SEGments

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Scientific Expedition Group Inc.

Cover Photo:
Southern Lake Eyre mound springs. Extinct mound springs on the horizon and current flowing spring, Jersey Springs, in foreground. Photo Rachael King.

The Scientific Expedition Group is a not-for profit organisation which began in 1984. SEG undertakes several expeditions each year to record scientific information on wildlife and the environment in many parts of South Australia.

A major expedition to conduct a biodiversity survey occurs each year over two weeks. Scientific experts lead volunteers in surveying mammals, reptiles, invertebrates, vegetation, birds and physical geography. The data collected on each survey are archived with the relevant State scientific institutions to ensure they are available to anyone interested in our State's environment.

In addition to the major expedition, a number of trips for the Vulkathunha-Gammon Ranges Scientific Project are organised annually. A long term study of rainfall on the ranges and of water flow in arid-zone creeks is undertaken. All data are supplied to the Department of Environment Water and Natural Resources and to the Bureau of Meteorology and are available for analysis.

SEG conducts four-day biodiversity surveys at eight different sites each autumn and spring in the Heritage Area of scrub on "Minnawarra" farm near Myponga. Data collected are entered into the Biological Data Base of SA. SEG also conducts annual mallee-fowl monitoring over a weekend in the Murraylands.

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EDITORIAL

I recently visited the Bureau of Meteorology (BOM) to attend a V-GRaSP planning meeting for the forthcoming April working trip to the western part of the Vulkathunha-Gammon Ranges. We were given a tour of the BOM forecasting area and were shown, on three computer screens, results of the various simulation models that analysts use when forecasting the weather for Adelaide and Regional South Australia. Such models rely on data from weather stations dotted around the country and from satellite data. The interpretation of the sometimes conflicting model predictions relies on the knowledge, skill and experience of the person sitting in front of the screens.

In thinking about the history of weather stations, and the siting of them, I was reminded of a visionary South Australian, Sir Hubert Wilkins (awarded the Military Cross and Bar during WW1), who made it his life's work to plan and work towards a global weather monitoring system that would include the polar regions to improve meteorological forecasting.

George Hubert Wilkins was born on 31 October 1888 at "Netfield" Mt Bryan East, the thirteenth child to his 52 year old father Harry and 50 year old mother Louisa. Mt Bryan is just beyond Goyder's Line of reliable rainfall used to define the limits of agricultural land, which had probably not been published when the Wilkins family settled at Mt Bryan. The Federation Drought of 1901 was a catastrophe, and George saw starving, dying sheep and paddocks turned to dust. After the drought, his elder brothers left home and George spent solitary days with his horse and dog mustering sheep and observing nature around him. The experience of the drought and the consequences of peoples' ignorance of the weather, gave him a determination to learn about meteorology and the young science of forecasting weather.

So began his life's work, although numerous other major ventures were undertaken throughout his life. At one point in his life he was perhaps the most famous man in the world and it is only with the publication in 2005 of "The Last Explorer" by Simon Nasht that many Australians have become aware of this famous Australian; myself included.

In 1921 George Wilkins put his proposal to the Royal Meteorological Society. His plan called for '32 manned stations in the Arctic and twelve spread around the Antarctic'. The meteorological observations would be transmitted by wireless (new then) to a central point.

With Ben Eielson as pilot and Wilkins as navigator, they set off in March 1928 after several years of failed attempts and successfully crossed the Arctic Ocean from Barrow Island in Alaska, to Spitsbergen in Norway, looking for land that could be a site for a meteorological station. No land was found; putting to rest the belief since Plato's mythical land, Ultima Thule, that there was land between Point Barrow and the North Pole. They crossed the Arctic Ocean in 20 hours, passing through 300 degrees of compass variation. Wilkins struggled to take sun sights by sextant, estimating the refraction of the sun's rays which is greatest at high latitudes with the sun low on the horizon. Later after looking at Wilkins' flight logs, the Chief Surveyor of the American Geographical Society stated "he accomplished a feat in navigation which can be confidently declared unparalleled in the history of flying". King George V bestowed a Knighthood on George Wilkins 'for 15 years of consecutive work in the interest of science and

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A small seep spring on the side of a mound, Elizabeth Springs.

OASES IN THE DESERT – A PEEK INTO THE LITTLE-KNOWN AQUATIC INVERTEBRATE COMMUNITIES OF THE SOUTH AUSTRALIAN MOUND SPRINGS

Dr Rachael King

Roughly an 8-hour drive north of Adelaide is the Oodnadatta Track, arguably one of the most well-known yet enigmatic unsealed roads in the South Australian outback. It stretches over 600km across arid desert gibber plains between the outback towns of Marree and Marla. It exists within an area known to be important to regional aboriginal culture, comprising known ceremonial sites and ancient trade routes. From the late 1800's this area had also become, in part, the route of explorer John McDouall Stuart's push north from Adelaide to the Northern Territory, and subsequently the route of the Australian Overland Telegraph Line and the Central Australian Railway (the original route of The Ghan).

Start of the Oodnadatta Track

It can be difficult to comprehend how this arid desert region has existed as such a hub of human activity across 1000's of years, that is, until you recognize that this area is also home to ancient freshwater springs, the South Australian mound springs. These springs are the only permanent source of surface freshwater accessible across the region and the availability of this water has been vitally important to regional aboriginal people, as well as to later explorers, pastoralists and land developers.

The mound springs are fed by water from the Great Artesian Basin (GAB) which stretches underground across roughly a quarter of the Australian continent, from Lake Eyre in South Australia, across northern New South Wales and as far as northern Queensland, and is the largest confined groundwater aquifer in the world. Rainwater across the Great Dividing Range provides freshwater input to the GAB, which has flowed underground over millions of years in a southwest direction. In South Australia, along the south-western edges of the GAB are fractures and fault lines in the rock strata that have allowed water to reach the surface and have led to the formation of springs in several "supergroups" around Lake Eyre, Lake Frome and Witjira National Park (Dalhousie Springs). The Lake Eyre supergroup has the largest concentration of freshwater

The isopod *Phreatomerus latipes* from Coward Springs.

Amphipod crustacean *Wangiannachiltonia guzikae* from Davenport Springs.

Amphipod crustacean *Arabunnachiltonia murphyi* from Strangways Springs.

springs (more than 600 individual springs) across the entire GAB, including the distinctive 'mound springs' formed from carbonate cementation of sand, silt and clay over millions of years.

My own interest in the mound springs lies with the wonderful communities of aquatic invertebrates that exist within them. We have known for a long time that many of the springs are

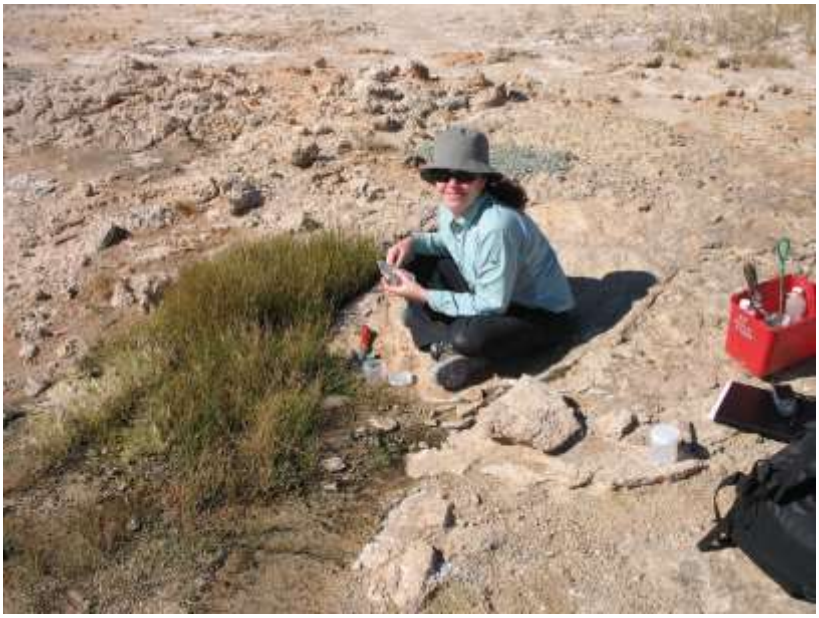
The isopod *Phreatomerus latipes* showing size.

home to several types of small (most less than 0.5 cm) crustaceans (amphipods, isopods, copepods) and molluscs.

These animals exist in what could be called desert oases; isolated freshwater habitats with enough nutrients to each support thriving populations of small invertebrates. The animals act together as an ecological community to break down organic matter through feeding, water filtering, sediment turnover etc. to keep the system clean and inhabitable.

Until around ten years ago it was assumed that the same species were found across all the Lake Eyre springs (one species of amphipod, one species of isopod etc.). However, our recent large scale scientific exploration of the springs combined with molecular and morphological work has shown that each spring or spring group (depending on their isolation) has completely unique communities of species endemic (found nowhere else) to that spring. In a group with which I have a particular specialty, amphipod crustaceans, we have gone from thinking that there was a single widespread species to discovering that there are at least 15 species from four genera, each species restricted within specific springs or spring groups. We have also found interesting evolutionary links between groups, for example, some South Australian species are more closely related to Western Australian species than they are to other South Australian groups.

For many of these invertebrates, our work has led to a massive increase in species detection and description across the springs. So why is it important that these little critters are found, defined and described? I would say because broadly it is important to understand Australian species diversity so that we can understand how to best manage and conserve species



The Author collecting with sieves and trowels in a small seep-type spring, Elizabeth Springs.

and resources. More specifically, the mound springs are a unique habitat that can be affected by aquifer draw down when groundwater used for mining, pastoral or settlement activities exceeds the flow of water recharging the spring. As we are learning, if individual springs go extinct we will potentially lose species found nowhere else on Earth. Lastly, much of the work we are doing brings light to evolutionary patterns over time: which species are more closely related to each other; links between species currently in different geological areas, etc. Our information about amphipod evolution and distribution across the mound springs can be included in "big picture" research looking at landscape changes across Australia over millions of years.

From our work so far, we hypothesise that the amphipods now present in the mound springs were once a diverse group living in streams, marshes and rivers in inland Australia as far back as the Miocene (23 million years ago). A subsequent series of climatic oscillations between wet and dry conditions, each occurring over thousands of years, eventually lead to aridification of inland Australia. The amphipods who managed to find refuge in spring fed freshwater systems (which eventually became the modern mound springs), survived and thrived. Other surviving species ended up in underground aquifers in Western Australia and yet more survivors ended up in rivers and streams across southern Australia.

For now, I continue to describe the abundance of new species as part of my work at the South Australian Museum. It continues to be a fascinating story to unravel and a wonderful privilege for me to be able to explore the biodiversity of mound springs invertebrates.

Useful References

Friends of the Mound Springs Group https://www.friendsofmoundsprings.org.au/

Department of Environment, Water and Natural Resources - SA Arid Lands site http://www.naturalresources.sa.gov.au/aridlands/water/managing-water-resources/ground-water

The main site for broad GAB information http://www.gabcc.gov.au/home

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The Great Artesian Basin shown in blue

A stepped mound spring with long tail, Elizabeth Springs

ABORIGINAL PLANT FOODS OF THE ADELAIDE PLAINS, SOUTH AUSTRALIA

Dr Philip A Clarke

In 1836 when the British colonists first arrived on the Adelaide Plains it was occupied by bands of hunter-gatherers who are today referred to as the Kaurna people. Throughout the year, Aboriginal diets here varied according to the band's movement patterns and the seasonal availability of meat and vegetable foods. Animal food sources were highly favoured when available, yet vegetable foods, such as roots and fruit, were the mainstay when meat was not easily obtainable. In spring, greens and grubs were mainly eaten, but with the beginning of summer, the eggs and young of birds were consumed, as were also kangaroos, emus, fish and lizards. During the hottest season of the year, possums and wattle gum were obtained, while in autumn, berries and nectar were available. In the winter, a wide variety of edible roots were gathered, while possums and other animals were hunted. Plant foods were important for Aboriginal subsistence at most times of the year.

Food foraging was subjected to Aboriginal division of labour by gender. On the Adelaide Plains, men hunted *paru* (meat), while women gathered *mai* (vegetables). In the case of *mai*, this consisted of roots, rhizomes, greens, gum, nectar, fruits, seeds and fungi. In 1841, missionary Christian G. Teichelmann, stated that when the Adelaide people are travelling 'the men start first, carrying nothing but a small net bag and hunting implements, - the women, burdened like camels, follow, gather & prepare on the road vegetable food for the night, whilst the men are looking out for meat'. Similarly, an English settler, Mary Thomas, claimed that when she arrived at Holdfast bay in 1836 Aboriginal women in the band carried everything, other than the 'warlike weapons' with which the men armed themselves. This arrangement was enshrined in Adelaide Plains mythology, as Teichelmann recorded that 'The Pleiades are girls gathering roots and other vegetables; the Orion are boys, and are hunting'.

Early historical accounts of Aboriginal foraging in temperate parts of Australia indicate that it was a common practice to deliberately burn off the vegetation. A colonial newspaper reported that in 1839 an Aboriginal man, who the English called Williamy, was charged with firing the grass in the Adelaide Parklands, but he was released due to lack of proof of malicious intent as Aboriginal people considered it 'a necessary and laudable practice annually to burn off withered grass on their hunting-grounds to facilitate and hasten the growth of the young grass of which the native animals are so fond'. Another settler, Pastor H. Finlayson, recalled that in the Adelaide Hills, during early February 1837, 'the natives had set fire to the long dry grass to enable them more easily to obtain the animals and vermin on which a great part of their living depends'. Mary Thomas claimed that Aboriginal hunters often set fire to large trees in order to catch possums. Many of the local Aboriginal foods benefited from the opening of the understorey and the build-up of ash produced from regular burnings.

Wetlands, such as those at the Fulham Reedbeds and along creeks crossing the plains, were the focus of many hunting and gathering activities, with middens (cooking mounds) building up at favoured camps. Most bands camped along the coast during summer, but moved inland during autumn and then sheltered in the forests of the foothills, before moving back onto the plains during spring.

Underground plant foods

For the whole southern South Australian region, the most commonly recorded Aboriginal food source was the bulrush, which are cosmopolitan plants also commonly known as broad -flag reed, cats-tail, cooper's flag, cumbungi and reedmace. The rhizomes, which are underground stems, were a rich source of carbohydrate, as well as a valuable source of fibre used for preparing the string required for making a wide variety of Aboriginal bags and nets that were essential for hunter gatherers. Wetlands were also a rich source of other edible plant foods. The rounded roots of the club rush, which

Bulrush (*Typha* species), which has edible rhizomes. Photo: P.A. Clarke, Torrens River, 2013

are commonly found growing on river flats, are walnut-sized and were prepared by being roasted and pounded between stones into a thin cake. Another aquatic food plant is water ribbons, a species with numerous fleshy edible roots.

In the grasslands on the open plains, Aboriginal people ate yam-daisy roots, which are white radish-shaped tubers. Other edible roots recorded from parts of temperate Australia and which occur in the Adelaide Plains region are the blue grass-lily, bulbine-lily, chocolate-lily, early nancy, fringe-lily, milkmaid and various orchids species. Bracken fern, as a

Yam-daisy (*Microseris lanceolata*) tubers. Photo: P.A. Clarke, Mount George, 2009

dryland plant species, is available in the moist gullies in the Mount Lofty Ranges, and this was probably a reliable food source for local gatherers, as the use of its rhizomes has been documented in the South East of South Australia and in western Victoria.

Munyeroo (*Portulacca oleracea*), with edible foliage, roots and seeds. Photo: P.A. Clarke, Kensington Park Reserve, 2018

Greens

As in most parts of temperate Australia, Aboriginal use of greens as foods on the Adelaide Plains was extensive. The thick pulpy leaves of the pigface (wild fig or Hottentot fig), which are saline, were eaten like a relish, and were gathered when the tips of the leaves became red, but before withering. Pigface grows in exposed areas along the coastal dunes, and Thomas recorded that the British colonists at Glenelg were eating it as greens in 1836.

Australian crucifer species, particularly cress, would have been growing thickly alongside the inland waterways of the early Adelaide Plains. Thomas recorded that for food at the Glenelg colonists' camp, an Aboriginal woman supplied them every morning for several weeks with a type of 'native watercress' similar to English cress. It is recorded that cress was steamed in earth ovens before eating. The fleshy leaf bases of the sagent, which grows as tussocks in sandy coastal areas, were chewed by Aboriginal people either raw or after cooking. The growth centres of grasstrees are edible, although removing them kills the plant. Extracting the individual edible leaf bases, which have a nutty flavour, is less damaging. Acidic plant material, such as sheoak foliage, was chewed as a thirst quencher when people were moving between camps or were foraging.

The tops of the scrub nettles are edible, but only after baking, which removes the stinging irritants contained in the hairs covering the leaves and stems. Warrigal cabbage has been widely recorded as an Aboriginal food across temperate Australia, as has the munyeroo (pigweed or portulacca) creeper, the foilage of which was used as a food source in the arid zone. In 1836, samphire foliage was being eaten by colonists at Glenelg according to Thomas, which was a practice they possibly acquired from local Aboriginal people.

Gums

One of the principle foods for Adelaide Plains people during the hot season was wattle gum, which was roasted on the fire before eating. The golden wattle was the main sources of edible gum, which exudes from the lower trunk during the warmer months, often caused by borer attack. It was traded by the Adelaide people to inland groups who did not have access to the trees. In general, the light-coloured wattle gums contain less of the unpleasant tasting tannins than the darker red-coloured ones. An Adelaide Plains colonist, F.M. Bailey, provided insights into the preparation of wattle gum as a food additive, recording that:

> … larger lumps of gum, formed on the stem of the golden wattle … were used for food, like we use bread with meat. Especially when they cooked fish, they would give the lumps of gum a little roasting in the embers. This roasting rendered it soft, and prevented it sticking.

Golden wattle (*Acacia pycnantha*) gum. Photo: P.A. Clarke, Ferguson Reserve, 2009

> Particularly I noticed them doing this on the Onkaparinga River, in about 1844.

At Adelaide in 1839, Thomas claimed that Aboriginal women often carried in their net bags 'pieces of gum, which is here found in great plenty'.

Nectar

For local Aboriginal people, there were many flowering plants as sources of nectar, particularly those of the Proteaceae (like honeysuckle trees and grevilleas), Myrtaceae (such as gumtrees, bottlebrushes and teatrees), Epacridaceae (like the native currant) and Xanthorrhoeaceae (grasstrees). The Adelaide Plains people created a sweet beverage, called

Nitre-bush (*Nitraria billardierei*) fruit. Photo: P.A. Clarke, Torrens Island, 1988

kundanye, which was prepared by soaking honeysuckle blossoms overnight in water held in a wooden bowl. Flowers from various gumtrees were sources of sweet refreshment for Aboriginal people on the Adelaide Plains, and a colonist named George B. Wilkinson wrote in 1848 that they 'often carry a bunch of the fragrant blossoms (*Eucalyptus*) with them, and suck the honey as they tramp along the roads'.

Fruits and seeds

Fruit species available to the Adelaide Plains people along the coast were juniper tree, leafless ballart, bitter quandong, monterry, nitre-bush, quandong, ruby saltbush and white currant. For forested areas, fruit species included kangaroo apple, mistletoe, native currant, small-leaved blackberry, wild cherry, wild cranberry and wild date. Of these plants, the monterry (or native apple) is one of the fruits that is currently being developed by the bush food industry as a food for wider commerical use. It is possible that the local Aboriginal people consumed the fruits from the grey mangrove, as varieties of this species were commonly used as a food source in northern Australia, where it required extensive processing to remove toxins.

Honeysuckle (Banksia marginata), a source of nectar. Photo: P.A. Clarke, Mount George, 2014

On the Adelaide Plains, the coastal wattle would have been a prolific source of what was elsewhere described as edible 'beans'. River red gum seeds would have been eaten after they had been leached in water to remove tannins. In contrast to desert dwellers in the north of South Australia, the Adelaide Plains people were not major users of grass seed as food.

Table of plant species used for food by the Kaurna people of the Adelaide Plains.

Species	Common Name	Edible Plant Part
Acacia longifolia var. *sophorae*	Coastal wattle	Seed
Acacia pycnantha	Golden wattle	Gum
Acrotriche depressa	Native currant	Fruit
Amyema species	Mistletoe	Fruit
Arthropodium species	Chocolate-lily	Tuber
Astroloma humifusum	Wild cranberry	Fruit
Avicennia marina	Grey mangrove	Fruit?
Banksia marginata	Honeysuckle tree	Nectar
Billardiera species	Wild date, apple-berry	Fruit
Bolboschoenus caldwellii &	Club rush	Tuber
Bulbine bulbosa	Bulbine lily	Tuber
Burchardia umbellata	Milkmaid	Tuber
Caesia calliantha	Blue grass-lily	Tuber
Carpobrotus species	Wild fig, pigface	Fruit, leaf used as savoury for meat
Casuarina species	Sheoak	Seed capsule
Clematis microphylla	Old man's beard	Tuber
Enchylaena tomentosa	Ruby saltbush	Fruit
Eucalyptus species	Mallee, gums	Root bark, nectar, leaves as food wrappers & for lining earth ovens
Eucalyptus camaldulensis	River red gum	Seed
Eucalyptus dumosa	White mallee	Root bark
Exocarpos aphyllus	Leafless ballart	Fruit
Exocarpos cupressiformis	Wild cherry	Fruit
Gastrodia sesamoides	Potato orchid	Tuber
Geranium species	Native geranium	Tuber
Halosarcia species	Samphire	Foliage
Kunzea pomifera	Monterry, native apple	Fruit
Laccocephalum mylittae	Wild truffle, native bread	Fungus
Lepidium species	Native cress	Foliage
Lepidosperma gladiatum	Sagent	Leaf base
Leucopogon parviflorus	Wild currant	Fruit
Lycium australe	Australian boxthorn	Fruit
Lycoperdon species	Puffball	Fungus
Malva weinmanniana	Australian hollyhock, mallow, wild	Tuber
Mentha diemenica	Slender mint	Foliage
Microseris lanceolata	Yam-daisy	Tuber
Myoporum insulare	Juniper tree	Fruit & gum
Myoporum platycarpum	Sugarwood	Gum
Nitraria billardierei	Nitre-bush	Fruit
Oxalis perennans?	Oxalis, native carrot, sorrel	Tuber
Persoonia juniperina	Geebung	Fruit
Pimelea microcephala	Rice flower	Fruit
Pittosporum phillyreoides	Native willow, apricot tree	Seed
Portulacca olereacea	Munyeroo, pigweed, portulacca	Foilage, root & seed
Pteridium esculentum	Bracken fern	Rhizome
Pterostylis species	Greenhood orchids	Tuber
Rubus parvifolius	Small-leaved blackberry	Fruit
Rumex crystallinus	Dock, wild rhubarb	Foliage
Santalum acuminatum	Quandong, wild peach	Fruit
Santalum murrayanum	Bitter quandong	Edible fruit & root bark
Solanum laciniatum	Kangaroo apple	Fruit
Sonchus oleraceus	Sow thistle	Foliage
Tetragonia tetragonioides	Wild spinach	Foliage
Thelymitra species	Sun orchid	Edible tubers
Thysanotus species	Fringe-lily	Tuber
Triglochin procerum	Water ribbons	Tuber
Typha species	Broad-leaved flag, bulrush, cats-tail, cooper's	Rhizome
Urtica incisa	Scrub nettle	Foliage
Wurmbea species	Early nancy	Root
Xanthorrhoea species	Grasstree, blackboy, yacca	Crown, roots & leaf stems

Fungi

The historical records of temperate Australia indicate that there were a wide range of fungi species, from beneath the ground, on the surface and in trees, which Aboriginal people collected as food, although they are rarely identified to species level. The wild truffle was often recorded as 'blackfellow's bread' or 'native bread', a fact which hints at its edible qualities.

CONCLUSION

The early Aboriginal uses of the Adelaide Plains flora shared many features with that of other parts of temperate Australia, which was a heavy bias towards the foraging of underground plant parts and seasonal fruits, with less reliance on the collecting and grinding of grass seeds. Due to the large scale of environmental and social change that has taken place on the Adelaide Plains, along with current changes in the climate, it is timely for contemporary residents to acknowledge that their district once supported the Kaurna people, who had a rich culture. Recent crises, involving droughts and water stress, have spurred on a renewed interest with planting indigenous gardens in suburbia. The development of the bushfood industry over the last few years may in the future lead to the reintroduction of some of the traditional wild foods from the area.

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Warning: The Author warns that many of these plants (e.g. the mangrove fruit) should not be tried without extensive preparation.

MINNAWARRA BIODIVERSITY SURVEY DATES 2018

Autumn - Thursday 12 April to Monday 16 April

Spring - Thursday 27 September to Monday 1st October

Come for half a day, one day or several days.

Minnawarra is situated on the southern Fleurieu Peninsula

For further information and registration forms, contact:

Janet Furler Janet on 0419 842 667 or thefurlers@gmail.com

Richard Willing on 0408 807 517 or rwilling01@gmail.com

THE GOBY DESERT
Dr Bob Wong

The mound springs of the Wabma Kadarbu Conservation Park along the Oodnadatta Track between Marree and William Creek (where the Bubbler Spring and Blanche Cup are located) are a spectacular sight to behold. In a sea of desert each spring is an oasis, providing a vital source of water for a variety of aquatic inhabitants, from freshwater snails to shrimp-like isopods. Invertebrates aside, some of these springs are also home to a most unusual fish, the desert goby (*Chlamydogobius eremius*).

A desert goby (*Chlamydogobius eremius*) courts a female.

Little Aussie battlers

Although conditions within the mound springs are relatively stable due to the supply of freshwater from underground (from the Great Artesian Basin), this is not always true of the waterholes and ephemeral rivers that desert gobies also inhabit. However, desert gobies are remarkably adaptable and are able to withstand conditions that most other fish species would find extremely difficult to survive under. For example, desert gobies are able to tolerate extremely low oxygen conditions by gulping air from the water's surface. They are also tolerant of a wide range of temperatures. Another amazing adaptation is their ability to survive under highly saline conditions, with fish inhabiting water that can be more than three times the salinity of the sea. The capacity to tolerate such environmental extremes is especially important for gobies inhabiting less permanent sources of water, allowing individuals to survive deteriorating conditions whilst waiting for the rains to arrive.

Go-Go gobies

Rainfall is scarce in the desert. However, heavy rain events have the capacity to completely transform the desert. With the rains, dry riverbeds begin to flow once again. And because the landscape is so flat, huge tracts of land are often flooded, connecting aquatic habitats that are otherwise isolated by impenetrable desert. Evidence from our recent population genetic studies suggest that desert gobies are able to take full advantage of these flood waters to help them disperse across the landscape. Specifically, gobies inhabiting disparate regions are genetically similar, demonstrating that populations are much more connected than anticipated, and underscoring the importance of flood events in moving gobies around the desert.

Although some populations may come together during times of flood, this is not always the case. In some parts of Central Australia, gobies living in distant habitats have been isolated for a very long time; so long, in fact, that they have evolved into different species. Scientists currently recognize no less than five different species of desert-dwelling *Chlamydogobius*.

Bringing up babies

Simply surviving out in the desert is not enough. Individuals also need to be able to find a mate and successfully reproduce. Like many other animals, desert goby males are larger than females. They are also more brightly coloured. Such traits have evolved as a direct result of competition among males for the opportunity to mate with females.

In desert gobies, males compete with other males for nesting sites under rocks in shallow water, which they will vigorously defend against intruders. Males that are successful in securing a nest site must then attract females. They do so using their bright colours and flashy courtship displays. If a male is successful in his efforts, the female will follow the male into the nest and deposit her eggs, which the male then fertilizes.

In desert gobies, it's the male that looks after the eggs. After spawning, the female will leave the male and take no further part in caring for the young. The male, meanwhile, will guard the eggs from potential predators. In order to ensure that the developing young have access to freshly oxygenated water, the male will fan the eggs with his pectoral fins until they hatch.

A Mound Spring

Fishy future?

Despite their remarkable ability to survive under extreme environmental conditions, desert-dwelling gobies currently face an uncertain future. Water is a valuable resource in the desert. It is needed not only by wildlife but is also relied upon by rural communities right across the region. Damage by

Male desert goby looking after developing embryos in an artificial nest in the laboratory. In the artificial nest the young gobies are attached to the rim of the nest box and the bright specks are their eyes.

trampling cattle, the tapping of ground water for industry, and the introduction of feral animals and plants can cause irreversible damage to the watery homes that gobies inhabit. Alarmingly, with more water being used for human activities, several mound springs have now stopped flowing. With the extinction of these springs, many of the animals that rely on them could also disappear. It is therefore important that we look after the delicate environment in which gobies are found because, as tough as gobies may be, even they can't survive without water.

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(All photographs by Dr P. A. Svensson)

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Threats to desert goby habitat include habitat degradation caused by livestock. A cow has got stuck in the mud and has died, adding pollutants to the water.

SEG HAS A FACEBOOK PAGE

SEG has now joined the world of social networking. We now have a Facebook page, along with our long established website. To find our page search for "Scientific Expedition Group" from within Facebook.

If you are a Facebook user you can now be part of the SEG social network, share your experiences and photographs of SEG events, and be notified about coming SEG activities as they are posted.

LIFE ON SOUTH AUSTRALIAN SALT LAKES

Dr Peter Hudson

Check out a map of South Australia or travel its many inland roads and you'll see that there are quite a number of salt lakes in our state. There are the obvious iconic lakes such as Lake Eyre, Lake Torrens, Lake Gairdner and Lake Acraman but there are also many others that are just as significant and just as beautiful. A common public perception is that these saline environments are biologically sterile – with nothing living on them. How could something live out on the hot, shimmering surface of Lake Eyre in the middle of summer you might ask. Well I can tell you that there are many arachnids and insects that do just that and most are restricted to these habitats. I have been studying the fauna of salt lakes for over 30 years and for the last few years Mark Stevens (Researcher at the SA Museum) and I have been sequencing this fauna to study their phylogeography.

To provide a glimpse of this diverse fauna I'm going to outline four interesting groups. The species in these groups are quite large, all are carnivorous and generally easy to find on salt lakes;

- *Tetralycosa* (a genus of wolf spider)
- *Australobuthus* (a genus of scorpion)
- *Pseudotetracha* (a genus of tiger beetle)
- *Cicindela* (another genus of tiger beetle)

Tetralycosa are restricted to saline habitats, and in South Australia can be found on marine shorelines, some mound springs, and on salt lakes. Eight species of salt lake inhabiting *Tetralycosa* have been described (Framenau & Hudson, 2017). Three are endemic to South Australia (*T. adarca*, *T. halophila*, and *T. williamsi*), whilst *T. eyrei* is found in South Australia, New South Wales and Victoria, and *T. alteripa* is found in South Australia and Western Australia. In South Australia the salt lake inhabiting species can be thought of as a "northern" group of species (essentially found north of Port Augusta and east of Penong on the west coast of Eyre Peninsula) and a "southern" species, *Tetralycosa alteripa* (found in a southern band stretching from the Western Australian border through to Lochiel).

Tetralycosa (a genus of wolf spider)

The salt lake scorpion *Australobuthus xerolimniorum*, described by Adam Locket in 1990 is also endemic to South Australia. Our recent investigation of the DNA of these scorpions suggests that *A. xerolimnniorum* is in fact five species! The distribution of these scorpions is quite interesting as they have only been found on lakes which have one of the "northern" species of *Tetralycosa* present – never on salt lakes where *T. alteripa* is present (Hudson, 1997).

Australobuthus (a genus of scorpion)

Tiger beetles in the family Cicindelidae are a common component of the salt lake fauna and have received considerable attention recently (*eg* Freitag, 1979; Hudson, 1994; Sumlin, 1997; Galian & Hudson, 1999; Lopez *et al.*, 2016). Two genera are commonly encountered on our salt lakes, *Pseudotetracha* (generally nocturnal) and *Cicindela* (generally diurnal). All stages of the life cycle of these beetles is spent on salt lakes.

Two species of distinctive metallic green coloured *Pseudotetracha* are commonly found on South Australian salt lakes. *P. australis* is widely distributed and is sometimes found in less saline wetlands. *P. whelani*, which is endemic to South Australia, is found on salt lakes such as Lake Torrens and Lake Gairdner (but not on Lake Eyre or Lake Frome). A further two species, *P. blackburni* and *P. mendacia* can be found on Eyre Peninsula salt lakes (Lopez *et al.*, 2016) and appear to be relictual populations of species more commonly found in Western Australia.

Rivacindela, a subgenus of *Cicindela*, is particularly diverse on Australian salt lakes as illustrated by Pons *et al.* (2006), who

Pseudotetracha (a genus of tiger beetle)

investigated species delimitation in 47 putative species of Australian *Rivacindela* using DNA sequencing. There are 14 described species of *Rivacindela* recorded from South Australia. Some species have a fairly wide distribution (*eg C. cardinalba*) whereas others are restricted to individual lakes (*eg C. gairdneri*) and it is not unusual to find two or more species living on the same lake. These diurnal tiger beetles are active on the lake surface during very hot days. They are extremely alert, with very large eyes and are quick to evade people walking on the lakes. Some species are flightless but can run extremely fast to catch prey or to avoid predators. In fact *C. hudsoni* is the world's fastest running insect and has been timed at 2.49m.sec^{-1}!

So how is it that these harsh environments can be home to such diversity? The key to survival on the lakes is a refuge, usually a burrow in the lake sediment or under debris on the lake surface. The burrow environment is not subject to the temperature extremes experienced on the surface, as the air is quite humid thus reducing water loss of the inhabitants. Also the presence of saline water serves to reduce potential for mould growth on the resident animals as well as on any food remains sequestered within the burrow. Although the lakes are typically dry for most of the time, flooding is always a potential hazard for terrestrial species living there. A sealed burrow provides temporary protection from flooding but eventually the occupants need to evacuate and move to the dry lake margins where they are subject to competition with other terrestrial fauna and an increased risk of predation. Even when lakes have been flooded for extensive periods of time (*eg* Lake Eyre and Lake Torrens) their fauna persists, however, the various species present have probably experienced substantial population "bottlenecks" which makes the study of their DNA quite interesting.

I'm often asked what they find to eat out on salt lakes. Well, many of the species are carnivorous and so if they are capable of subduing it they'll eat whatever passes by or they run into – other salt lake inhabiting species or vagrant insects and spiders that have flown out or walked onto the lakes. Their prey is very likely an important source of water in such a saline environment. The wolf spiders (*Tetralycosa* spp) are sit-and-wait predators and don't tend to roam very far from their burrows except when males go in search of females. The scorpions (*Australobuthus* spp) roam widely over the lake surface, mainly during the evening. They are known to predate upon *Tetralycosa* and take over residence of their burrow. The green, nocturnal tiger beetles (*Pseudotetracha whelani*) also cover vast distances during the evening in search of prey or mates. By sunrise they have excavated a new shallow burrow which they shelter in until the following evening or, in the case of harsh conditions where they remain, deepening the burrow if needed, to get nearer the water table and away from the inclement surface conditions.

The four groups briefly outlined above form just part of the ecosystem associated with salt lakes. Next time you're travelling past one of these lakes why not take a break and check out for yourselves what could be living there?

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WITCHELINA VEGETATION TRANSECTS 2016 - METHODS FOR ASSESSING TRENDS FROM HISTORICAL IMPACTS

Justin Jay

Background

The Witchelina pastoral lease was bought by Nature Foundation SA (NFSA) in 2010 and is managed for nature conservation. Witchelina Reserve covers an area of 4,219 sq km and is located between the north-eastern shore of Lake Torrens in the south and west, and extends north almost to the township of Marree. Management by NFSA of the Reserve has focussed on reduction of grazing pressure from cattle, sheep and goats, and control of feral predators (cats and foxes).

The Pastoral Board of South Australia oversees the use of pastoral land. Following settlement of South Australia the tenure for pastoral leases began as annual licences, but were extended after 1851 to 14, 21 and 35 years, and are presently 42 years. The South Australian *Pastoral Land Management and Conservation Act 1989* requires an assessment of Land Condition for each pastoral lease within a Soil Board area at intervals of not more than 14 years (equating to 3 visits over the period of a 42 year lease).

In assessing land condition, the Pastoral Management Branch lease assessment program requires that perennial plant species are described and characterised for each pasture component within a broader hierarchy of communities e.g. Chenopod shrublands, mixed woodlands, mallee and grasslands. These descriptions are based on a Soil Board area e.g. Northern Flinders Ranges, NW & Gawler Ranges, NE and Eastern Districts, and are produced as a manual describing the biophysical components to assign a score of disturbance.

Importance of Perennial Vegetation

Perennial plants provide stability to pastoral grazing management systems due to their ability to persist in dry periods. Under grazing, the retention of various key perennial species known as “decreasers” is a management priority, as decreasers form the mainstay vegetation reserve once ephemeral/annual vegetation has been grazed. Abundance of decreasers can be reduced (or completely removed) under persistent and/or heavy grazing from sheep and other herbivores.

The introduction (or increased abundance) of “increaser” perennial species may then proliferate and dominate the vegetation. Increaser species are commonly less palatable than decreaser species. In highly degraded areas, once decreaser species are removed or severely reduced, the original plant community may shift to a less preferred assemblage of perennial indicator species. Further degrading trends in these communities may aid in the total removal of perennial shrubs/perennial grasses thereby tending towards seasonal vegetation structure comprising annual grasses and woody forbs and shrubs.

To satisfy the Pastoral Management Branch lease assessment program, perennial species are described and characterised in terms of mix, structure, abundance, life stage and soil surface and erosion status.

Jessup Transects for Long Term Monitoring

In 2014 Flinders University established 26 Jessup Transects at existing photopoint sites on Witchelina for the purpose of measuring perennial shrub populations, and the presence or absence of key indicator species such as *Atriplex* and *Mairaeana ssp*. (chenopods) and other shrubs and tussock (perennial) grasses. These 26 Transects form part of the Pastoral Management Branch lease assessment program, covering the Northern Flinders Ranges Soil Board region (1999), and are intended as long term monitoring sites for perennial shrub populations. Jessup data collected in 1999 from the previous lease assessment is available for 5 Transects on Witchelina, providing a longer term comparison of perennial shrub populations and presence or absence of indicator species.

Photopoints are permanent general view photographs (landscape or feature photographs) which provide a qualitative record for documenting and evaluating vegetation changes over time. They are retaken from the same location and fill the same frame each time, allowing for a consistent comparison of changes between years. Photopoints on Witchelina were placed in each paddock and are generally 1.5 to 2 kilometres away from major waterpoints.

Recovery Following Reduced Grazing Pressure

Once the level of grazing has been reduced or removed due to management, and as seasonal conditions allow, the recovery stages for low shrubland communities typical of those on Witchelina may see the re-introduction of perennial plants. Such recovery may also depend upon: the availability of seed for key indicator species such as *Atriplex* and *Mairaeana ssp*. and soil surface condition; the extent of increaser species; and further seral (intermediate) stages developing whereby the original decreasers may appear once again as a key component of the plant community.

The measurement of plant attributes such as density and frequency of perennials, particularly those which are palatable, are important in understanding plant dynamics and rangeland condition. Plant counts made within a fixed belt Jessup Transect of 100m x 4m are used to determine the density of shrubs, and repeated measurements allows density changes to be detected. The counting of age-classes of shrubs (adult/juvenile) gives further information on population changes. Monitoring over time provides an indication of recruitment trends. Hence data collected using transect-based techniques can be assessed to detect population shifts.

The “Jessup” data is compared with cover levels for communities in good condition, measured at sites that represent a benchmark or reference for the vegetation type. These benchmark sites are largely ungrazed, and show a

diverse assemblage of indicator species. Such shrub communities will display plants of good vigour and health, with mixed age classes; have a high retention of resources such as intact/stable soil surface condition; good litter levels; and inclusion of the key vegetation components describing that community. On Witchelina, the existing Jessup Transect sites display a range of condition classes. Those exhibiting little or no grazing impact may act as benchmark sites; typically they are distant from a waterpoint and so animals have not congregated in those areas.

SEG Expedition to Witchelina

Over the period 12th to 23rd September 2016, the Scientific Expedition Group visited the northern portion of the Witchelina lease (north of the main mail road). During the biodiversity survey, SEG's vegetation teams visited 14 of the 26 Jessup Transects, re-measuring perennial shrub populations.

During the survey, a vegetation team of 2 botanists and four volunteers set out from the homestead each day to find the photopoint sites selected for the day. Travelling was sometimes along rough bush tracks which were overgrown and often muddy since there had been a lot of rain prior to and during the survey period. At each photopoint, a 100m transect was measured along the line of sight of the photopoint. Each team of one botanist and two volunteers (working on either side of the transect line) carefully surveyed an area 10m x 2m looking for indicator plants, and recorded data for plant attributes (cover abundance, height class, life stages etc). The teams looked for perennial plants, finding on some sites *Atriplex vesiacaria*, *Maeriana pyramidata*, *Maeriana astrotricha*, low level bluebush, plus grasses. Each succeeding 10m x 2m area was surveyed until the 100m transect had been completed.

Within the confines of a photopoint (100m x 100m), the vegetation teams also measured all the species present, and made estimates of Crown Separation Ratio or CSR for each species, to determine cover. Average crown spacing between plants is assigned a class ranging from: overlapping crown; distinct clumps; or scattered individuals. Age classes or cohorts can also be determined by examining the different structural heights groupings for each species.

At each photopoint, plant specimens were collected to validate the occurrence of new species at a site. Collecting also offers the opportunity to introduce basic plant identification skills to survey participants. These plants are later labelled with an identification number, pressed, and sent to the State Herbarium for identification and recording in the State's records.

Land Condition Index

Land condition for pastoral leases is assessed using the photopoint data, as well as scores from 100 random sites across the lease describing the individual pasture or plant communities. These scores are used to calculate a Land Condition Index (LCI) for the pastoral lease. The sites are sampled at 100 randomly selected points along the traversable tracks connecting old waterpoints and are compared with a reference benchmark for the identified pasture type. Each of the 100 sites is assessed and ranked as being in good, fair or poor condition and recorded using a points-based score: 3 – intact good condition; 2 – some disturbance due to current and historical impacts; 1 – high degree of disturbance and loss of attributes. A Land Condition Index is then calculated for the lease using the average scores for the 100 sites sampled to give an LCI of between 1 and 3.

On the SEG survey, re-sampling 100 sample sites along the track network was made difficult by the disappearance of tracks. Whilst the technique doesn't rely on using the same track route, it assumes that roughly equal areas of grazing intensity (covering all land systems accessible to herbivores) will be designed into the track route, i.e. all paddocks regularly stocked will be included, but also areas out of grazing range or greater than 5 km from water will be represented.

Conclusions

Empirical records (photo observation & interpretation), collection of population data of low shrubs (typically chenopod shrubs) using Jessup Transects done in tandem with photopoints, and the Land Condition Index provide a good assessment of the overall health and biodiversity of pastures utilised by herbivores, with the added benefit of providing training opportunities for volunteers and operational personnel. Monitoring over long periods covers the various life stages of the dominant vegetation communities (decades to hundreds of years for chenopods), and covers various climatic regimes.

The value in using photopoints as a method for evaluating biodiversity allows for:

- examining changes in vegetation composition, abundance and structure under various levels of utilisation i.e. pre stock removal, removal of stock, management of goats, feral animals, rabbits and abundant native animals i.e. macropod
- examining vegetation responses of species through seedling, recruitment, establishment, revegetation and mortality under various grazing and climatic regimes.
- comparisons over the period 1999 to 2016 to demonstrate changes in population of species , recruitment events , life stages and vegetative response.
- plant specimen collections to validate the occurrence of new species at sites.
- quantifying shrub density reductions of key indicator species with below average rainfall and subsequent drought condition.

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FRIENDS of VULKATHUNHA-GAMMON RANGES NATIONAL PARK

The Friends group have in collaboration with the Department of Environment, Water and Natural Resources undertaken two major projects in the Vulkathunha-Gammon Ranges National Park and have recently released dates for working bees.

Environmental Monitoring in Weetootla Gorge

The monitoring involves observation on fish numbers and sizes in spring-fed pools, measurements of water quality in pools, weed assessment and containment, assessment of the impact on vegetation of browsing by goats and other animals and recording of sightings and signs of yellow-footed rock wallabies and other animals

The monitoring trips are April 10-15 and August 23-27. The group will be accommodated at Balcanoona in the shearing quarters.

Weetootla Gorge

During the April trip the group will be talking with members of the Nepabunna community about the cultural significance of the park for aboriginal people and about the possibility of their being involved in our group's activities.

Most of the work, while scientifically based, is quite capable of being done effectively by anyone with a bit of on-the-job training and practice. The people going on the April trip are keen to provide this training for interested people.

Some maintenance work at Balcanoona will be undertaken including repairs of irrigation systems, replanting of trees and shrubs, campsite delineation near existing fire pits at Weetootla campground and sanding and oiling of seats and tables at rest stops.

The convenor of this project is Ray Hickman, his email address is raywen@bigpond.net.au

Oocaboolina Hut Refurbishment

The Friends group received approval in 2016 to refurbish the old Outstation at Oocaboolina.

This project aims to restore a structurally sound building, which currently has no working internal facilities, to a condition where it will be suitable for use by a variety of groups The group has worked with members of Department of Environment, Water & Natural Resources in identifying works that can be carried out by the group. These will commence in April and continue with a further two visits during 2018 and more will be planned for the years ahead.

Oocaboolina Hut

The working bees will be from 18th - 23rd April, and 14th - 20th July with a third visit sometime in the spring. In April they will commence work on the grounds surrounding the building which include, fencing repairs, installation of a rainwater tank and connecting downpipes, cleaning of roof gutters and installing gutter guard, permanent removal and poisoning of Athel Pine.

Other work to be undertaken in later trips will include measuring of window and door frames to be replaced, investigate repairs to a hot water donkey, an outside toilet and removal of a shed. Some of the work involved will require trade skills in order to ensure that the building is safe for people to occupy. But there is other work that can be done by experienced people without formal trade qualifications, and then there is work that any enthusiastic person will be able to do.

If you are interested in getting involved with this project please contact the convener Graeme Oats at gdoats@bigpond.net.au

More information about the Friends group can be found on its website at http://www.rayh.id.au/vulkathunha/index.html

Graeme Oats

Editorial - Continued from page 1

national service'. George, not presuming to use the King's name, was known formally as Sir Hubert Wilkins from then on. Wilkins with his pilot conducted flights to Antarctica over the following years, flying many thousands of kilometres over uncharted territory searching for suitable sites for weather stations.

Today there are many Arctic and Antarctic manned and unmanned weather stations fulfilling Wilkins dream of more accurate weather forecasting.

Helen Johnson

Note: The recently refurbished Australian Polar Gallery at the South Australian Museum includes material on Sir Hubert Wilkins.

SCIENTIFIC EXPEDITION GROUP INC.

APPLICATION FOR MEMBERSHIP AND MEMBERSHIP RENEWAL for 2017 —18

Membership is open to any persons, family or organisation interested in the following aims:

* The promotion and running of expeditions of a scientific, cultural and adventurous nature.
* The furthering of knowledge, understanding and appreciation of the natural environment.
* Promotion of the values and philosophy of wilderness.
* Enabling people to learn the skills required for planning and running expeditions, and to develop sound field techniques

SUBSCRIPTION RATES

Adult member - - - - - - - - - - - - - - - - - - $35.00
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HARD COPY SEGments:- If you like to receive a hard copy through Australia Post of our quarterly journal – SEGments, please include in your payment an additional $30.00 for a SEGments subscription. All members will receive an electronic copy by email.

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Details of scientific, cultural, and adventuring or other relevant skill or interests you may be prepared to share with the group:

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. . . . . .

ELECTRONIC PAYMENT

If you have access to the internet, payment can be made using SEG's bank account at Bank of South Australia, details as follows:
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Or send a cheque payable to Scientific Expedition Group Inc. with a photocopy of this page to:

The Secretary
Scientific Expedition Group Inc.
P.O. Box 501
Unley S.A. 5061

EXPEDITION IKARA

This year's SEG expedition will be to Ikara - Flinders Ranges National Park between 15 and 27th September 2018.

Ikara - Flinders Ranges National Park is the traditional home of the Adnyamathamha people who co-manage the area with the South Australian Department of Environment, Water and Natural Resources.

Ikara includes the iconic Wilpena Pound and is at the core of "Operation Bounceback", a landscape scale ecological restoration program. Recently this has involved reintroducing Quolls and Brush-tailed Possums to areas where they had disappeared. This was only possible after over twenty years of controlling feral cats and foxes. Reduction of these introduced predators has also seen the return of good numbers of Yellow-footed Rock Wallabies.

The expedition will undertake a combination of: (1) revisiting long-established sites to monitor animal and plant responses to environmental change brought about by the Bounceback program, and (2) establishing new survey sites in poorly understood areas of the park.

Accommodation will be in the Shearer's Quarters at Oraparinna Homestead, the Headquarters of the park.

Costs haven't been worked out yet.

To register your interest please phone Trent Porter on 8278 9078 (at home) or email: trentasaurus@bigpond.com. A limited number of student concessions will be available.