; understanding the ecology of species or communities; and understanding threats to biodiversity and management of those threats.

The Conservation Biology Grants aim to extend the excellent work undertaken by research students on aspects of the biodiversity of South Australia. Previous grants have contributed to research into diverse topics including studies of the ecology of single species and assemblages (eg. systematics and phylogeography of stone geckos; and guanophillic arthropod ecology and conservation in bat caves), interactions between ecosystem components (eg mistletoes in Pink Gum Woodlands; and the importance of hypogeal fungi in the diet of bettongs) and the effects of human interactions with biodiversity in South Australia (eg. ecotourism as a means of encouraging ecological recovery and conservation).

The application process is simple and asks for only a brief outline of the research to be undertaken. Guidelines and application forms are available on the NCSSA web site: *www.ncssa.asn.au*

The closing date for applications for the 2009 Conservation Biology Grant is **16th April 2009.**

2008 Conservation Biology Grant recipients were:

Melissa Schlein, Flinders University	Pollination biology and ecology of saltmarsh communities in S.A. (with a focus on the impacts of introduced plants, *Limonium* spp.)
Udani Sirisena, University of Adelaide	Systematic studies on *Thysanotus* R. Br. (Fringe Lilies)

HANDS ON ACTIVITIES FOR MEMBERS

CLIMATE FUTURES A 12 part public lecture series is being held by the University of Adelaide Environment Institute -

The Climate Futures lecture series 'Climate Change Mitigation and Adaptation' explores leading edge developments to enable society to adapt to anticipated future changes in our climate.

The Climate Futures lecture series will be presented on Wednesdays at 5-7pm in the Horace Lamb Lecture Theatre, University of Adelaide North Terrace campus, from 4 March to 8 April and from 29 April to 2 June.

The 12 lectures are convened by specialists in these fields, and will feature 2-3 expert speakers. The presentations are suitable for anyone with an interest in the challenges posed by climate change for a sustainable society.

The seminars are free of charge and further information and registration is available via email environment@adelaide.edu.au

Upcoming activities of the Threatened Plant Action Group (TPAG)

Come and be involved in some **hands~on** action to help threatened plants and vegetation communities recover with the Threatened Plant Action Group. Training and some tools are provided on the day. Most working bees are in the morning, generally from 9.30 am onwards, with training and some tools provided on the day. Please dress sun-smart, wear a hat and sturdy footwear. Everyone welcome. Upcoming working bees over the next few months will occur on the following dates.

Millbrook Reservoir **Every Tuesday (except fire ban days)**

Come help with the management and restoration of grassy Red gum - Blue gum Woodlands that are habitat for threatened orchids and herbs like *Caladenia rigida*, *Glycine latrobeana* and *Diuris behrii*.

Belair **Saturday April 11, Saturday May 9 and Saturday June 13**

Pitch in by joining efforts to protect and restore habitat for the Leafy Greenhood orchid (*Pterostylis cucullata*) at Belair National Park. Share in the action by doing a morning's work amongst beautiful Manna Gum woodland in the southern Mount Lofty Ranges.

Tarlee **Friday May 22**

Help recover threatened threatened Temperate grasslands and Spalding blown-grass (*Lachnagrostis limitanea*) at sites north of Adelaide. Activities include, weeding, slashing, planting and site management.

Pine Point, YP **Weekends of April 25 & 26 & June 27 & 28**

Join in the planting and weeding on these weekend trips to restore habitat for *Acacia rhetinocarpa*.

Mount Lofty /Cleland **Friday June 5**

Come work in perched swamps to help manage threats and monitor endangered plant species and communities.

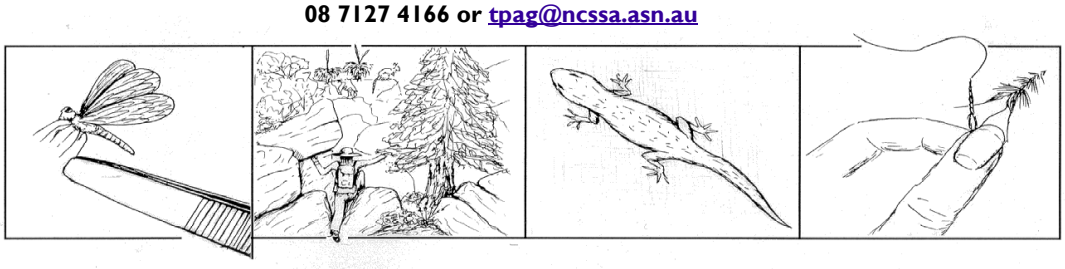
Kulpara, YP **To be announced**

There is a lot of work to do to help Limestone phebalium (*Phebalium glandulosum* ssp. *glandulosum*) with weeding of Bridal Creeper, Horehound and Boxthorn. Bird surveys will also be conducted.

Finniss **Saturday July 18**

In order to help restore the habitat of *Acacia pinguifolia* and *A. rhetinocarpa*, site monitoring and threat abatement of *Asparagus* weeds will be continued.

Dates are subject to change due to weather and seasonal factors so for information please contact Tim Jury on 08 7127 4166 or tpag@ncssa.asn.au



Scientific Officer's Report:

Firstly, as one of the Society's two new Scientific Officers I'd like to say how excited I am about taking on this role. Tim Milne and I (Annie Bond) will be sharing this work while the wonderful Georgina is busy with the demands of motherhood. I have such admiration for all that's been achieved by the Society and feel really privileged to have this opportunity to contribute.

This summer we have been busy making comments on several planning documents as well as the independent review of the *Environment Protection and Biodiversity Conservation Act 1999*. Below I have provided a brief summary of the recent submissions we've made.

South Australian Murray Darling Basin Natural Resources Management Plan

This plan is a comprehensive document that provides a broad overview of the biodiversity assets of the region, specifies targets across multiple timeframes and details actions to achieve these targets. The SAMDB NRM Board has brought these components together well. However, the Plan also serves as a notice of the generally poor state of biodiversity in the region, and the urgent need for action.

Whilst we understand that, to some extent, the Plan must be general in nature, we were concerned that a great number of the actions flag further planning or knowledge gathering rather than immediate practical measures for biodiversity conservation. Any decision to delay action, in favour of further knowledge gathering or planning, needs to recognise the real trade-off against ongoing degradation and loss of biodiversity.

In this light, we urged the Board to optimise the delivery of on-ground action for biodiversity protection and restoration, by acting on current knowledge and ensuring this is done within an adaptive management framework (ie learning by doing). This approach will deliver improved knowledge without compromising opportunities for on-ground outcomes. We believe it is the Board's role to support organisations and agencies prepared to show leadership in this area.

Independent review of the *Environment Protection and Biodiversity Conservation Act 1999*.

On behalf of the Society we raised concerns about the following:

- The precautionary principle isn't employed often enough when assessing the impact an action might have on a matter of national environmental significance (eg threatened species).
- The Act currently allows for many actions which have a small or 'insignificant' impact to take place which may cumulatively result in a large or 'significant' impact.
- The Bilateral Agreement (which was executed last year without NCSSA's concerns being adequately addressed) weakens protection for matters of national environmental significance in South Australia.
- Decision making under the Act is not as transparent as it could be, due to inefficient data management.
- While there are opportunities for public participation in decision making processes under the Act, current processes and structures provide opportunities for exploitation of the good will and substantial knowledge held by community members.
- There has been a strong focus on developing recovery plans under the Act (which is commended) but this must be matched by a strong focus on implementation. Investment in planning is all but wasted if the plans are never implemented.

Belair National Park Trails Master Plan: Preliminary Issue

This Plan relates to proposed redevelopment of the trails network in Belair National Park. This includes the possibility of increased access for horse and mountain bike riding and the construction of some new tracks where none currently exist. As many members would be aware, Belair National Park is a place with highly significant biodiversity value, including many threatened species and ecological communities. Therefore, our grave concerns about the impact of the proposed trails redevelopment are sure to be shared by many.

Thanks to the outstanding effort of Tim Jury, an extensive submission was made on this Plan. Our concerns addressed a litany of planning deficiencies, including inadequate consideration for the protection and management of the Park's biodiversity assets and numerous conflicts with legislation (*National Parks and Wildlife Act 1972* and *Environment Protection and Biodiversity Act 1999*) and key Government planning documents such as the *Management Plan for Belair National Park*.

Draft Regional Recovery Plan for the threatened species and ecological communities of Adelaide and the Mt Lofty Ranges

We are very pleased that this plan covers threatened species listed at the state and regional level in addition to those listed at the national level. The Plan's treatment of threats in the region is thorough and does not avoid controversial issues. Likewise, the complex and difficult task of prioritisation has been executed well, and will serve as a useful (although not definitive) guide. Unfortunately the significant contribution of community groups and non-government organisations is marginalised by the Plan, and opportunities to capitalise on the strengths of this sector have not been adequately identified or included. It is very important that implementation of the plan is adequately supported and resourced so that the potential benefits of this planning approach can be realised.

2009 Duck Hunting Season

The Society recommended to the Department for Environment and Heritage that there be no Duck Hunting Season in 2009 due to continued rainfall deficit, poor wetland condition and low waterfowl numbers in Southern South Australia.

West Avenue Watercourse

We have also been keeping a close watch on developments with the proposed drainage in the West Avenue Range (Upper South East). The Department of Water Land and Biodiversity Conservation recently commissioned an independent assessment of the risks and benefits posed by drainage to the West Avenue Watercourse environmental values. We are currently awaiting the results of this assessment.

Fire and Native Vegetation

Over the upcoming months we will be providing comment on native vegetation management, fire, and development planning and how these three issues relate to one another.

The Society will be continuing to pursue the protection of these important and unique areas and will keep all members informed via the website or following issues of *Xanthopus*. Tim and I welcome your assistance with the Society's work on these issues. So if you are interested in becoming involved, perhaps by providing comment or assisting with research, we encourage you to contact us on the email **scientific@ncssa.asn.au** or by telephoning the office **(08) 7127 4630**

NCSSA CONSERVATION BIOLOGY GRANT 2007 REPORT:

Sexual Dimorphism, Demography & Habitat use of the Flinders Ranges Scorpion (*Urodacus elongatus*)

In 2008 I graduated with an Honours First Class Bachelor of Science Biodiversity & Conservation Degree from Flinders University, South Australia. My major Honours research project was on the Flinders Ranges Scorpion (*Urodacus elongatus*).

The genus *Urodacus* is endemic to Australia and the limited research that has been done is mostly decades old.

U. elongatus is endemic to the Flinders Ranges, and has patchy distribution primarily limited to gully areas. The species displays a sexual dimorphism that is extreme amongst scorpions. My study represented the first research done on this species.

My research project had two major components:
a demography study and a habitat use survey.

Demography study

This targeted a specific population located along the Mambray Creek entrance road at Mount Remarkable National Park.

Field trips for the study involved two nights once or twice a month between March and August 2008.

During each night an ultraviolet (black) light was used to scan a 45x45m area for 2-2.5 hours following sunset. The exoskeleton of scorpions fluoresce bright green under UV light making individuals easy to detect in a relatively non-invasive way.

Active scorpions either in the open or at the entrance to burrows were collected using forceps. Scorpions were photographed, measured, marked with an individual dot number using non-toxic paint, weighed, sexed and returned to the place of capture.

The growth and development of scorpions occurs as a series of instars that increase in size during the intervening moult.

Sexual maturity is usually reached at the final moult. The body measurements (morphometrics) collected in the study were used to create discriminant functions (formulas) that can be used to assign an individual to a specific instar.

I was able to confirm that *U. elongatus* has six instars and reaches maturity at the fifth or sixth instar.

I discovered some anatomical features can be used to distinguish sex from at least the second instar. Particularly, this includes pectine length and pectine teeth number. Pectines are a comb-like sensory structure unique to scorpions, they occur as a pair on the ventral surface.

Male *U. elongatus* have longer pectines containing more teeth, than female individuals. The primary feature of the sexual dimorphism of the species is the longer metasomal (tail) segments of the male, hence the species name *elongatus*. Adult males can reach 12cm and adult females 10cm in length. I discovered that this feature does not become fully expressed until the fifth or sixth instar.

Habitat survey

This was primarily done during the first week of July 2008, and involved the assistance of a group of ten volunteers.

The survey involved 5x5m quadrats along transects based along fire access tracks throughout Mount Remarkable National Park. The quadrats represented the range of habitat types present in the park including ridges, slopes and gullies.

The habitat qualities of each quadrat were recorded along with the presence/absence and number of scorpions observed. Habitat qualities recorded included slope, aspect, tree cover, and ground cover (vegetation, rock, litter, and bare ground).

Flinders Ranges Scorpion (*Urodacus elongatus*) Photo Jennifer Munro

Since *U. elongatus* had previously been observed to burrow under rocks, rock qualities of length, width and depth were also recorded for rocks where scorpions were present and for a series of randomly selected rocks within the quadrats.

From the data collected I was able to significantly predict the presence of scorpions using the habitat qualities rock and slope.

Scorpions were most likely to be present at sites of low slope (<30°) and moderate rock cover (20 - 40%).

Habitat survey quadrat in Mount Remarkable National Park Photo J Munro

The specific rock qualities of length, depth, and volume indicated that rocks of medium (0.050 - 0.300m^3) volume were most likely to be associated with scorpion presence.

Within Mount Remarkable National Park, sites with these qualities are typically represented by creek bed and flood plain areas. These sites also are those most impacted by humans, particularly via tourist activity.

Therefore my research has highlighted the need for continued monitoring and management of human impact on the natural habitat of this endemic species.

By obtaining an understanding of the life history and habitat use of this endemic South Australian scorpion species, my research has contributed to our ability to conserve and protect this species within its natural habitat.

This project was supported by research grants received from *ZoosSA*, *Nature Conservation Society of SA*, and *Nature Foundation of SA.*

Jennifer Munro
B.Sc. BiodivCons (Hons) Dip.Nat.RN

View of Mount Remarkable National Park from the Battery Ridge Photo J Munro

XANTHOPUS

The views presented in this newsletter are not necessarily those of the NCSSA

Copy deadline for the Winter edition is **30th April** 2009.
Contributions in a variety of formats will be considered, but electronic submissions are preferred.

Editorial Team for this issue: Elizabeth Lonie, Penny Paton and Helen Vonow

NCSSA CONSERVATION BIOLOGY GRANT 2008 REPORT :

Knowing our natives: the beautiful fringe lilies

As we all know, effects of large scale habitat clearing and climate change can cause extinction of natural ecosystems, along with animal and plant species. Even now, species extinction is happening slowly and it is time to save our species. But, do we know enough about our native fauna and flora in order to save them?

My work on *Thysanotus* (fringe lilies) was initiated mainly to improve knowledge and identification tools for this group of plants, and then to assess their diversity (of already-known and new species). Proper identification of species is very important to estimate the species diversity.

Once a species is defined one can begin to assess the priority for conservation by determining the numbers and the sizes of its populations still surviving in the wild.

The genus *Thysanotus* (Thysanos means a fringe in Greek) was erected by Robert Brown when he visited Australia in early 1800s as the naturalist with the expedition led by Captain Mathew Flinders.

The genus is distributed throughout Australia and consists of about 50 species, with highest diversity of species concentrated in Western Australia and South Australia.

One species, *T. chinensis* extends to the mainland of China and some parts of south East Asia. A second species *T. banksii* extends into New Guinea and the islands of the Torres Strait.

Many *Thysanotus* species possess underground fleshy tubers which were once used to be food for aboriginal people.

My initial work mainly involved looking at the morphology of the specimens already collected and preserved (Herbarium specimens).

This helped recognising any ambiguous specimens. Some herbarium material lacked some plant parts such as tubers, roots, fruits and flowers which made the specimen identification difficult. Therefore collecting a good plant specimen for future reference including all possible plant parts seemed very important.

Field trips were carried out during the months of October and November each year.

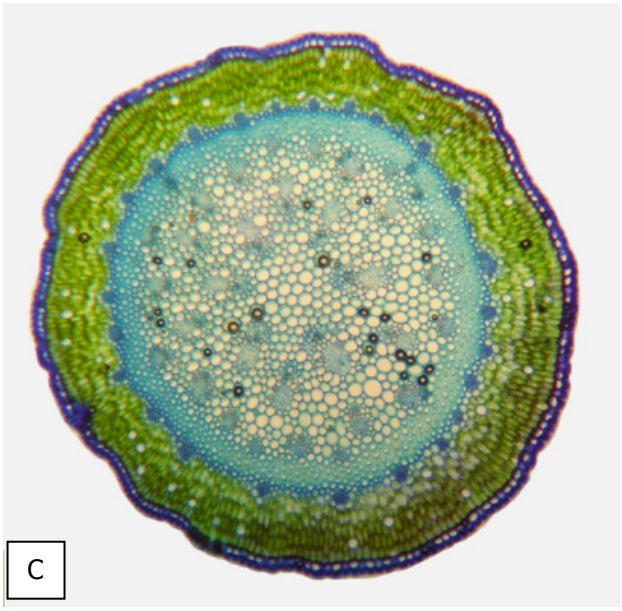
Any whole *Thysanotus* specimen collected from the field is identified, dried, labelled with collection date, flowering time, locality etc. and deposited at the state herbariums of South Australia or Western Australia. In this way the specimen is preserved for future reference.

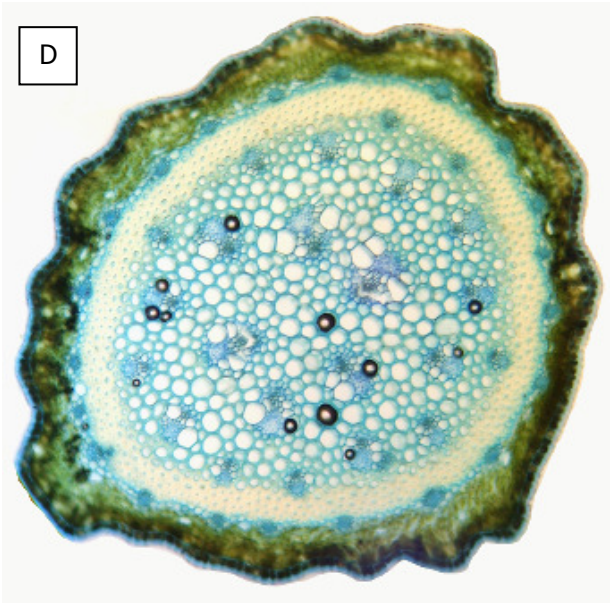
For my molecular work, small plant parts (leaves, stems etc.) are collected into specimen jars containing silica gel. Fresh flowers and stems are preserved in 70% alcohol for morphological and anatomical studies.

During these collection trips I realised that some *Thysanotus* species are not common as you would expect and often have a population size of only about 15- 20, or even less, individuals.

It was pleasantly surprising to find some species which have been collected about 50 years ago still persist in the same locality despite the large scale habitat clearing and the effects of climate change.

A: *Thysanotus formosus* from Western Australia (*photo: Udani Sirisena*)
B: Thysanotus juncifolius from South Australia (*photo: Cecilia Trujillo*)





C: Stem transverse section of *T. juncifolius* from SA Photo: Udani Sirisena
D. Stem transverse section of *T. juncifolius* from NSW - different from South Australian *T. juncifolius* (C) Photo: Udani Sirisena

I was amazed to see the variety of habitats in which *Thysanotus* occurs. Some of these habitats are *Eucalyptus* woodlands, heath lands, marshy habitats and rocky outcrops with very shallow soil.

By examination of herbarium material, I discovered that *T. juncifolius* from NSW (the type locality for the species) is different from south Australian *T. juncifolius*. This leads to the question whether what we have in South Australia is really *T. juncifolius*? This is being further studied using morphology, anatomy and DNA sequences.

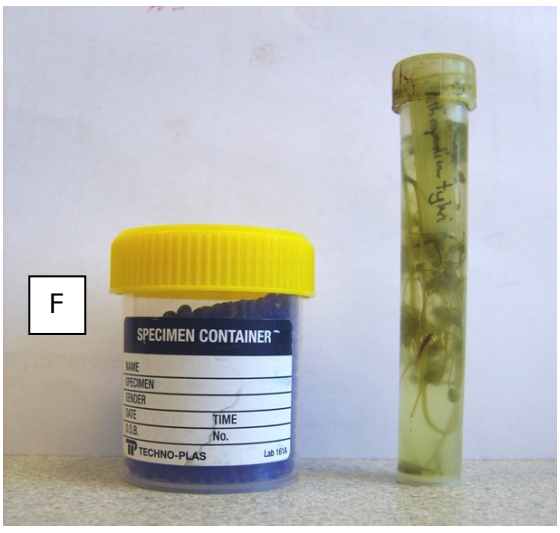
Also, there were differences in *T. exiliflorus* collected from South Australia and Western Australia.

The common and widely distributed *T. patersonii* (twining fringe lily) also showed variation in flower and seed morphology and DNA sequences. A major achievement of this project is the discovery of a new species from south west of Western Australia.

I will provide a further update in *Xanthopus* in few months time.

I thank Nature Conservation Society of South Australia for funding this project in 2008. The money was useful for both field and lab work. As part of this project, I was privileged in gaining many skills such as carrying out molecular work, using different microscopes and field equipment, etc.

Udani Sirisena
Ph.D. candidate, The University of Adelaide



E. Rocky outcrop where *T. isantherus* was growing, in very shallow soil Photos: Udani Sirisena
F. Container with silica gel (left) samples collected for DNA and sample preserved in alcohol (right) for anatomical work

The challenge of species adaptation:
Implications of climate change for conservation planning and practice

Background

South Australia faces the twin challenges - not only responding to the current biodiversity crisis, but also the impacts of climate change.

There is a need for concerted action to ameliorate the impacts of climate change upon biodiversity, as there is for addressing currently recognised threats to biodiversity from habitat loss and fragmentation, declines in native vegetation condition, salinity, weeds, drought stress etc. Climate change is most likely to exacerbate these existing impacts rather than generate a suite of new impacts. Addressing current threats will continue to remain a key focus for biodiversity conservation in the face of environmental change.

This discussion paper addresses the challenges of assisting the mitigation and adaptation of species and ecosystems to future climate stress and discusses how these challenges can be integrated into conservation planning frameworks such as *Naturelinks*.

The purpose of the paper is to simulate debate on the direction of future action to best protect vulnerable species and ecosystems.

Many of the concepts in this paper come directly from Dunlop, M., & Brown, P.R. 2008. (Implications of climate change for Australia's National Reserve System: A preliminary assessment). Other concepts come from various speakers at the recent "Saving a sun burnt country: The challenges of species adaptation in a heating land" conference organized by the Nature Conservation Council of NSW (12-13 Nov 2008).

Part 1: The changing conservation challenge

There is considerable evidence that climate change is already affecting and will continue to affect many species and ecosystems. Even if emissions were reduced substantially to year 2000 levels, temperatures would continue to increase for decades (Solomon et al. 2007). It is also likely that some of society's responses to climate change (e.g. intensive agriculture shifting to new regions) will increase existing threats and pressures on native species and ecosystems.

Climate change threatens biodiversity in four key ways:

- By changing the availability and use of water
- By prompting native and exotic species to move into new areas
- By stimulating changes in land uses
- By altering fire regimes

Expected impacts of climate change on the physical environment include:

- Increases in the concentration of carbon dioxide
- Increasing temperatures, with some regions, seasons and daily patterns changing more than others
- Changes in rainfall, with less rain in some places and more rain in others, as well as changes in seasonal patterns, changes in the intensity of rainfall, and changes to the amount of time some places go without rain
- Changes in the frequency, timing and severity of floods, storms, heatwaves and fire
- Rising sea levels, as well as increased sea temperatures and acidity.

Climate change is also likely to affect individual plants and animals through:

- Changes in growth, reproduction and survival of species
- Changes in the distribution and abundance of species
- Changes in interactions between species
- Change how threats affect species
- Change the structure and functioning of ecosystems

Below is a schematic diagram of the many different types of impacts that climate change may have on biodiversity in terms of a "cascade of impacts".

Climate change will have direct ecological impacts on individual organisms (such as changes in breeding, growth, establishment, competition and mortality). These changes will inturn affect the relative abundance of species in assemblages, vegetation structure and shifts in the distributions of species. Such 'population' impacts will affect gene frequencies, local extinction rates and the dynamics of invasive species.

Through this series of cascading effects, changes in the composition, structure and function of assemblages and ecosystems will occur as result of cumulative impacts on many species. This will alter species interactions, the magnitude of various threats and change the functioning and service provision of ecosystems.

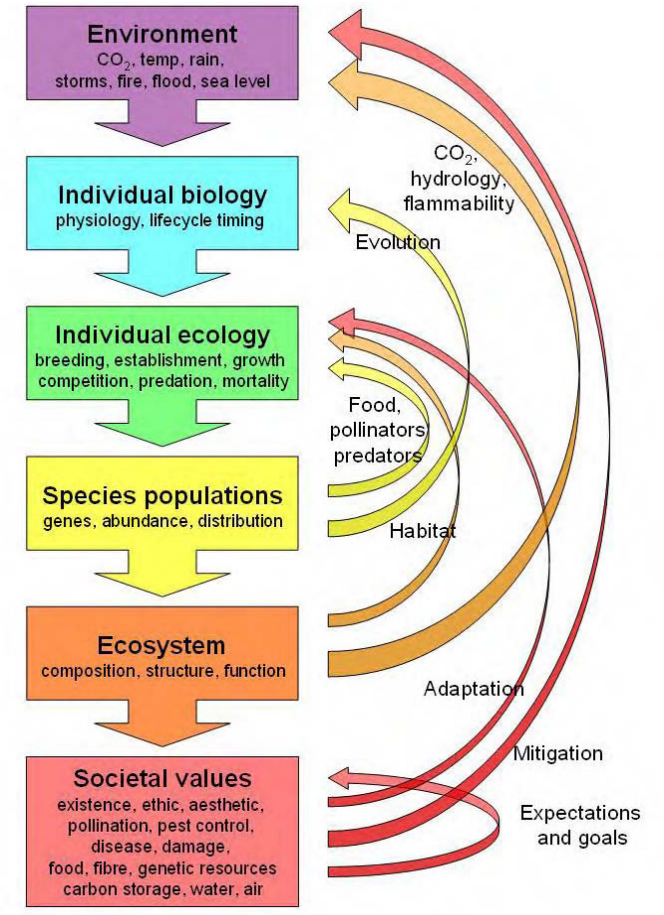


Figure A. A schematic representation of the cascading impacts of climate change on biodiversity. The direct flow of impacts is represented by large arrows. Important indirect impacts are shown as feedbacks (From Dunlop and Brown 2008).

Ultimately these changes will affect human well-being and the benefits we derive from both the consumptive and non-consumptive use of biodiversity (e.g. production of food and fibre, water quality etc.)

In combination, these changes have considerable implications for the task of conserving biodiversity. There are many indirect feedbacks that will affect stability of ecosystems including their capacity to resist change.

What types of impact are likely to occur?

Our knowledge of ecological systems and biodiversity are insufficient to anticipate exactly what impacts climate change will have on biodiversity and how we should best manage landscapes to maximize biodiversity benefits and outcomes.

Many different types of impact have been hypothesised and we know that different species will respond in different ways.

We have some idea about the types of changes that might occur – but it is difficult to predict what changes will occur for any species or location, or how fast they will occur.

Currently, most models focus only on one response (typically distribution shifts) but there are many critical drivers of change including species interactions and climate variability.

This uncertainty has considerable implications – strategies that address one potential change but ignore others are likely to be inefficient (at best) and counter productive (at worse).

What we know about species natural adaptation strategies?

Species are expected to try to adapt to climate change in three primary ways:

- Shift their range to track changing environmental conditions
- Change population size and density to match changes in local habitat quality
- Alter the timing of resource use or events such as breeding to match climatic changes

These types of strategies can provide a template for how we can incorporate climate change in to biodiversity conservation planning.

One of the key issues in understanding the impacts of climate change is the relative importance of a species ability to move in response to changing climate versus their ability to persist in a local area.

Current levels of habitat fragmentation across much of the agricultural regions in South Australia make it difficult to employ all three of these adaptation strategies. One of the most important actions we can take is to reduce fragmentation effects by increasing physical connectivity in a way that will promote the movement and dispersal of native species.

Understanding connectivity and the importance of regional biodiversity corridors

Regional biodiversity corridors link core areas of the existing reserve network and comprise a variety of tenures. They facilitate the dispersal and movement of species in response to changing conditions and catastrophic events; allow fauna to undertake natural migrations; enable nomadic species to continue to move around the landscape and allow different populations to the same species to interact.

If we are going to attempt to increase the physical connectivity of landscapes then we want to ensure that this will promote the movement and dispersal of native species. We also want to make sure we understand how various species use the corridors. For example, do individuals use the corridors as stepping stones or do they reside there? If the later do corridors act as sinks or can they sustain viable populations?

At the ecosystem level - how are things likely to change?

There are three alternative mental models of how communities or ecosystems might change under climate change

1. Relative abundance change model (*in situ* changes in the relative abundance of most species)

The abundance of most species is affected by the combination of impacts, leading to *in situ* changes in relative abundance and ecosystem structure and function, but minimal changes in composition. The model predicts that some species do well from change and increase in abundance, while others will be negatively affected and decline

2. Long-distance or rapid distribution change model (rapid or long-distance distribution expansion by a few species)

Altered environmental conditions lead to improved establishment opportunity beyond existing ranges. A small proportion of species respond rapidly via rapid gradual expansion or long-distance dispersal, usually followed by local population expansion. These species may have a major impact on other species and potentially transform ecosystem structure and function.

3. Gradual distribution shift model (gradual distribution changes by many species)

Changing climate leads to shifts in the bioclimatic habitats in which populations currently exist; the direction of shifts is dominated by warming but rainfall is also important. Gradual species turnover drives shifts in structure and function. Species will respond differently, so communities and ecosystems will change as well as shift in distribution.

What evidence is there to support each model?

Each of the models has good evidence – but we don't know what will happen in any one situation. We know that all impacts will happen, the important question is - which model will dominate at what scale? This may depend on:

- the process and dynamics of declines in abundance;
- the nature of expansions in distribution and abundance;
- the key drivers of change (direct or indirect impacts); and
- the timing of changes

Observations of actual changes combined with improved modeling will be needed to distinguish which changes will actually dominate in different settings.

Also we don't understand the cause and consequences of things such as thresholds or tipping points which can affect the rate at which changes occur and the ability of ecosystems to recover from particular types of disturbances.

We have to accept there is going to be lots of different types of change – with different consequences. The models are useful however for the formulation of hypotheses about particular regions or ecosystems, and to ensure adaptation responses are designed to address the full range of possible changes.

Regional impacts of climate change

Dunlop and Brown (2008) provide a qualitative assessment of the impacts of climate change on biodiversity in each of ten agro-climatic zones in Australia (Figure B). The assessment used the agro-climatic zones of Hobbs and McIntyre (2005).

The challenge of species adaptation cont.

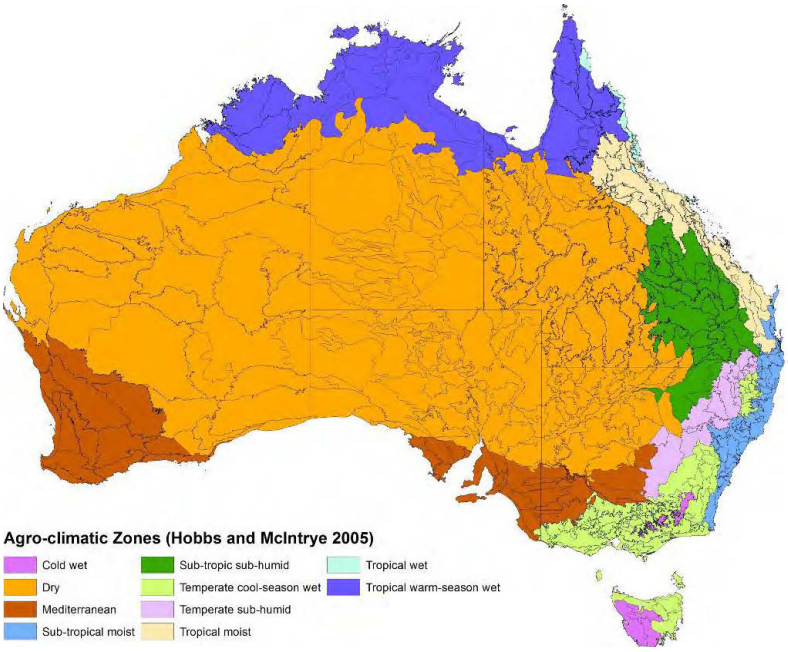


Figure B. Agro-climatic Zones (From Dunlop and Brown 2008)

Key predictions for the Mediterranean Biome

Climate: Warm climate. Moisture index high in winter, low in summer. Peak growth in winter and spring

Key issues:

- Increased fire frequency and changed seasonality and intensity.
- Change in vegetation structure from forest to woodland and from woodland to shrubland and grasslands.
- Significant land use changes, some agriculture retirement/abandonment, conversion of pasture and wetlands to crop in wetter areas.
- Increased variability, more opportunists, semiarid and weedy species.
- Impacts on wetlands and rivers, and water extraction - dams, groundwater.

Key predictions for the Dry (Arid) Biome

Climate: Warm to hot and dry. Moisture index and growth index loss all year.

Key issues:

- Fire important but limited by growth and grazing, both of which are uncertain.
- More summer and autumn rain may increase suitability for new species from north and new pasture species.
- Potential for overgrazing high as productivity decreases.
- Pastoralism may decline and perhaps some retirement of drying areas.
- Reduced or changed ground and surface water would have big impact on agriculture and refuge-dependent native flora and fauna.

Part 2: Implications for conservation planning and practice

Understanding the challenges resulting from climate change is a complex task for planners, managers and conservation stakeholders. It will necessitate changing the very nature of Australia's core conservation objective from essentially "preventing ecological change" to "managing the change to minimise loss in the face of considerable uncertainty".

Conservation planners must accept that change is inevitable and it may be impossible to stop some species becoming extinct in the wild and to prevent ecosystems from transforming. However, it is reasonable to try to maintain healthy functioning ecosystems, and minimize the number of extinctions. A broad debate is needed about what change is acceptable and what we want to maintain.

Biodiversity conservation under a changing climate will require a range of strategies from minimizing habitat loss and establishing connectivity to managing insitu threats and dispersal.

Future conservation strategies are likely to have two major objectives:

- To facilitate natural changes in species and ecosystems, including natural adaptation
- To protect individual species or ecosystems that are particularly threatened and valued by society, as a type of 'safety net'.

Conservation strategies that provide opportunities for many species to survive continual but unspecified change may become increasingly important compared to those targeting individual species, or those that require an accurate knowledge of future biodiversity changes.

Facilitating change may require:

- using species that can cope with predicted environmental changes in restoration
- protecting newly establishing native species
- allowing fire regimes to change
- managing reduced flows in rivers and wetlands
- removing barriers to plant and animal dispersal.

On the other hand, preserving vulnerable species and ecosystems may involve:

- restoring with local varieties only
- controlling establishment of new species
- maintaining historic fire regimes
- maintaining historic water flow regimes
- restricting dispersal into the region

What are the existing priorities for conserving biodiversity under climate change?

At a regional level a range of management strategies will always be required – some focused on individual species, others on suites of species – others on ecosystems or entire landscapes.

Below are a set of ten recommendations that could help us improve the planning for large scale conservation programs such as *Naturelinks*. Note that these recommendations give no sense of where we must act, how or when? They don't provide any insight into the sorts of ecological changes we should regard as acceptable or constituting a loss - nor do they provide guidance on whether it is best to act to facilitate change in order to avoid loss or act to minimise the risk of change (that is, within our ability to manipulate).

Current mechanisms used for biodiversity conservation by land managers are simplistic in many respects, however they can be effective and in many cases they may be the only options available for ameliorating the impacts of climate change.

The recommendations below do not provide any new insights or tools for addressing climate change. It is the scale of application that is of critical importance when considering whether these recommendations are likely to be effective.

Much of the debate over future action is likely to revolve around not how to manage and conserve biodiversity effectively but rather the current scale of application vs what is needed? Of critical importance is the recognition that without a significant increase in the intensity and spatial extent of various activities we are unlikely to make much progress.

Irrespective of what is being managed (species, assemblages, landscapes) it is also vital that management objectives be carefully formulated, priorities well articulated and that mechanisms are in place to assess progress towards meeting the objectives.

Recommendation 1: Renew emphasis on protecting a diversity of habitat types at local and regional scales to provide as much opportunity as possible for species to adapt and evolve.

In a generic sense – we know that having high diversity of habitat types available for native species is a good insurance policy and safety net for their long-term persistence at local and regional scales.

We know that if we can protect and restore different types of habitat at different scales – then we have a good chance of minimising extinction rates under climate change.

The process for assessing the comprehensiveness and representativeness of the National Reserve System is one approach we could use to identify and protect a diverse array of habitat types at multiple scales. It provides a sound basis for developing a network of protected areas that attempts to conserve as many species as possible in the face of climate change.

This process in itself will not guarantee that all species will be protected, but given the likely changes and uncertainties, it is probably the best available strategic option for identifying priorities for habitat protection at regional or state-wide scales.

Additional emphasis should be placed on maintaining landscape diversity (including both well connected and isolated areas of habitat), conserving areas with high habitat and species diversity, and areas that act as important fire and climate refuges.

Recommendation 2: Reduce the impacts of stress caused by invasive species, land use intensification, excessive fire and other threats to minimise species loss

We know that the nature and impacts of threats to biodiversity are likely to change over time. If we accept that there is going to be many different types of change, it makes sense that our long term goal should be to facilitate change and natural adaptation. However, the short-term (or immediate) priority may always be to mitigate specific threats in order to protect vulnerable assets/ elements.

Key threats that are likely to drive changes include:

- altered fire regimes;
- the arrival of new (native and exotic) species;
- changing land use; and
- altered hydrology.

These threats are best addressed at broad-scales via the coordinated efforts of a variety of conservation programs. It may be possible to anticipate the changing nature and impacts of some threats, but others will need ongoing monitoring, and a flexible and adaptive approach to management.

Recommendation 3: Manage for increases and decreases in connectivity to protect important refuges, noting that some species may be best protected on "islands"

We know that the distribution and abundance of species are influenced by other species. If our long-term aim is to increase connectivity to facilitate dispersal and range shifts in species, then we need to anticipate which species are likely to benefit the most – and how these species are are likely to impact on others.

Many of the strategies we use to better conserve threatened species (like countering the effects of fragmentation) may be the antithesis of approaches to limit the spread of invasive species – or disease causing species. Connectivity may also facilitate the spread of fire and movement of non-invasive species that might have negative impacts on other species. For this reason, it may be beneficial to protect species by creating or maintaining "islands". These islands need not be isolated patches; they could be large fenced areas such as the Arid Recovery Reserve.

Over time, it will become increasingly important to assess the potential risks and benefits of increasing the connectivity of habitats.

Recommendation 4: Improve our understanding of how biodiversity may respond to climate change and use this information to guide conservation planning and practice.

To effectively address climate change we need a broad understanding of the possible changes to species and ecosystems, and the implications of those changes for conservation.

Opportunities for learning about impacts of climate change can be facilitated by the changes presented in the models above. In particular, we need to develop a better understanding of what species and communities are most at risk of change?

Some species are likely to have the capacity to move across landscapes and adapt to changing conditions. However, it is unlikely that all species will be able to shift their range to new (favourable) climatic zones. These species will need to be managed in situ or physically translocated to more favourable habitats.

Recommendation 5: Manage to maintain or improve resilience and ecosystem function

One of the ruling paradigms in conservation planning is that we can not optimise individual components of system in isolation of the rest of the system. Management actions that are designed to exert greater and greater control over the system usually either exacerbate the problem or leave us with a solution that comes at a cost that is too high to sustain in the long-term.

For this reason, we need to focus some effort on managing systems to improve resilience. This is the ability of a system to absorb disturbance and still retain its basic function and structure – in other words - its ability to return to a particular state following some shock or disturbance.

To do this we need to understand the current state and likely trajectory of the system. We also need to understand complex interactions within the system such as food webs, regenerative processes, cleansing and regulating services etc. These services need to to be maintained or enhance if the system is to remain in a stable state (or be considered sustainable).

The challenge of species adaptation cont.

More research is need to understand the key variables driving the health, dynamics and regime shifts in ecosystems. This work is important because we know that resilient systems are better able to cope with multiple uses and avoid unwelcome surprises.

There is much literature available on how we can assess and evaluate resilience in ecological systems. An excellent book which looks at how landscapes and communities can absorb disturbance and maintain function is:

Walker B. & Salt, D. (2006) *Resilience thinking – Sustaining Ecosystems and People in a Changing World*. Island Press, Washington.

Recommendation 6: Set clear management objectives based on extensive baseline studies and identified appropriate 'predictor sets' for monitoring changes in ecosystem health

Under climate change the nature of adaptive management itself may change. For example, there may come a time when it makes no sense to establish long-term self-improving management trials when the goals themselves keep changing over time.

If ecological monitoring is to be useful in an era of change it is important that management objectives and targets be derived from appropriate baseline studies.

In today's current environment – there appears to be a growing trend by governments and management agencies to select a small number of easy-to-measure indicators, when these indicators provide no indication of what is happening to the system as a whole (they only tell us what is happening to those particular species or environmental variables at the sites where they are being monitored). Many academics and scientists are advocating that this simplistic approach is not the right way forward.

There are many good examples of large scale conservation programs which have identified appropriate 'predictor sets' for monitoring ecosystem health that have been derived from properly designed baseline studies. There is an opportunity to develop innovative approaches to measuring changes in resource condition and to report this information back to the public in an informative fashion.

Recommendation 7: Current planning mechanisms and protection tools are inefficient at dealing with climate change. We need better implementation strategies

There are many types of strategic planning tools and policy documents available for managing natural resources in South Australia (ie biodiversity strategies, management plans, recovery plans, threat abatement plans etc). It is very easy for policy makers to set overarching goals and targets – but getting there has often proved difficult.

Many plans and policy documents do not provide the opportunity or flexibility to act on new information, and most poorly define the roles of who does what on the ground. This can cause confusion among stakeholders as to what they have to deliver on the ground and what types of actions are appropriate, where.

If we are to get better delivering on-ground outcomes we need to develop better planning frameworks that consider the resources available to met the objective and current level of institutional commitment and whether this can be sustained in the long-term.

There is a need for a fundamental realignment in the way that existing tools are used and actions are prioritised. In the future, it may become increasingly important to question the usefulness of existing plans and documents in light of the level of future uncertainty and the magnitude of change we need to prepare for.

There are many good examples of implementation strategies that have been developed using a consistent framework, which is focused on setting realistic, quantitative objectives and specific management targets.

Recommendation 8: Understanding how climate change will influence the broad-scale distribution of invasive species is crucial for any strategy to reduce climate change impacts on biodiversity

Invasive species are great environmental exploiters. Most do well in new environments. As climate change alters the environment it is predicted that many invasive species will become worse and some sleeper species will take off and become more invasive.

Reducing the impacts of invasive species helps makes landscapes more resilient and needs to be a central part of any climate change response strategy.

Recommendation 9: Use the best available scientific principles and practices to improve natural resource management

Once the objectives of a conservation program have been determined – it is important that the program use the most effective mix of mechanisms to achieve these objectives. This will involve using the best available scientific principles and practices to manage the resource in question. To do this effectively knowledge and insights gained from the fields of landscape ecology, conservation biology and ecological restoration need to be embedded in policy and practice.

Recommendation 10: All levels of government need to work together to better manage landscapes and ecosystems (coastal, marine and terrestrial)

This message was delivered by two keynote speakers at the recent "Saving a sun burnt country conference". This includes Professor Bruce Thorn, chair of the Wentworth Group of Concerned Scientists and Dr John Williams, Commissioner with the NSW Natural Resources Commission.

In particular - we need to move towards a more consistent approach to identify and deal with issues that transgress state boundaries, as they arise.

Dr Allen McIlwee
NCSSA Member

References

Dunlop, M., & Brown, P.R. 2008. Implications of climate change for Australia's National Reserve System: A preliminary assessment. Report to the Department of Climate Change, February 2008. Department of Climate Change, Canberra, Australia.

Hobbs, R. J. and McIntyre, S. (2005). Categorizing Australian landscapes as an aid to assessing the generality of landscape management guidelines. Global Ecology and Biogeography 14, 1-15.

Solomon, S., et. al .(2007). Technical Summary. In 'Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change'. (Eds. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller.) pp. 19-91. (Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA.)

Road to extinction??

Monarto is synonymous for many people with its world famous Zoological Park. This is an iconic facility with an enviable reputation for research, conservation and breeding. But there are other gems at Monarto less publicly known and just as deserving of attention.

These are the two Conservation Parks on Ferries-McDonald Road: namely Monarto Conservation Park, the smaller of the two whose eastern boundary is flanked by the road, and Ferries-McDonald Conservation Park, proclaimed in 1956. Ferries-McDonald Road is currently a local gravel road which runs straight through Ferries-McDonald CP, dividing it approximately into an eastern two-thirds and a western one-third segment.

Both Parks are rich with original mallee vegetation and wildlife. They are spectacular all year round. The jewel in their crown is that they, and privately owned scrub between them, are home to the last known population of Malleefowl west of the River Murray, genetically distinct from their eastern cousins.

In recent years, the local Council, the Rural City of Murray Bridge, has had a plan to convert Ferries-McDonald Road into a sealed high speed heavy transport route. So determined were they that it was prematurely announced at a public meeting in May 2008 that roadworks would commence in July and be complete by December, 2008. The necessary green lights had however not been obtained, and unfortunately for them, but fortunately for the Malleefowl and other wildlife, Canberra disagreed.

Council had not recognized that the presence of two Conservation Parks and a population of threatened native bird may pose some environmental, ecological and conservation centred questions which first needed to be addressed. Not the least of which is, "why do we need the road at all?" The result was a Controlled Action placed on the proposal under the Environment Protection and Biodiversity Conservation Act 1999. A long list of "please explain" was sent to Council by the Federal Department of Environment, Heritage and the Arts.

Almost amusing, if not so potentially dire in consequence, is that the road is totally unnecessary as it goes virtually nowhere. From the South Eastern Freeway, Ferries-McDonald Road heads south towards the Lower Lakes – and we all know the sorry state of affairs there, a national disgrace. The very wobbly reasons given are to provide a transport corridor from the Langhorne Creek wine district to the Barossa Valley for grapes (grapes need water, river is dying……), and for the transport of green waste from a composting facility in Alexandrina Council. Exactly how powerful are these lobbies? Two existing bitumen roads serve their purposes quite adequately.

But there is more. There is a group called the Monarto Common Purpose Group comprising three Councils (Murray Bridge, Mount Barker and Alexandrina) and three Regional Development Boards (Murraylands, Fleurieu and Adelaide Hills). This group would like to see an Intermodal type transport hub at Monarto, very near Monarto Zoological Park. This group would like to see an Airport at Monarto, at least of the size of Parafield north of Adelaide, if not a relocation of Adelaide Airport itself. This group thinks that a high speed bitumen road from nowhere through two Conservation Parks right in the middle of Malleefowl territory is integral to the Intermodal project. The Intermodal needs the road just like the road needs the Intermodal! So Ferries-McDonald Road has been identified as a high speed transport corridor by this group.

Speaking of corridors, in November 2008, Environment Minister Jay Weatherill announced the five NatureLinks wildlife corridors in South Australia, first aired in his Department's publication, *No Species Loss – A Conservation Strategy 2007-2017.* The Monarto area is right in the middle of the Murray-Coorong NatureLinks Corridor. One would imagine that the corollary, if not the sole purpose, of such a corridor would involve preservation of threatened species (one being the Malleefowl).

Wildlife corridor or high speed transport corridor? NatureLinks versus the B-Double? The two are about as incompatible as it is possible to be. Curiously, the right hand seems not to know what the left is up to, with NatureLinks announced a month before the consultants report into the Intermodal was released.

Throughout all of this, local residents have been the voice of reason, looking for good outcomes across money, society and the environment. To both preserve and promote the area. We love this region. We live here because we love its ancient and striking beauty, the peace, the wildlife and the bushland. We have harnessed our resources and amassed shreds of spare time into countless hours, to put a structured set of proposals to Council to better achieve sustainable outcomes. We don't want trucks, we want the road through the Parks enhanced by wildlife crossings and single lane slow points. This area has inherently so many natural attributes.

The last thing it needs is diesel and bitumen, with the associated exponential increase in roadkill and, quite conceivably, the demise of the Malleefowl. Now that would be a memorable legacy for the future to remember the activities of the Rural City of Murray Bridge and agencies forming the Monarto Common Purpose Group.

Dr Rachel Westcott BVMS (Hons), BSc, DipAppSc

GENERAL MEETINGS

will generally be held on the first Thursday
of every second month at the University of Adelaide

Upcoming meetings:

General Meeting: Thursday March 5th, 5.30pm
Dr. Wayne Boardman
Manager Conservation Programs, Zoos South Australia
Conservation Medicine—monitoring the health and disease status of wildlife in Australia
5.30pm BBQ at back of Benham Building
6.00pm meeting at Benham Lecture Theatre, Benham Building

General Meeting: Thursday May 7th, 6.30pm
Conservation Biology Grant recipients, reporting on their research projects
Benham Lecture Theatre, Benham Building

PLEASE NOTE - OUR NEW OFFICE ADDRESS IS
260 Franklin Street, Adelaide SA 5000

Phone: (08) 7127 4630