BushBlitz
SPECIES DISCOVERY PROGRAM

Great Victoria Desert South Australia

18–27 September 2017

Bush Blitz Species Discovery Program

Australian Government
Department of the Environment and Energy

bhpbilliton
Sustainable Communities

EARTHWATCH INSTITUTE

Australian Biological Resources Study

What is Bush Blitz?

Bush Blitz is a multi-million dollar partnership between the Australian Government, BHP Billiton Sustainable Communities and Earthwatch Australia to document plants and animals in selected properties across Australia.

This innovative partnership harnesses the expertise of many of Australia's top scientists from museums, herbaria, universities, and other institutions and organisations across the country.

Abbreviations

ABRS
Australian Biological Resources Study

ALA
Atlas of Living Australia

ANIC
Australian National Insect Collection

APY
Anangu Pitjantjatjara Yankunytjatjara

CSIRO
Commonwealth Scientific and Industrial Research Organisation

DEWNR
Department of Environment, Water and Natural Resources (now Department for Environment and Water) (South Australia)

EPBC Act
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

NPW Act
National Parks and Wildlife Act 1972 (South Australia)

SHSA
State Herbarium of South Australia

SAM
South Australian Museum

WAM
Western Australian Museum

UNSW
University of New South Wales

Summary

In September 2017, a Bush Blitz expedition was conducted on Maralinga Tjarutja Lands in the Great Victoria Desert, South Australia. The study area included Mamungari Conservation Park and adjacent land. Mamungari Conservation Park, a UNESCO World Biosphere Reserve containing pristine arid zone wilderness, is co-managed with the South Australian Government.

The extreme remoteness of the study area means there had been little previous survey work so the Bush Blitz provided an opportunity to greatly increase the knowledge of the flora and fauna of the region.

Approximately 1638 species were recorded during the Bush Blitz. At least 1114 species had not been recorded previously in the study area (4 reptiles, 1039 invertebrates, 48 vascular plants, 1 bryophyte, 10 fungi and 12 lichens) and 50 of those may be completely new to science (6 bees, 2 wasps, 1 beetle, 8 true bugs, 27 jumping plantlice and 6 spiders). Many unnamed or not formalised invertebrate taxa were collected and these may assist scientists to revise, compare and describe species in the future. Four of the vascular plant species recorded are listed as Vulnerable in South Australia—*Sclerolaena fusiformis*, *Swainsona kingii*, Club Spear-grass (*Austrostipa nullanulla*) and Sandalwood (*Santalum spicatum*).

Some highlights of this Bush Blitz included:

- recording several known insect species for the first time in South Australia, including three wasps, two jewel beetles and a true bug
- recording one vascular plant species and one subspecies that were previously considered endemic to WA
- large range extensions for four reptile species, which altered perceptions of these species' distributions in South Australia
- the collection of high quality specimens of Broad-banded Sand-swimmer (*Eremiascincus richardsonii*) that are likely to become type specimens and contribute to work determining whether this widespread skink includes one or more cryptic species
- the collection of seventy specimens of edible insect larvae.

The only exotic or pest invertebrate species recorded were a Rutherglen Bug (*Nysius vinitor*) and a Cabbage White Butterfly (*Pieris rapae*). This was almost certainly due to the pristine nature of the vegetation—most of the study area had intact native vegetation, free of weeds, or with only a few low-impact taxa. In contrast, five pest mammal species were recorded, including the One-humped Camel (*Camelus dromedarius*) which can cause significant damage to native vegetation.

Only seven weed taxa were recorded, extremely few taxa for such a large area. Most are deemed common and widespread weeds and they were mainly restricted to roadsides. The only weed species found in Mamungari Conservation Park was Sow Thistle (*Sonchus oleraceus*), a very widely distributed alien species of low impact. The most concerning exotic plant species encountered outside the park was Buffel Grass (*Cenchrus ciliaris*), a high priority species and declared weed.

The report suggests land management practices should be aimed at preventing degradation of broad ecosystems/habitat types within the desert environment, and should include fire management and the control of exotic species.

Contents

What is Bush Blitz? **2**

Summary **3**

Introduction **5**

The Great Victoria Desert Bush Blitz 5

Acknowledgements 6

Reserve overview **7**

Description 7

Conservation values 7

Methods **8**

Taxonomic groups studied and personnel 8

Site selection 9

Survey techniques 10

Identification 13

Results **14**

Species lists 15

Discussion **16**

Putative new species 16

Threatened species 19

Exotic or pest species 20

Range extensions 23

Other points of interest 27

Glossary **40**

Introduction

The Bush Blitz program aims to improve our knowledge of Australia's biodiversity. Bush Blitz is an initiative of the Australian Government, through the Australian Biological Resources Study (ABRS), in partnership with BHP Billiton Sustainable Communities and Earthwatch Australia. Bush Blitz aims to:

- promote, publicise and demonstrate the importance of taxonomy through species discovery
- undertake a national species discovery program
- support the science of taxonomy in Australia through training students and early career researchers, and by providing grants for species description and resolution of taxonomically problematic, nationally important groups
- promote partnerships between scientific institutions, government, industry and non-government organisations
- inform reserve managers and other stakeholders of the results of Bush Blitz projects.

This report summarises scientific findings from the Bush Blitz held in the Great Victoria Desert in September 2017.

The Great Victoria Desert Bush Blitz

Modelling conducted by CSIRO for Bush Blitz in 2014 identified the Great Victoria Desert as a priority for biological survey. Experts from South Australia and Western Australia confirmed that the area is of great interest and poorly known to western science, and nominated Mamungari Conservation Park as a particular priority. Maralinga Tjarutja (SA) and Pila Nguru, the Spinifex People (WA), are the traditional owners of Mamungari Conservation Park. Bush Blitz was given permission by Maralinga Tjarutja and Pila Nguru, as well as the Mamungari Conservation Park Co-Management Board, to mount an expedition to Mamungari Conservation Park and adjacent areas of the Maralinga Tjarutja Lands.

There had been heavy rainfall in the study area during the previous summer, and some rainfall over winter, but conditions during the Bush Blitz were rather dry, resulting in less flowering than in a good season. However, the warm spring weather was conducive to activity by reptiles and many other fauna groups.

Bush Blitz provided the logistical coordination and overall leadership for the survey. The South Australian Museum (SAM) and the State Herbarium of South Australia (SHSA) were the host institutions for this Bush Blitz, accessioning specimens into their collections. Experts from the following organisations also conducted field and laboratory work:

- Western Australian Museum (WAM)
- Western Australian Herbarium
- The University of Adelaide
- Flinders University
- La Trobe University
- University of New South Wales (UNSW)
- Alinytjara Wilurara NRM
- Department of Environment, Water and Natural Resources (South Australia) (DEWNR)

Acknowledgements

The ABRS acknowledges the traditional owners of country throughout Australia and their continuing connection to land, sea and community. We pay our respects to them and their cultures and to their elders both past and present.

The study area holds great significance for the Spinifex People (Pila Nguru) and traditional owners affiliated with Maralinga Tjarutja.

The Bush Blitz team consisted of Brian Hawkins, Megan Donaldson, Tyrie Starrs, Rebecca Harris and Sue Fyfe. They would like to thank the Maralinga Tjarutja and Pila Nguru, traditional owners from Oak Valley and Tjuntjuntjara communities, especially the Spinifex Rangers, and Alinytjara Wilurara NRM. Traditional owners provided access to land, performed cultural clearances of sites, helped with camp setup and assisted with fieldwork. In particular, the team would like to thank the following people for their generous support and assistance—Sam Doudle, Shane Doudle, Brett Backhouse, Jamal Lebois, Jeremy Lebois, Pia Richter, Vaughn Waye, Ian Baird, Bruce Macpherson, Wayne Madden, Sharon Yendall and Roger Williams.

Pilots Tim Anderson and Clayton Hampshire, along with Erin Gibson from Helifarm, did a great job getting participants to and from survey sites.

Finally, the team would like to thank Robbie Bayliss and Paul Doolan for their excellent catering and open-air cinema.

Reserve overview

Name: Mamungari Conservation Park and adjacent Maralinga Tjarutja Land, Great Victoria Desert, SA

Area: approximately 4,800,000 ha

Description

Mamungari Conservation Park covers over 2,100,000 hectares of the arid western margin of South Australia. It is an inverted 'L' shaped park with a latitudinal and longitudinal scope that incorporates a section of the stark limestone plains of the Nullarbor Plain, the ancient palaeo-channels of the Serpentine Lakes and extensive dune fields that run across the heart of the Great Victoria Desert.

This environment supported a fully nomadic population of Anangu until as recently as the 1950s and Anangu living in the adjacent communities retain knowledge of the natural resources of the park. There has been little environmental change since the area was permanently occupied and the area is still used and managed by Anangu in a customary way as they travel through, forage and camp within the park.

Conservation values

Mamungari Conservation Park is one of the most remote continental conservation areas on the planet and consequently has high wilderness values. It is one of the least altered landscapes in the region and consists of a semi-desert dune system, with low dunes up to 20 m high and up to 100 km long with clay pans, and saline areas in lakebeds. In 1977, Unnamed Conservation Park, as it was then known, was listed as a UNESCO World Biosphere Reserve. The park was handed back to Maralinga Tjarutja in 2004, as the first co-managed park in South Australia, and was later renamed Mamungari Conservation Park.

Mamungari Conservation Park, together with the surrounding lands, has played a critical role in the evolution and dispersal of many of southern Australia's unique flora and fauna species. It is likely to play a significant role in the continued survival and evolution of many of these species in the face of significant increasing pressures associated with climate change.

The 2011 Mamungari Conservation Park Management Plan refers to over 270 plant species, including nine plants listed as Rare or Vulnerable and one species previously thought to have been extinct. Vegetation is distributed in six major vegetation associations including open Marble Gum (*Eucalyptus gongylocarpa*) woodland, that is restricted to the Great Victoria Desert, and a unique geo-botanical association of Black Oak (*Casuarina cristata*).

The remoteness of the park supports a poorly known fauna that includes several threatened species. The management plan notes that over 120 species of birds have been recorded for the area, including the Scarlet-chested Parrot (*Neophema splendida*), Princess Parrot (*Polytelis alexandrae*) and Malleefowl (*Leipoa ocellata*) (nganamara*). Mammals include the Central Marsupial Mole (*Notoryctes typhlops*) (itjaritjari*), Hairy-footed Dunnart (*Sminthopsis hirtipes*) (mingkiri*) and, possibly, the Sandhill Dunnart (*Sminthopsis psammophila*) (mingkiri kutjarpa*). The Mamungari Conservation Park is also known to support a high diversity of reptile species with 42 species identified within the region in 2011.

* Anangu name

Methods

Taxonomic groups studied and personnel

A number of taxonomic groups were selected as targets for study. Table 1 lists the groups surveyed and the specialists who undertook the fieldwork, made identifications and reported on the findings.

Table 1 Taxonomic groups surveyed and personnel

Group	Common name	Expert	Affiliation
Vertebrates	Mammals and reptiles	Mark Hutchinson	SAM
		Paul Doughty	WAM
		Dave Armstrong	DEWNR
		Dave Stemmer	SAM
Hymenoptera	Bees	Remko Leijs	SAM
	Wasps	Ben Parslow	Flinders University
		Erinn Fagan-Jeffries	The University of Adelaide
Lepidoptera	Butterflies and moths	Mike Moore	SAM
Coleoptera, Diptera, Neuroptera, Homoptera, orthopteroid orders	Beetles, flies, lacewings, leafhoppers and froghoppers	Richard Glatz	SAM
Buprestidae	Jewel beetles	Peter Lang	SHSA
Heteroptera	True bugs	Marina Cheng	UNSW
Psylloidea	Jumping plantlice	Gary Taylor	The University of Adelaide
Odonata	Dragonflies	Nik Tatarnic	WAM
Edible insects	Maku	Conrad Bilney	La Trobe University
Arachnida	Spiders and scorpions	Mark Harvey	WAM
Vascular plants, bryophytes, lichens and macrofungi		Peter Canty	SHSA
		Peter Lang	SHSA
		Jürgen Kellermann	SHSA
		Ryonen Butcher	Western Australian Herbarium

The Bush Blitz team would also like to acknowledge the contributions of the following people:

- Katja Hogendoorn (The University of Adelaide) assisted with native bee identifications.
- Gerry Cassis (identifications, data management and report author) and Ryan Shofner (identifications and photography) from UNSW assisted with Heteroptera.

- Susan Lawler and Michael Shackleton, from La Trobe University, supervised Conrad Bilney's PhD on edible insects and assisted him with reporting.
- Julianne Waldock from WAM assisted with identification and report writing for arachnids and myriapods.
- Robyn Barker, Bill Barker, Laurie Haegi, Martin O'Leary, Helen Vonow, Molly Whalen (all SHSA), Kelly Shepherd (Western Australian Herbarium) and Philip Short (Australian National Herbarium) contributed vascular plant identifications.
- Graham Bell undertook bryophyte and lichen identification, Chris Brodie undertook weed identification and Pamela Catcheside undertook fungi identification (all SHSA). Other SHSA staff who contributed were Ainsley Calladine (data processing), Chelsea Tothill and Kat Ticli (specimen and data processing), and Michelle Waycott (edit and review of SHSA report).
- D.C. Cargill (Centre for Australian National Biodiversity Research) examined liverwort specimens.

Site selection

All scientists surveyed two standard survey sites, selected by Bush Blitz using modelling prepared by CSIRO. Each standard survey site was centred on a point (permanently marked), but the actual area surveyed varied between taxa. Standard methodologies were used to sample these sites.

The use of standard survey sites provides a unique opportunity to examine broad-spectrum biodiversity. Among other benefits, this will enable Bush Blitz's partners at CSIRO to test assumptions that underpin many conservation decisions (e.g. assumptions about relationships between the diversity of different taxa). It will also allow comparisons between sites, and establish a basis for future monitoring by reserve managers.

The standard survey sites were chosen to reflect the influence of time since fire—Standard Survey Site 1 was located in a recently burnt area and Standard Survey Site 2 in a long unburnt area. However, it should be noted that there is significant potential variation due to a multitude of factors including weather on the day of surveying, vegetation species mix and distribution, and trapping methods used.

Apart from standard survey sites, site selection and collection methods were left to the discretion of the individual scientist. Site selection depended on access, suitability for trapping and time restrictions. Further considerations included:

- Vertebrate sites were selected that included the major structural and vegetation combinations, a recently burnt area, and the effects of soil types and sand dune structuring, with traps on various sand-clay combinations in swales and on soft dune shoulders and crests. Bat traps were set up at most vertebrate sites (those that had tall trees) and at five other locations chosen for suitable tree cover.
- Bee sites were selected to sample as many different vegetation types and areas with different fire history as possible, particularly sites with a large variety of flowering plant species.
- Wasp sites were selected to sample as many different vegetation types as possible. Wasps can be found in a multitude of habitat types and at different stages of development, including adult insects attracted to floral resources or intercepted in transit, and immature stages in or on hosts located on vegetation and substrates. Over 60 different locations were sampled.
- Moth sites were chosen where known host plants were obvious or where many plants were in flower. Moths need host plants for caterpillars to grow and develop, and nectar plants for adults to feed on—for many species these associations can be very specific.

- Edible insect sites were selected daily by the traditional owners.
- Lerp insect and 'psyllid' sites were based on different habitats, concentrating on areas of diverse vegetation types. Due to high host specificity recorded for the Psylloidea, individual plant species at each site were selected and sampled. A sampling unit was determined as an individual plant, or group of plants of the same species in close proximity (within 20 m), at the same locality.
- For general invertebrates, collecting in vehicles was limited to open tracks (100 m each side on foot). Sites distant from tracks (to be accessed by helicopter) were selected prior to the Bush Blitz. Fire was considered the most influential gradient affecting vegetation in the area. Some sites were pre-selected based on fire history and vegetation, to sample a range of vegetation types and ages, as well as significant land features such as salt lake margins. Other sites were chosen by observation during vehicle travel to cover a range of vegetation types and landforms.
- Jumping plantlice sites were selected to survey a broad range of habitats.
- Arachnid site selection was designed to access as many different landforms as possible, including sand dunes, saltbush, salt lakes and rocky breakaways.
- A few flora sites were selected based on the CSIRO model. Site selection also considered land systems and vegetation community types in the region, along with geology and soil types. The botany team aimed to spread survey sites across Mamungari Conservation Park and the Maralinga Tjarutja Lands to maximise collections from different plant communities, fire histories, soil types and moisture gradients. During the pre-Bush Blitz field work, desktop survey, satellite imagery and maps were studied. Sites were chosen in which different habitats occurred in close proximity. Other priority areas were clay pans, salt lakes, and escarpments with rocky slopes and small sheltered gullies with more mesic environments that are likely to support species of restricted distribution and endemic taxa. Locations that were only accessible by helicopter and away from roads and tracks were also prioritised. The list of potential collection sites was expanded during the Bush Blitz, through decisions in the field and information provided by traditional owners. Collections were made at 96 sites.

Site locations were recorded using global positioning systems.

Survey techniques

A standard suite of survey techniques was used:

- **Vertebrate** survey techniques were based on live trapping at 11 designated sites. At each site a 30 m fly-wire mesh drift fence was established, along which were six pitfall traps. Pitfall traps were of two sizes—a standard size trap approximately 20 cm in diameter and 40 cm deep, and a large size trap with approximately double these dimensions. The larger traps were employed at softer sandier locations thought to be potential sites for the capture of larger, more agile small mammals (hopping mice, larger dunnarts). Along each drift fence, six funnel traps were also placed. Adjacent to each drift fence line, a series of 15 Elliott aluminium box traps, baited with peanut butter and rolled oats, were laid out. Live trapping for bats employed harp traps (Faunatech), of which four were available for the survey, allowing multiple sites to be trapped.

  In addition to trapping, reptiles were also collected by hand. Day-active species were located by sight and caught by hand or by fishing line noose on a 3 m fishing rod. Cryptic species were searched for in litter and *Triodia* using rakes or moving embedded ground cover. Nocturnally active species were searched for at night using focusing beam head torches.

  Indirect survey methods were also used. Adjacent to each bat trap 'Anabat' recording devices were installed to collect the calls of bats that were active in the area. Scientists surveyed for signs of

Central Marsupial Mole (*Notoryctes typhlops*), by establishing two 'mole trenches'. They revisited these sites over several days to observe cross sections of burrows intersected by the trenches.

All handling and surveying protocols were approved under animal ethics and scientific research permits obtained prior to the survey. At standard survey sites, all these survey methods were employed except the mole trench.

- **Wasps** were sampled using passive flight intercept traps, sweep-netting, direct visual sighting and aspiration off vegetation, active collecting at a light sheet and a vehicle-mounted insect net for parasitoid wasps. Two types of flight intercept traps were used, Townes-style malaise and SLAM vane traps. These were deployed in natural flight corridors around flowering plants. The traps were deployed for an average of seven days at a site before being relocated. Active searching and sweep-netting of wasps at flowering plants and among a variety of vegetation types was also carried out, as well as using a vehicle net for collecting startled and flying insects during transit.

  Both standard survey sites were sampled by sweep-netting available vegetation across an approximate 100 m^2 area. A Townes-style malaise trap was set up at each standard survey site for the duration of the survey. At Standard Survey Site 2, a light sheet was used and yellow pan traps were set up for a seven-hour period.
- **Bees** were mostly collected individually using a hand net, by sweep-netting of specific plants, using blue vane traps, malaise traps and using a vehicle net. Plant species on which the bees were collected were recorded. At standard survey sites, blue vane traps and hand-netting of flowering plants were the techniques used.
- **Butterflies** were collected with an entomological collecting net (1500 mm handle length, 450 mm net diameter). They were either swept out of the air in mid-flight using a largely horizontal motion or netted when on the ground or plant, using a largely vertical motion. The specimen was trapped in the end of the net and then given a "thoracic squeeze." This action removes air from the internals of the specimen and either kills them, in the case of small species, or stuns them, in the case of larger ones. The specimens were then transferred to a clean dry bottle and stored in the dark until they could be frozen to ensure death of the specimen.
- **Moths** were collected using a light trap. This involved using two white "queen-sized" bed sheets laid side by side upon a waterproof "tarp" that was itself laid upon the ground. On the first night, UV LED strips were used at base camp but on other nights, a 400 W halogen light was placed in the middle of the "sheet" attached via a power lead to a small four-stroke petrol generator. Moths were attracted to the light and specimens were picked off the sheet and placed in killing jars charged with 30% ethyl acetate—this killed the specimens quickly so they would not damage themselves in the process of dying. The light traps were only run for 3–4 hours per night. Ideally, the trap would have been run all night, as the variety of species usually varies with the time of night, however, this was not done due to a consideration of the next day's activities. When dead, the specimens for the day were placed in layers separated by tissue paper in a flat plastic container and packed with tissue paper to stop specimen movement and to absorb any excess water. A plastic container per day was used. Relevant collection information was placed in with the specimens. The "daily catch" containers were placed in a fridge-freezer operating at -17°C. On return to SAM, the moths were briefly thawed, an insect pin pushed through the thorax and they were refrozen. The pin makes handling much easier. Light traps were run on five of the nine collecting nights.
- **Edible insect (maku)** collection involved digging up the soil using a digging stick or shovel and breaking off root fragments suspected of having larvae within. When large numbers were in one host plant species, the head capsule widths of specimens were measured to see if the number of instars could be calculated. The location and host plant species of specimens collected were recorded. Grubs retained for further examination were preserved in 70% ethanol for later DNA extraction and sequencing to identify each species.

- **General insect** collection was carried out using a variety of methods:

  Insect net: either by sweeping vegetation or catching insects that were observed. Smaller specimens were gathered from the net using an aspirator.

  Light: two types of attractant light—UV LED and mercury vapour—were used to capture insects at a range of sites. Insects were also attracted to incandescent light at base camp.

  Blue pan trap: a small blue pan containing water and detergent was placed on the ground to catch opportunistic visitors or those that were attracted to the colour of the trap.

  Blue vane traps: vanes of blue plastic (two at 90˚ to each other) placed above a funnel leading into a dry collecting bottle (1 L volume) below. These traps primarily capture flying insects that are attracted to the colour of the vanes.

  Malaise trap: a structure made of insect netting supported with poles and guy ropes. The trap was set amongst vegetation to intercept walking or flying insects, some of which crawled up the walls of the trap and were funnelled into collecting bottles filled with ethanol.

  Vehicle net: a net (supported by a metal frame and guy ropes) was attached to the top of a vehicle. The net was about as wide as the vehicle and approximately square at the entrance. When the vehicle was driven, the net opened and sampled insects in flight or on vegetation clipped by the net. Insects were collected into a "capture-bag" at the apex of the net.

  Bark pulling: bark was pulled from trees and an insect net placed below to catch any insects that fell.

  Vertebrate traps: opportunistic insect captures occurred in pitfall traps set to capture mammals or reptiles and harp traps set to capture bats.

  Manually: some opportunistic captures were simply made by hand or with a vial jar. This was the preferred method for some delicate or large specimens.

  A subset of these methods was applied to the two standard survey sites—sweeping with an insect net, Malaise trap, light, vertebrate traps and manual capture.
- **Jewel beetles** were collected by opportunistic sweeping of potential host plants using an insect net, hand collection from the ground of beetles attracted to light at night (*Merimna*), hand collection from flowers (*Neospades*), blue vane traps, blue pan traps, and a vehicle net. Blue vane traps were used at the standard survey sites.
- **Heteroptera** specimens were collected primarily by beating or sweeping vegetation, focusing on flowers, fruits and seeds. Specimens were also obtained by direct collecting, general collecting and light trapping. At standard survey sites, consistent with previous heteropteran Bush Blitz surveys, beating or sweeping of vegetation took place for one hour.
- **Jumping plantlice** were collected by sweep-netting one particular plant species at each site, due to host specificity of many psyllids and to record host data. This means that sampling was generally restricted to one plant specimen (if sufficiently large) but may have included up to 20 plant specimens in an area of up to 20 m x 20 m, including additional plant species. At standard survey sites, Malaise traps were set but this is generally a poor method for collection of psyllids.
- **Arachnids and myriapods** were mainly collected by manual searching. This included searching under rocks, under the bark of trees, sweeping vegetation and searching for burrows in the ground. Most work was conducted during the day, although night collecting was conducted at several sites, including the standard survey sites, to search for nocturnal spiders. Leaf litter lying on the ground was sifted at several sites. Specimens were also collected in traps set for other taxa, particularly the large pitfall traps used by the vertebrate team.
- **Vascular plants, bryophytes, lichens and macrofungi** collections were made of individuals bearing fertile structures (buds, flowers, fruits, sporangia, apothecia). Specimens were photographed *in-situ* to record important features and habitat. Gatherings were made either of one or more entire individuals (small herbaceous plants) or portions of stems bearing representative foliage, flowers,

etc. Plant specimens were collected when a taxon was first encountered in suitable condition. Additional specimens at other locations were collected, if they were of superior quality (i.e. had flowers and/or fruits when the first specimen did not) or were of particular interest. Leaf tissue subsamples were taken for nearly all samples. Leaves were collected from a single branch into empty, unused 'tea bags', and then stored in containers of silica gel for rapid desiccation. These vouchered samples are stored at the SHSA for use with genetic and other molecular research projects, such as DNA sequencing for phylogenetic analyses, or other tissue analyses. Where possible, sufficient material was collected to prepare duplicate specimens to be sent to the Western Australian Herbarium. Soil crust lichens were collected with the associated soil to which they were attached. Saxicolous lichens were collected with the associated rock. Opportunistic collections were also made by botanists *en route* to survey sites, and zoologists also provided a few collections from their sites. At the standard survey sites a full floristic inventory was recorded within a 20 m x 20 m quadrat. Voucher specimens were collected for every vascular plant species found within the quadrats.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria. Fauna specimens were deposited in the SAM collection. Vascular plants, bryophytes, lichens and fungi were deposited in the SHSA. All specimen data from Bush Blitz expeditions are entered into the holding institution's database. These data are uploaded to the public databases Australasian Virtual Herbarium and Online Zoological Collections of Australian Museums, and are available through the Atlas of Living Australia (ALA) portal.

Results

Locational data for all flora and fauna records are available to reserve managers. At least 1114 species were new records for the park (some results are yet to be finalised), including 50 putative new species—these await formal identification. Four threatened plant species, seven pest animal species and seven exotic weed species were recorded.

Table 2 Summary of flora and fauna records

Group	Common name	Total species recorded	Species newly recorded for reserve	Putative new species	Threatened species*	Exotic and pest species**
Mammalia	Mammals	19	0	0	0	5
Aves	Birds	67	0	0	0	0
Reptilia	Reptiles	53	4	0	0	0
Hymenoptera	Bees	157	157	6	0	0
	Wasps	232	232	2	0	0
Lepidoptera	Butterflies and moths	86	86	0	0	1
Trichoptera	Caddisflies	1	1	0	0	0
Diptera	Flies	109	108	0	0	0
Coleoptera	Beetles	171	122	1	0	0
Neuroptera	Lacewings	12	4	0	0	0
Hemiptera	Leafhoppers and planthoppers	55	53	0	0	0
	True bugs	167	167	8	0	1
	Jumping plantlice	43	43	27	0	0
Orthoptera	Grasshoppers and crickets	32	1	0	0	0
Embioptera	Web-spinners	2	2	0	0	0
Blattodea	Cockroaches	11	9	0	0	0
Mantodea	Mantids	4	0	0	0	0
Phasmida	Phasmids	1	0	0	0	0
Myriapoda	Centipedes	3	2	0	0	0
Arachnida	Spiders	49	46	6	0	0
	Scorpions	5	5	0	0	0
	Pseudoscorpions	1	1	0	0	0

Group	Common name	Total species recorded	Species newly recorded for reserve	Putative new species	Threatened species*	Exotic and pest species**
Vascular plants		319	48	0	4	7
Bryophytes		9	1	0	0	0
Fungi		12	10	0	0	0
Lichens		18	12	0	0	0
Total		1638	1114	50	4	14

* Species listed as Threatened under the Commonwealth EPBC Act or under State legislation.
** Includes native species that at times are pests or are exotic to this region.

Species lists

Lists of all species recorded during the Bush Blitz are provided in Appendix A. Species lists were compiled using data from participating institutions. Lists of species previously known to occur in the study area were provided for some taxonomic groups but not others so this should not be considered a complete species list for the study area.

Some specimens were only able to be identified to family or genus level. This is partly because identification of specimens is very time-consuming, with detailed microscopic examination needed in many cases. Also, some groups are 'orphans': currently no experts are working on them, or are available to work on them, and the taxonomic literature is out of date; species-level identification is not possible for these groups. Unidentified Bush Blitz specimens are held in institutional collections where they are available for future study. Collections hold many such specimens, among them species not yet described (i.e. unnamed species) as well as described species that have not been identified. For example, ANIC holds tens of thousands of unidentified specimens. Specimens often wait decades before the resources become available for their study. A key component of Bush Blitz is the funding of studies of specimens collected on Bush Blitz surveys.

Nomenclatural and taxonomic concepts used in this report are consistent with the Australian Faunal Directory, Australian Plant Name Index, Australian Plant Census, AusMoss and The Catalogue of Australian Liverworts and Hornworts.

Discussion

Putative new species

Here we use the term 'putative new species' to mean an unnamed species that, as far as can be ascertained, was collected for the first time during this Bush Blitz. It is confirmed as a new species once it is named and its description is published. Specimens collected during the Bush Blitz also include unidentified taxa that are already known from museum and herbarium collections—these are not counted as putative new species.

Fauna

Invertebrates

At the time of reporting approximately 30% of the general insect specimens collected were still waiting to be sorted and given an initial classification. There are likely to be a range of new species within the collections made, particularly within the Diptera and Homoptera (leafhoppers and psyllids), and to a lesser degree from Coleoptera. Despite dry conditions, these three groups yielded 378 species. It is likely that each of these groups contains a range of species new to science that will be revealed in the coming months and years as further work continues. Different taxonomic groups have been sent to various experts around Australia to facilitate new species discoveries and better classify the survey material in general.

Bees

At least six putative new species have been recognised from the specimens collected. It is likely that further examination of unidentified native bee specimens will result in the recognition of additional new species in the genus *Leioproctus*.

Wasps

Two wasp species have been described using specimens collected during this Bush Blitz. Other new species of parasitic wasp are expected to have been collected—not all recognised morphospecies of parasitic wasps had been comprehensively identified at the time of reporting as there are large knowledge gaps, with available keys and expertise only available for some groups.

Jewel beetles

Paracephala "Nurrari Lakes" is a possible new species. The single diminutive specimen collected from a pitfall trap near Nurrari Lakes could not be identified with certainty. It comes closest to *Paracephala hesperia* (a Western Australian species not recorded from South Australia) but differs in its broader pronotum and cordate to scutellate scutellum. It also resembles *Meliboeithon* in some features, but has only a feeble longitudinal depression rather than the deep groove on the frons diagnostic of that genus.

True bugs

Eight heteropteran species, from three families, are recognised as putatively new to science.

Jumping plantlice

Only nine of the 43 species of psyllid collected are described. At least 27 are new to science and the status of the remaining seven species remains to be elucidated. Bush Blitz funding has been provided to assist with the description of eight of the new *Acizzia* species.

Spiders

Six putative new species of spider were collected during the Bush Blitz. These included two small mygalomorph spiders from the genus *Cethegus*—one was collected from two sites and the other from a single site in saltbush. A small, dark gnaphosid spider was caught at the main camp, feeding on ants. A large spiny *Idiosoma* trapdoor spider was collected at several sites, where it constructed a burrow in the ground with a thick lid. Males of a dark *Aname* trapdoor spider were collected at two sites. A small zodariid spider, collected at base camp at night, may represent a new genus.

Table 3 Putative new invertebrate species

Family	Species
Bees	
Colletidae	*Hylaeus (Hylaeteron)* sp.VDRL037 n.sp.
Colletidae	*Hylaeus (Hylaeteron)* sp.VDRL055 n.sp.
Colletidae	*Leioproctus (Cladocerapis)* sp.VDRL011 n.sp.
Colletidae	*Leioproctus (Colletellus)* sp.VDRL017 n.sp.
Halictidae	*Lasioglossum (Chilalictus)* sp.VDRL116a n.sp.
Halictidae	*Lasioglossum (Chilalictus)* sp.VDRL131 n.sp.
Wasps	
Braconidae	*Dolichogenidea garytaylori*
Braconidae	*Dolichogenidea kelleri*
Jewel beetles	
Buprestidae	*Paracephala* “Nurrari Lakes”
True bugs	
Miridae	*Austromiris* sp_BBGVD17_msp052
Miridae	Gn_ms_"Austrotylus" sp_BBGVD17_msp055
Miridae	Gn_ms_"Irymplea" sp_BBGVD17_msp071
Miridae	Gn_ms_”Rankiniella” sp_BBGVD17_msp044
Miridae	*Myrtlemiris* sp_BBGVD17_msp105
Miridae	*Ommatodema* sp_BBGVD17_msp003
Pentatomidae	*Thryptomenocoris* sp_BBGVD17_msp023

Family	Species
True bugs (continued)	
Tingidae	*Nethersia* sp_BBGVD17_msp015
Jumping plantlice	
Psyllidae	*Acizzia* sp.1
Psyllidae	*Acizzia* sp.2
Psyllidae	*Acizzia* sp.3
Psyllidae	*Acizzia* sp.4
Psyllidae	*Acizzia* sp.5
Psyllidae	*Acizzia* sp.6
Psyllidae	*Acizzia* sp.7
Psyllidae	*Acizzia* sp.8
Psyllidae	*Acizzia* sp.9
Psyllidae	*Acizzia* sp.10
Psyllidae	*Acizzia* sp.11
Psyllidae	*Acizzia* sp.12
Psyllidae	*Acizzia* sp.13
Psyllidae	*Acizzia* sp.14
Psyllidae	*Acizzia* sp.15
Psyllidae	*Acizzia* sp.16
Psyllidae	*Acizzia* sp.17
Psyllidae	*Acizzia* sp.18
Psyllidae	*Acizzia* sp.19
Psyllidae	*Acizzia* sp. FMS2
Psyllidae	*Acizzia* sp. FMS3
Psyllidae	*Acizzia* sp. FMS4
Psyllidae	*Acizzia* sp. FMS6
Psyllidae	*Acizzia* sp. FMS7
Psyllidae	*Acizzia* sp. FMS8
Triozidae	*Triozidae* new genus 1 species 1

Family	Species
Jumping plantlice (continued)	
Triozidae	*Triozidae* new genus 1 species 2
Spiders	
Dipluridae	*Cethegus* 'GVD MYG001'
Dipluridae	*Cethegus* 'GVD MYG002'
Gnaphosidae	*Eilica* 'GVD ARA002'
Idiopidae	*Idiosoma* 'GVD MYG004'
Nemesiidae	*Aname* 'GVD MYG006'
Zodariidae	Zodariidae 'BB-GVD gen. 1, sp. 1'

Threatened species

Australia is home to an estimated 580,000–680,000 species, most of which have not been described. Approximately 92% of Australian plants, 87% of mammals, 93% of reptiles and 45% of birds are endemic. Changes to the landscape resulting from human activity have put many of these unique species at risk. Over the last 200 years, many species have gone extinct; many others are considered to be threatened, i.e. at risk of extinction.[1]

Flora

Vascular plants

Four vascular plant species recorded during the Bush Blitz are listed as Vulnerable under the *National Parks and Wildlife Act 1972* (South Australia) (NPW Act). Sandalwood (*Santalum spicatum*) is threatened due to illegal harvesting for the fragrant properties of its timber. Although widespread in the arid zone, Sandalwood appears to have suffered a major decline in many parts of its range, probably due to the combined impacts of harvesting and browsing of seedlings by stock and feral animals.

A further six species are scheduled as Rare under the NPW Act, but this status does not necessarily indicate that the species is threatened in South Australia, and there is no corresponding category under the EPBC Act. These are *Acacia helmsiana*, Sand Lily (*Corynotheca licrota*), *Eragrostis lacunaria*, *Eucalyptus canescens* subsp. *beadellii*, *Eucalyptus wyolensis* and *Frankenia cinerea*. Sand Lily is typically found in deep sand, often on the crests of dunes, and has a wide range on this habitat within South Australia. It is probably often overlooked when not in flower and is thus likely to be more common than the limited number of collections would suggest. It is also under consideration for de-listing in South Australia.

[1] Chapman, A. D. 2009, Numbers of Living Species in Australia and the World, 2nd edn. Australian Biological Resources Study, Canberra.

Table 4 Threatened flora species

Family	Species	Listing status	Comments
Chenopodiaceae	*Sclerolaena fusiformis*	Vulnerable (NPW Act)	One patch of about 50 plants
Fabaceae	*Swainsona kingii*	Vulnerable (NPW Act)	Rare, sparsely scattered; less than 50 plants seen at one site and less than 20 at the other
Poaceae	*Austrostipa nullanulla*	Vulnerable (NPW Act)	Locally common at one site; occasional at second site where it was restricted to a kopi (gypseous) lunette
Santalaceae	*Santalum spicatum*	Vulnerable (NPW Act)	Single plant at one site with four others seen further north along the track

Exotic or pest species

Fauna

Vertebrates

Five vertebrate pest species were recorded during the Bush Blitz. While the native vegetation in the study area was generally in very good condition, the impact of camels was obvious and extremely widespread. Observations from the helicopter showed extensive tracks in many interdunes, salt lakes and drainage depressions. Observations on the ground of footprints, dung and scrapes confirmed that these tracks were made by camels. Some shrubs and trees, including Quandong (*Santalum acuminatum*), showed evidence of severe browsing damage by camels. Camels cause significant damage to native vegetation and should be controlled where possible. The only evidence of rabbit impact was the observation of some old warrens on gypseous lunettes and margins of clay pans.

Table 5 Exotic or pest mammal species

Family	Species	Common name	Comments
Camelidae	*Camelus dromedarius*	One-humped Camel	Sighted from helicopter and on road by many participants at several locations; due to recent culls, numbers relatively low;
Canidae	*Vulpes vulpes*	Red Fox	
Felidae	*Felis catus*	Cat	Sighted at night during spotlighting at several locations

Family	Species	Common name	Comments
Leporidae	*Oryctolagus cuniculus*	Rabbit	Present at low abundance, except for some areas around the Serpentine Lakes where warrens were common and sometimes extensive
Muridae	*Mus musculus*	House Mouse	The most commonly trapped small mammals; numbers possibly due to good rains earlier in the year

Invertebrates

Single specimens of Rutherglen Bug and the exotic Cabbage White Butterfly were recorded. Rutherglen Bug is a native true bug that is a pest of numerous crops across Australia. This low level of exotic and pest species was undoubtedly due to the pristine nature of the vegetation.

Table 6 Exotic or pest invertebrate species

Family	Species	Common name	Comments
Lygaeidae	*Nysius vinitor*	Rutherglen Bug	Single specimen collected
Pieridae	*Pieris rapae*	Cabbage White Butterfly	Single specimen seen but not collected; flying downwind N-S at Serpentine Lakes; may have originated far to the north in altered habitat

Flora

Vascular plants

Most of the area surveyed had intact native vegetation, free of weeds, or with only a few low-impact taxa. All weed taxa seen within the study area were collected and documented. Details for all weed taxa recorded in the study area are listed in Table 7. Only seven weed taxa were recorded, extremely few taxa for such a large area. Most are deemed common and widespread weeds and were mainly restricted to roadsides. The only weed species found in Mamungari Conservation Park was Sow Thistle (*Sonchus oleraceus*), a very widely distributed alien species of low impact.

The most concerning exotic species encountered was Buffel Grass (*Cenchrus ciliaris*), a high priority species and declared weed. The Maralinga Tjarutja Lands are almost free of this species and eradication of these small infestations as soon as possible is highly advisable. Buffel Grass has had major ecological impacts in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands to the north and it is highly desirable to prevent further spread of this invasive species to the south. Buffel Grass was collected at two locations: on the main access road to Oak Valley and on the southern extension of the Rodinia Track. The latter occurrence, comprising two individuals on the road verge, is of interest because it is a less frequently used route.

Also of particular concern is Saffron Thistle (*Carthamus lanatus*), collected on the verge of the main road, since it has not previously been collected from the Great Victoria Desert area. It appears to be an isolated outbreak and is worth eradicating.

Ward's Weed (*Carrichtera annua*) was observed more extensively along sections of this road and appeared to be restricted to the road verges. It is unclear whether this restriction was just a seasonal effect, but the species has the potential to cover large areas of non-sandy habitats. It needs further investigation.

Like Saffron Thistle, Wild Sage (*Salvia verbenaca*) is a concern because it has not previously been collected from the Great Victoria Desert area. It may be a small roadside outbreak that can be controlled before it spreads further.

Colocynth (*Citrullus colocynthis*) was detected and removed from several locations on the main (northern) Rodinia Track, but still remains at others. Follow up visits to this section of the track are recommended.

Weeds should be monitored and any significant population spread or increase, especially in areas of high traffic, controlled to reduce the possibility of further spread. Advice on feasibility and methods of control for individual taxa should be sought from Alinytjara Wilurara NRM.

Table 7 Weeds

Family	Species	Common name	Comments
Asteraceae	*Carthamus lanatus*	Saffron Thistle	Only observed at one location, with a few hundred plants
Asteraceae	*Sonchus oleraceus*	Sow Thistle	Very sparsely scattered in low numbers
Brassicaceae	*Brassica tournefortii*	Wild Turnip	Occasional on roadsides and drainage depressions
Brassicaceae	*Carrichtera annua*	Ward's Weed	Locally abundant on small sections of main road; unclear whether this annual is in an early stage of invasion due to road works, or was limited by seasonal conditions to areas where water accumulates
Cucurbitaceae	*Citrullus colocynthis*	Colocynth	Sparsely scattered along road verges
Lamiaceae	*Salvia verbenaca* var. *vernalis*	Wild Sage	Localised occurrence on road verge of thousands of plants
Poaceae	*Cenchrus ciliaris*	Buffel Grass	Observed on roadsides; a highly invasive plant in need of control

Range extensions

Fauna

Vertebrates

Reptiles

Virtually all of the species recorded had not been previously noted within the areas visited. This is due simply to the remoteness of the area and lack of previous survey work. The broader area to the north, along the Anne Beadell Highway and south of Vokes Hill, and southeast around Oak Valley and Maralinga had been surveyed and most of the species recorded from these regions are now also known from the study area. Many of these records would be technical small range extensions southward but, overall, patterns of distribution of many species are not firmly enough established to make such small-scale claims significant.

Only four species are genuinely new to the area. These four reptile species, listed in Table 8, had large range extensions, which altered perceptions of these species' distributions in South Australia.

A number of other species are notable as they represent second occurrences of species previously thought to have only a marginal presence in the nearby areas. New records help to establish these species as being typical of a larger area of the Great Victoria Desert and South Australia than was previously the case. Included in this group are the Black-collared Dragon (*Ctenophorus clayi*) the skinks *Ctenotus calurus*, *Ctenotus dux*, *Lerista bipes* and *Lerista taeniata*, and the snake *Simoselaps anomalus*.

Historic records for all species were sourced from the SAM database and Vertebrate Census of South Australia which are based on voucher specimens held at the SAM or confirmed sightings compiled by DEWNR. Most of these records date to no older than 1980 and are accompanied by GPS-quality location information. A few older records have less precise data and were excluded.

Invertebrates

Due to the large number of taxa collected, the very small amount of previous work on invertebrates in the area and the lack of a single repository for distribution information, it is time consuming and difficult to ascertain the true degree of range extensions with accuracy. However, most of the species recorded in the area for the first time are likely to be significant range extensions of hundreds of kilometres simply because of the limited sampling that has occurred. Specific range extensions have mostly not been identified for the significant number of new records that occurred.

Parasitic wasps

Several species of wasp were found in South Australia for the first time. *Miropotes goobitis* has been tentatively identified from specimens collected on the survey. If this identification is confirmed, this is a large infill in the distribution of the species, otherwise known to occur in southern Western Australia, the Northern Territory and Queensland, but not yet recorded for South Australia.

Butterflies and moths

The collections of Rayed Blue (*Candalides heathi)* and Amethyst Hairstreak (*Jalmenus icilius)* were the most westerly in South Australia, and *Eremophila gilesii* is probably a new food plant for Rayed Blue in South Australia.

Jewel beetles

Among the 12 species newly recorded for the study area, two were new to South Australia, being range extensions of known Western Australian species. The first South Australian collection of *Castiarina octopunctata* is a female and its identity can be confirmed by the distinctive acutely lobed proctiger that is diagnostic for females of the species. It represents a major disjunction for a species that until now has been regarded as endemic to Western Australia.

True bugs

There was a considerable range extension of *Myrtlemiris tesselatus*, which was previously thought to be endemic to south-western Western Australia. The species was found at two localities during the Bush Blitz and was collected from a host plant of the myrtaceous tribe Chamelaucieae.

Jumping plantlice

All nine described species collected are significant 'infill in distribution records' or range extensions.

Table 8 Fauna range extensions

Family	Species	Comments
Reptiles		
Diplodactylidae	*Strophurus strophurus*	200 km east of nearest record at Ilkurlka, WA
Elapidae	*Barachyurophis fasciolatus*	250 km north-west of nearest record around the Maralinga town site
Scincidae	*Ctenotus piankai*	200 km south of nearest record in Birksgate Ranges; only third locality for SA
Scincidae	*Liopholis striata*	200 km south of nearest record in Birksgate Ranges; only third locality for SA
Wasps		
Braconidae	*Miropotes* cf *goobitis*	600 km; first SA occurrence of this species; infills the otherwise disjunct range of the species; further work will be needed to confirm the identification
Gasteruptiidae	*Gasteruption youngi*	900 km; only previous records from Kangaroo Island and Wirrabara State Forest in SA
Gasteruptiidae	*Pseudofoenus crosskeyi*	800 km; first SA occurrence of this species; previously only collected from WA
Gasteruptiidae	*Pseudofoenus marionae*	1000 km; first SA occurrence of this species; previously only collected from WA
Butterflies and moths		
Lycaenidae	*Candalides heathi*	Airport Corner; 100 km; probable new food plant record for SA

Family	Species	Comments
Butterflies and moths (continued)		
Lycaenidae	*Jalmenus icilius*	Vokes Hill Road; 100 km
Jewel beetles		
Buprestidae	*Castiarina elderi*	First definite, or at least only the second, SA record; closest known collection (the holotype) made further north in 1891 from 'Victoria Desert' and attributed to WA
Buprestidae	*Castiarina octopunctata*	First SA record; apparent disjunction for a species hitherto regarded as endemic to WA; of the 15 WA collections on ALA, the closest record is from near Kalgoorlie
Buprestidae	*Castiarina puteolata*	Only the second collection from SA
Buprestidae	*Paracephala pistacina*	Substantial western expansion of the range; not recorded from the western half of SA in the 1987 revision of the genus
Buprestidae	*Synechocera setosa*	First SA record; nearest known record is from Israelite Bay in WA
True bugs		
Miridae	*Myrtlemiris tesselatus*	Standard Survey Site 1; 1300 km from nearest known record
Jumping plantlice		
Psyllidae	*Acizzia amyemae*	Infill in distribution records (1050 km from SE; 1250 km from SW); closest recorded localities are Burra, SA and Stirling Range, WA
Psyllidae	*Acizzia loranthacae*	Range extension (1050 km from SE); closest recorded locality is Spring Gully Conservation Park, near Clare, SA
Psyllidae	*Acizzia nestor*	Infill in distribution records (900 km from W; 750 km from ESE); recorded from Credo Station WA, and 105 km W Wilcannia, NSW and Andamooka Station (Lake Torrens Bush Blitz)
Psyllidae	*Kenmooreana trilateralis*	Range extension (650 km from W); recorded from Laverton and 175 km E Norseman, WA
Triozidae	*Casuarinicola australis*	Infill in distribution records (1100 km from SE; 1400 km from W); closest recorded localities are Adelaide, SA and Geraldton, WA

Family	Species	Comments
Jumping plantlice (continued)		
Triozidae	*Myotrioza flindersiana*	Range extension (750 km from ESE); recorded from Witchelina Station, SA and Andamooka Station (Lake Torrens Bush Blitz)
Triozidae	*Myotrioza longifoliae*	Range extension (1100 km from SE); recorded from Moorunde Reserve near Blanchetown, SA
Triozidae	*Myotrioza myopori*	Range extension (650 km from SE); recorded from Moorunde Reserve near Blanchetown and Hiltaba Reserve
Triozidae	*Myotrioza oppositifoliae*	Range extension (500 km from WSW); recorded from Credo Reserve near Coolgardie
Centipede		
Scolopendridae	*Arthrorhabdus mjobergi*	Etadunna Homestead; 1000 km

Flora

All the plants listed as newly recorded for the study area are, strictly speaking, extensions or infills to the known range. Even a widely distributed and common species such as Native Carrot (*Daucus glochidiatus*) had a significant gap in its distribution through the Great Victoria Desert area, which is now filled as an outcome from this Bush Blitz. This example, where a well-known, widely distributed species from a diverse range of habitats is not represented in collections exemplifies the issues with remote locations. Specifically, surveys in remote locations are typically *ad hoc* at best, and unless there is a charter for collections to be made of all taxa in an area, species perceived as common may be overlooked.

Only the most notable and substantial range extensions for flora are included in Table 9. Two taxa, *Acacia eremophila* and *Tecticornia pterygosperma* subsp. *denticulata*, were recorded for the first time in South Australia. Previously, both were considered endemic to Western Australia. Two species collected, *Eremophila undulata* and *Sclerolaena eurotioides*, had only recently been discovered in South Australia by the South Australian Seed Conservation Centre, with each known only from a single location in the study area. The Bush Blitz discovered new populations and significantly expanded knowledge of their known range.

Table 9 Range extension of flora species

Family	Species	Comments
Asteraceae	*Carthamus lanatus*	First record from North-west botanical region; a major infill of its known distribution
Chenopodiaceae	*Sclerolaena eurotioides*	Second record for SA; only recently discovered in SA on the north side of the Anne Beadell Highway

Family	Species	Comments
Chenopodiaceae	*Tecticornia pterygosperma* subsp. *denticulata*	First record of the subspecies for SA; a major disjunction from the nearest known occurrence in WA
Fabaceae	*Acacia eremophila* var. Numerous-nerved variant (A.S. George 11924)	First record of the species for SA; a significant disjunction from the nearest known occurrence in WA
Fabaceae	*Daviesia aphylla* (syn. *D. benthamii* subsp. *acanthoclona*)	First record from north-western region; a northern extension of range in SA
Fabaceae	*Daviesia arthropoda*	First record from the study area; a major infill of its known distribution, with only one other collection from the north-western region of SA
Malvaceae	*Sida* sp. Watarrka (D.E.Albrecht 8672)	The second collection of this species in SA; major southern extension of range with only one other SA collection from the extreme north-west of SA with the imprecise location 'Tomkinson Ranges'
Poaceae	*Zygochloa paradoxa*	An extreme western outlier from the species' principal distribution in sandy deserts of central to north-eastern SA; only known in north-western SA by one previous collection in the APY Lands, which was a single plant occurrence considered a possible introduction
Scrophulariaceae	*Eremophila undulata*	Second record for SA; only recently discovered in SA

Other points of interest

Fauna

Vertebrates

The Great Victoria Desert is an important area for the understanding of desert lizard diversity, both in Australia and, in a comparative sense, around the world. While baseline surveys of the diversity and distribution of reptiles and mammals have been initiated in all subregions, the large Maralinga subregion, where the Bush Blitz took place, is by far the least accessible and has been studied the least. Sampling has been carried out along parts of the three main roads that cut through the region, two acting as east-west transects, the Anne Beadell Highway and the Lake Dey Dey Road, and one north-south linking these two, the Vokes Hill Road. Collections from the earlier trips are lodged in the SAM and provided general background for the Bush Blitz. However, the Bush Blitz survey sites were all in previously unsampled or barely visited areas of the subregion, so knowledge of the Bush Blitz sites stems almost entirely from this expedition.

A very high reptile diversity was recorded during the Bush Blitz. Combining the Bush Blitz data with historic records for Mamungari Conservation Park and the land immediately adjacent to its east, shows

that this area has an extremely diverse reptile fauna, with 72 species now known to occur there. While diversity was high, abundance was relatively low, potentially due to comparatively cool and dry conditions experienced on most days.

Of particular interest were high quality specimens of Broad-banded Sand-swimmer (*Eremiascincus richardsonii*). Genetic and morphological evidence is accumulating to indicate that this widespread desert skink may include one or more cryptic species. The specimens collected on this survey are likely to become type specimens and will contribute towards unravelling this uncertainty.

Mammal diversity was much lower than reptile diversity. The long unburnt nature of much of the understorey has led to large areas of ageing *Triodia*, which provide poor habitat for small terrestrial vertebrates. During the Bush Blitz, 19 mammal species were recorded, taking the number of mammal species known from the study area to 24. This seems a relatively low number and there are several additional mammal species, known patchily across the Great Victoria Desert bioregion, that could occur in the study area. More survey work is needed to verify the presence of other native mammal species.

Mammal abundance was also low, with the only group caught in numbers being bats. All four species of bat known to occur in the study area were recorded and three of those were common and widespread—Gould's Wattle Bat (*Chalinolobus gouldii),* Lesser Long-eared Bat *(Nyctophilus geoffroyi)* and Central Long-eared Bat (*N. major*). The large numbers of bats, in contrast to terrestrial mammals, can be explained by the abundance of old, unburnt trees that provide numerous hollows for roost sites.

One of the mammal records, the Central Marsupial Mole (*Notoryctes typhlops*) is only tentatively included as the records are based only on burrow cross sections detected in the mole trenches. It is unclear how long these signs last and therefore how confident one can be about equating the burrow signs with a conclusion that species is currently present in the area.

The reptile fauna of the study area is almost identical to that of the northern, Kintore, subregion. Although the Yellabinna subregion is geographically close, there seems to be no strong influence from the southern Yellabinna (mallee belt) species. Typical Yellabinna reptiles that are missing include Starred Knob-tailed Gecko (*Nephrurus stellatus*), *Delma petersoni*, Southern Mallee Ctenotus (*Ctenotus atlas*), Pink Two-line Dragon (*Diporiphora linga*) and Shingle-back (*Tiliqua rugosa*). Similarly where small mammals show alternate species in the two regions, some southern species are absent (e.g. Southern Ningaui (*Ningaui yvonnae*), Little Long-tailed Dunnart (*Sminthopsis dolichura*)), although there are past records of two of the southerly species (Mitchell's Hopping-mouse (*Notomys mitchellii*) and Bolam's Mouse (*Pseudomys bolami*)) extending close enough to overlap with their northern sister species (Spinifex Hopping-mouse (*Notomys alexis*) and Sandy Inland Mouse (*Pseudomys hermannsburgensis*)). The survey produced several range extensions of northern and western reptile species into this part of South Australia, confirming the more inland character of the fauna.

Two significant species were identified pre-survey as possible inhabitants of the area—the Sandhill Dunnart (*Sminthopsis psammophila*), which is listed as Endangered under the EPBC Act, and the poorly known Western Desert Taipan (*Oxyuranus temporalis*). Neither was located, but conditions were not considered ideal for the capture of either species, both of which may be present in low numbers or be patchy in occurrence. It is recommended that future management plans consider specific survey activities directed towards locating both species in the area, using a variety of methods and at various times of the year.

Fire management is an important aspect of environmental health in this region. The prevalence of long unburnt, old *Triodia* provides poor quality habitat over much of the area. A judicious use of low intensity, patch burning of old *Triodia* is likely to be followed by regrowth of younger, denser bushes. At

the same time, such fire management must be carried out carefully to conserve the complex and ecologically valuable tree overstorey that is responsible for vital nesting and sheltering microhabitats.

Invertebrates

Wasps and ants

Hymenoptera (bees, wasps, ants and sawflies) is considered one of the most species-rich orders of insects, and members of the group exhibit extreme variability in both habitat and life history. During the Bush Blitz, two PhD students focused on Hymenoptera (excluding bees) and collected over 514 specimens. It is likely that these were among the first Hymenoptera collected and recorded for the area, with no records of Hymenoptera other than the Formicidae (ants) publicly available for Mamungari Conservation Park or surrounding areas. As ants have not been identified to morphospecies, these historical records are not included in Appendix A, but are available in the ALA.

The wasp specimens represent at least 18 families and 232 morphospecies. The largest diversity of morphospecies was found for the family Braconidae (64), although this may be biased due to author expertise in this group. The families Crabronidae (35), Ichneumonidae (22), Tiphiidae (21) and Pompilidae (20) also had high numbers of morphospecies identified. Specimens were identified to family level where possible, however, the superfamilies Chalcidoidea and Platygastroidea were mostly left unidentified due to time and expertise restrictions. The number of families is likely to rise as the diverse superfamily Chalcidoidea is further identified. Once identified to family level, specimens were sorted into morphospecies, and in some cases identified to subfamily level.

The Microgastrinae (Braconidae) and the Gasteruptiidae were identified to genus or species level where possible, as these were the groups in which the authors had the most expertise. As most taxa could not be identified to species level, only eight named taxa were able to be recorded for the area. This does not mean these are the only named taxa recorded on the Bush Blitz. With further study of different hymenopteran groups by experts, this number is likely to rise.

The main focus was on the superfamily Evanioidea and the subfamily Microgastrinae (Braconidae). The Evanioidea is comprised of three parasitic wasp families: Aulacidae, a small cosmopolitan family which comprises ectoparasitoids on xylophagous coleopteran larvae (Cerambycidae and Burprestidae) and wood wasps (Xiphydriidae); the Evaniidae, a unique family with larvae that are solitary egg predators in oothecae of cockroaches; and the Gasteruptiidae, predator-inquilines in nests of cavity nesting Hymenoptera. Published host records state Gasteruptiidae are considered predator-inquilines in nests of solitary bees (families Colletidae, Megachilinae, Apidae) with indirect evidence of occurrence in solitary wasp nests (families Crabronidae, Sphecidae and Vespidae). The Australian fauna has remained largely unstudied since 1957 yet is the conjectured origin of the group, with the highest recorded diversity (113 described spp. with >100 undescribed spp.) and most specialised forms. Within the Gasteruptiidae only the subfamily Hyptiogastrinae has been well surveyed across South Australia. In the subfamily Gasteruptiinae, only the genus *Gasteruption* has been recorded in Australia, with Pasteels (1957) revision of *Gasteruption* covering the Western Australia, Queensland and Victorian fauna in depth but neglecting the South Australia and Northern Territory fauna.

The global described microgastrine fauna comprises approximately 2700 species placed in 63 genera, although the understanding of generic boundaries and relationships is in flux and likely to change as current anchored-enrichment phylogenetic studies of the subfamily are completed. In Australia, there are 97 species described from or introduced to the country, currently placed in 21 genera. The Australian fauna contains many undescribed species, with identifications hindered by keys to genus level requiring female specimens and no keys available for the majority of genera in Australia.

Whilst only broad conclusions can be made about hymenopteran diversity due to the limited number of species identified for the group, there was a significant number of families and morphospecies present and collected. Further study of these specimens by experts, including comparison to collections, identification to genus and species level, and molecular studies, will shed further light on the diversity of Hymenoptera for the Great Victoria Desert.

Mamungari Conservation Park and associated areas are high in Hymenoptera diversity. Wasps are conserved when their habitat, flowering plants, and hosts species (such as spiders, bees, and other insects) are conserved, and thus will benefit from the overarching protection and conservation management of the park.

Bees

Before the Bush Blitz, there was no data on the occurrence of native bees for the study area—map searches, using the PaDIL-pollinators website, within a rectangular area that roughly encompassed the study area, did not return native bee species. Considering there are currently around 1650 known native bee species in Australia, including a large number of undescribed species, the Bush Blitz was expected to increase the number of species known from the area and result in the discovery of new species.

During the Bush Blitz, 557 native bee specimens were collected from 24 different flowering plant species. These specimens belong to all five Australian bee families, 23 genera (17 identified subgenera) and an estimated 157 different species. These numbers, and the species listed in Appendix A, are based on the identification of specimens collected from blue vane traps and flowering plants. Hundreds of additional specimens were collected using the vehicle net and stored in ethanol for future examination. It is expected that additional species will be found among these samples.

Only 40 of the 157 species could be identified as described species. The remaining 117 species are different morphospecies that are waiting to be identified, or could not be identified using available publications. A number of species are confirmed to be undescribed, but it is expected that several others will be undescribed as well, after further identifications and careful comparison with museum specimens. A large number of specimens, especially in the Colletinae and Megachilidae, could not be identified to species level because identification keys for these groups do not exist. These specimens were identified to morphospecies level and were given a unique species identifier. Further work would be necessary to identify these specimens. This work will consist of comparing specimens with identified species in museum collections or comparing DNA barcodes of the collected specimens with a DNA reference database of Australian bee species once such a database becomes available.

As most species were only encountered in low numbers, and the survey occurred during a short period, the findings are just a snapshot of the potential bee biodiversity in the area. Native bee diversity will be much higher when surveyed over longer times and during different seasons. Native bees collected during an earlier Friends of the Great Victoria Desert trip revealed about 80 different species, with only a small overlap with the species collected during the Bush Blitz.

Butterflies and moths (Lepidoptera)

Although Lepidoptera is traditionally divided into the categories of butterflies and moths there is no taxonomic validity for this division. Butterflies are diurnal ‘moths’ occupying six families—Papilionidae, Pieridae, Nymphalidae, Riodinidae, Lycaenidae and Hesperidae. These families have however been studied in much more detail and there is considerably more information available about their identification, distribution and biology. For convenience, butterflies and moths will be dealt with separately here.

Although no previous surveys of Lepidoptera in the study area are known, the major modern reference on butterflies suggested that 13 species of butterfly could be expected to be collected. While much time was spent looking in likely areas for additional species, only those 13 species were collected or positively identified.

Only Two-spotted Line-blue (*Nacaduba biocellata*) (Lycaenidae) could be considered widespread and common. This species lives on a wide variety of *Acacia* species and was present in large numbers at each of the sites sampled. At sampling time, none of the other species was common, though five were widespread:

- Small Grass-yellow (*Eurema smilax*) (Pieridae): The host plant of this species was common and widespread and it was surprising that it was not present in larger numbers. They do prefer to lay eggs on small, young plants of the host plant species and low numbers of young plants may have been a limiting factor in their population size.
- Lesser Wanderer (*Danaus petilia*) (Nymphalidae): This was encountered at three widely spread localities. The encounters with this species grew as the sampling period reached its conclusion.
- Meadow Argus (*Junonia villida*) (Nymphalidae): This was encountered at three sites but they were widely spread and only single specimens were seen at each location.
- Amarylis Azure (*Ogyris amaryllis*) (Lycaenidae): This larger Lycaenid was widely spread and quite common. It lives on a variety of mistletoe species (particularly *Amyema pressei*) but seems to prefer those rooted on *Acacia* shrubs, however it can also be found on mistletoe species that prefer tree species.
- Common Grass-blue (*Zizina otis labradus*) (Lycaenidae): This was encountered at three widely spaced sites.

The remaining seven species were only encountered at single sites:

- Cabbage White Butterfly (*Pieris rapae*) (Pieridae): This introduced pest species was seen only once flying on the breeze north to south and may have been blown from a more suitable location for this species.
- Australian Painted Lady (*Vanessa kershawi*) (Nymphalidae): This species feeds on a wide variety of daisy species but only a single specimen was seen (not collected).
- Long-tailed Pea-blue (*Lampides boeticus*) (Lycaenidae): This species and *Zizina labradus* both feed on legumes. A lack of suitable legumes in this area might explain the low numbers.
- Amethyst Hairstreak (*Jalmenus icilius*) (Lycaenidae): Seven specimens were collected (and many others missed) over a one and half hour period. *Senna artemisiodes*, this species' food plant, was common in the area but the ants that this species needs to develop and survive were only found at the base of one plant. A hatched pupal case was found attached to plant debris at the base of that plant, so it was reasonable to surmise that the plant had been used as a host plant for larvae. No eggs were found on the plant and no more specimens were seen or collected on a return to the area four days later.
- Wattle Blue (*Theclinesthes miskini*) (Lycaenidae): This species lives on a variety of wattle species and wattle species were common throughout the sample area however this butterfly was only encountered once on the last collecting day.
- Chequered Blue (*Theclinesthes serpentatus*) (Lycaenidae): This is usually a common dry zone butterfly because it feeds on a wide variety of chenopods but, in the study area, it was only collected at one locality.
- Rayed Blue (*Candalides heathi*) (Lycaenidae): Whilst only collected in one location, it was common in that location and it is likely to be found at other places where the same community of plants exist.

> In the southern parts of its range *C. heathi* lives on Plantain (an introduced weed species) and *Eremophila longifoliae*, where it is usually associated with small black ants. A food plant for this species in Victoria is recorded as being *Eremophila gilesii*. Interestingly, there were masses of *E. gilesii* subsp. *gilesii* where this species was located in the sampling area. *E. longifolia* was also present in this area but it did not seem in any way attractive to the butterflies. It appeared that *C. heathi* was using *E. gilesii* subsp. *gilesii* as its food plant. Along the most westerly of the N-S roads there were other large stands of *E. gilesii* subsp. *gilesii.*

The majority of the Lepidoptera, the moths, have been poorly studied. It is thought that less than half of the Australian moth fauna has been named, let alone studied in any depth with regards to their distribution or biology. Family keys are not available for species identification in any of the larger moth family groups.

Specimens were labelled and placed where possible into superfamilies and then families. Unfortunately, even to positively identify specimens to the family level can, in some groups, mean dissection of the genitalia and this was not possible in the time available. Identifying unfamiliar specimens was therefore reduced to looking at images and/or referencing the collection. Due to time and distance considerations the main reference was the SAM specimen collection however ANIC would be a more complete collection to use for this purpose; some moth species were not in the SAM collection, or they were in the collection but not named.

Most of the moth specimens collected had not been identified at the time of reporting and Appendix A only includes the 27 taxa that had been identified to species. As expected, the two best represented superfamilies were the two largest, Geometroidea (30 species) and Noctuoidea (14 species). Additional species in the family Geometridae are likely to be one species of the genus *Paramelora*, one *Paralaea*, one *Taxeotis*, and three *Dichromodes*. One species collected is probably of the genus *Euproctis* and another almost certainly a *Polydesma* sp.—this species is well collected in the SAM collection but no name is attached. An additional species was identified to the family Lasiocampidae. There were seven additional species from the superfamily Pyraloidea and 7 additional species from the superfamily Gelechoidea.

Ochrogaster lunifer was a particularly common species. This is a very variable species in both size and colour and all the size and colour morphs were collected. This moth was also seen commonly flying during the daylight. Lepidopteral population sizes are influenced by a wide range of factors including availability of host plant, availability of suitable nectar plants, suitable environmental conditions and size of predator and parasite populations.

More collecting is required in this area if a complete list of Lepidoptera is to be assembled. This collection could only be considered the briefest of snapshots. Collections over an extended period, in different seasons and in different climatic conditions are the best way of establishing a species list for such a poorly surveyed area.

Edible insects

Edible insects such as the ‘witchetty grub’ remain a preferred dietary item for Aboriginal people in Australia. Conrad Bilney is an Indigenous researcher who studies insects consumed by Indigenous Australians. During the Bush Blitz, Conrad aimed to identify which insect larvae are consumed in the study area and their host plants. The Bush Blitz study area is part of his grandfather’s country. His grandfather was born at Ooldea Soak, which was one of the sites that was targeted but not visited due to cultural concerns. Some of the traditional owners involved in the Bush Blitz were his family and one

was able to provide him with new information about his grandfather. For Conrad, there were significant cultural as well as scientific outcomes from being part of the Bush Blitz.

There was a possibility that new information about edible insects or host plants would be revealed on the Bush Blitz because no literature was available on the dietary habits of the Aboriginal people of this region and very little had been documented about moths, butterflies, caterpillars or beetles in the Mamungari Conservation Park. The closest region where information had been documented was at Ooldea Soak, 422 km to the south-west of Mamungari Conservation Park. Ooldea Soak is part of the Maralinga Tjarutja management responsibilities and also lies within the southern Pitjantjatjarra language region. Aboriginal people are referred to as 'Anangu' and the witchetty grub is called 'maku'. Earlier publications included observations of Aboriginal diets and customary lore, use of plants for food and medicinal use, spirituality and ceremony, and the activities of men and women in their traditional roles. Most notably, Norman B. Tindale named *Endoxyla leucomochla* as the 'witchetty grub' from a larval specimen taken at Ooldea Soak and *Acacia kempeana* as the 'witchetty tree'.

During the Bush Blitz, 70 edible insect larvae were collected from various locations in the Mamungari Conservation Park. This was achieved with the assistance and expertise of the traditional owners, and highlighted that much biological and cultural knowledge still exists. Little is remembered specifically about where to find edible insect larvae, and little evidence was found that could either agree or disagree with previous conclusions. Almost all specimens collected were moth (Lepidoptera) species, with only around 8% beetles (Coleoptera).

Some specimens were weighed and measured across the crown of the head to determine the nutritional value of the contents. Roots containing more than one specimen were taken back to base camp and later transferred to La Trobe University's Bundoora campus for protein analysis.

Although traditional owners were asked to scan for a variety of host plants, they pointed out mainly one species—Sandhill Wattle (*Acacia ligulata*) (Watarrka) was the host plant for 90% of the specimens collected. Other host plants were Desert Poplar (*Codonocarpus cotinifolius*) (Katatjii), Bramble Wattle (*Acacia victoriae*) (Ilkurlka), Hop Bush (*Dodonaea viscosa*) (punti) and *Zygophyllum* sp. The only traditional owner who was able to identify and provide Aboriginal names for host plants other than *A. ligulata* was an elderly woman from Tjuntjuntjarra. Unfortunately, she was only with the research team for about four hours before having to travel to another location for cultural reasons.

As insect taxonomy is based on adult morphological characters, it is generally impossible to identify larvae to the species level by sight, however, DNA barcoding has the capacity to genetically isolate invertebrate specimens down to species level. Adult Lepidoptera and Coleoptera species have been well documented (including genetics) so tissue DNA from larvae can be extracted and the bar codes compared with existing data from adults. DNA barcoding will be used to determine the genetic identity of the specimens collected however, as this had not been completed at the time of reporting, edible insects are not included in Appendix A.

The outcomes of the collection of edible insect larvae and associated host plant species from Mamungari Conservation Park was both pleasing and disappointing. Pleasing because of the numbers of larvae collected, but disappointing because of the low diversity of larvae and host plants, and no previously unknown larval species or host plants were discovered. Data from other sites was consolidated to confirm that host plants from arid and semi-arid regions are predominately the same. Further research is needed to determine whether larvae have an affiliation with particular host plants.

It had been hoped to collect larvae from *A. kempeana*—to examine the genetic identity of any larvae found, to support or challenge the results of Tindale. Traditional owners commented that, as *A.*

kempeana was flowering, it was not the right time to gather larvae from the plant. As a result, no larvae were collected from that species. This was disappointing as earlier collections did not include larvae from *A. kempeana* either. More time and resources are needed to collect specimens from *A. kempeana*, perhaps on another trip to Ooldea Soak.

General insects

A general entomology survey focussed on beetles (Coleoptera) and flies (Diptera)—these are two of the most diverse orders of terrestrial animals, with beetles being the most diverse. Other orders of insects were included as they represented gaps in the survey effort or were of particular interest. With regard to previous effort in the region, some Coleoptera, Neuroptera and orthopteroids have been previously collected, however, there are minimal previous records of Diptera, Homoptera, Embioptera and Trichoptera.

Due to the very limited amount of previous work in the area, and to make full use of the time and resources required to conduct a survey in this remote area, a large number of taxa were targeted. This approach should lead to large number of new species discoveries in the future, due to the large number of taxa collected from a poorly characterised region. However, it means that at the time of reporting the number of species-level classifications and newly identified species will appear relatively low.

Invertebrate diversity was close to that predicted prior to the survey despite the dry conditions that prevailed in the region at that time. While specimens from some groups, from this and previous surveys, are not yet classified to species level, most species are likely to be new records for the region. The expertise required to classify insects unambiguously (particularly groups that are diverse and small) means that most previous occurrence data are based on genera or informal species classifications (e.g. morphospecies). It is also difficult to be sure about what has not been collected in a region; here it is assumed a taxon has not been collected if no record can be found in readily available sources. It should be noted that there is no single repository for data on the current distribution of insects and no way to be sure that an insect has not previously been collected in an area unless it has been explicitly stated. Taxa have been determined to be new records when they do not appear to have been collected in the area based on information that is readily available—ALA and data from a 2003 survey of the general area. For informal taxa, where there is a possibility of them being the same species as those previously listed (e.g. two undefined species of the same genus or family), these have not been noted as new records. For example, of over 30 weevil species collected, although most are likely new records, only a few were listed as new records because many of the weevils previously listed from the region were not classified to species, as was the case for this survey. Additionally, some 30% of specimens collected on the survey remained to be sorted and classified. For some taxonomic groups, there are no previous records of their occurrence in the region and so all associated species are listed as new records.

Coleoptera was the most diverse group collected, with 171 species from 31 families, followed by Diptera with 109 species from 27 families. Coleoptera, Diptera and Homoptera contained the highest numbers of new records for the region. The most diverse family was Cicadellidae (Homoptera), followed by Bombyliidae (Diptera) and Curculionidae (Coleoptera). Each of these families has further species among the specimens that remain to be sorted.

Interestingly, two species of webspinner (Embioptera) were collected along with one species of caddisfly (Trichoptera) which requires fresh, moving water that apparently did not occur in the vicinity.

This Bush Blitz only scratched the surface of insect biodiversity in the Great Victoria Desert—many endemic species from dry/variable habitats have adults that are ephemeral and larvae that are hidden. Thus, a broad survey conducted over a week or so would likely uncover adults that are obvious or

abundant, and discovery of new species would likely reflect the poor representation of diverse groups such as Diptera in existing collections from the Great Victoria Desert.

Importantly for management of wilderness areas, there is much to learn about how insect communities interact with other organisms (and each other) to play important functional ecological roles in the area. This is information that would be useful for increasing the level of nuance in monitoring and management of desert.

Jewel beetles (Buprestidae)

A download from ALA of records within the Great Victoria Desert bioregion and the Maralinga Tjarutja Lands (and filtered to exclude records with a precision of 100 km or more) delivered 16 Buprestidae records, but none that plotted within the defined Bush Blitz study area. The only accessible source providing any historical Buprestidae records from the study area was the private collection of P.J. Lang.

During the Bush Blitz, 41 Buprestidae specimens were collected, representing at least 13 species. This is considered to be only a moderate yield, and probably reflects the series of drier months that ensued after good rains earlier in the year. Some key plant species for nectar-feeding Buprestidae such as *Grevillea pterosperma* were not flowering, while others such as *Leptospermum fastigiatum* and *Thryptomene* species were flowering poorly or were well past their peak and often in poor condition, as were other key species such as *Eremophila scoparia*.

Of the 13 species recorded, only one, *Neospades rugiceps*, is known to have been collected previously from the study area, although it is not listed on ALA. This species was regarded as endemic to Western Australia until it was first collected in South Australia in November 2012 during the Hiltaba Bush Blitz and its identity was subsequently confirmed by DNA studies. It was first collected in the current Bush Blitz study area in September 2014.

Large numbers of *Paracephala pistacina* were observed on two species of spear grass (*Austrostipa*) and the collections made provide important vouchers for this adult host plant association (which is also suspected to be the larval host). Significantly, the specimens appear to be closer to *P. pistacina* than the closely related *P. deserta* which Bellamy (1988) described and named after the Great Victoria Desert location of the type specimen from near Neale Junction in Western Australia. The differences between these species are slight, but the Great Victoria Desert collections emerge as a western extension of the range of the eastern Australian *P. pistacina* which in Bellamy's treatment only reached the eastern part of South Australia, and are supported by collections of similar material made on northern Eyre Peninsula.

Neospades chrysopygia is a widely distributed and highly variable species complex found across Australia, which exhibits a wide variety of colour forms, many of which have been named and later placed in synonymy. It is in much need of revision. Six of the specimens collected were assigned to *N. chrysopygia* "Narrow variant"—these differed from the four more typical forms of *N. chrysopygia* collected in the study area in a number of size and shape characters, as well as colour and tarsal claw morphology. Although no intergradation between these entities was apparent here, similar forms have been collected elsewhere and further study is needed to determine whether the distinction stands up in a wider context, and whether it is supported by DNA/molecular evidence. The variant shows some similarities to type specimens of *Neospades picta* from Brisbane, and the limits of that species and its relationship to *N. chrysopygia* "Narrow variant" also need investigation.

A total of 11 specimens, representing seven species that were suitably preserved, were subsampled to provide tissue samples for DNA. These were stored in a freezer until being submitted to the Australian Biological Tissue Collection.

True bugs (Heteroptera)

The Heteroptera of Australia comprise approximately 2500 species. Recent surveys during Bush Blitz Phase 1 revealed 1391 species of Heteroptera, of which 391 are recognised as being new to science. In a report to the ABRS on Bush Blitz Phase 1, Prof. Cassis and Prof. Laffan indicated that the species taxonomic accumulation curve was not levelling, and predicted that the total Heteropteran fauna of Australia would amount to approximately 6500 species.

This expedition was the first to the Great Victoria Desert by the Cassis Laboratory and resulted in the collection of 167 true bug species from 25 localities. Eighteen families of Heteroptera were represented in the collection, with the greatest species richness occurring in the Miridae.

Jumping plantlice (Psylloidea)

As a result of recent taxonomic output, there are now over 400 described species of Australian jumping plantlice (Psylloidea), but many more undescribed species are represented in collections and remain to be collected. Few species are recorded from South Australia, as much of the taxonomic work has concentrated in eastern Australia.

A total of 43 species of Psylloidea were collected during the Bush Blitz, representing a remarkable diversity for the region. At least 27, but possibly up to 34 of these, represent new, undescribed species. Nine species (in four genera and two families) were identified as described species. The status (described or otherwise) of the remaining seven species (in four genera) remains to be elucidated.

Plant species were selectively targeted during sampling to determine important host associations for these phytophagous insects. The Psylloidea are highly host specific and host association data were recorded for most species, including various species of *Acacia*, *Amyema*, *Casuarina*, *Daviesia*, *Dodonaea*, *Eremophila*, *Eucalyptus, Grevillea, Hakea, Myoporum* and *Senna*. The distributional data represents new species and host records for the region, with significant infill distribution records for the nine described species.

The Bush Blitz also provided data for a current ABRS Tactical Taxonomy Research Grant awarded to Dr Gary Taylor to investigate the three species of psyllids recorded from the region that are thought to be important traditional foods of Indigenous Australians. These are *Creiis* sp. and *Glycaspis* spp. from the Victoria Desert Mallee (*Eucalyptus concinna*) and *Kenmooreana trilateralis* from the iconic Marble Gum (*Eucalyptus gongylocarpa*). Additionally, new material will contribute to a current ABRS-funded project awarded to Gary Taylor describing new species of *Acizzia* under “Systematics, biodiversity and host associations of Australian psyllids: Implications for conservation and biosecurity”.

The greatest diversity occurred within the genus *Acizzia* with a total of 28 species collected, comprising three described species from mistletoe and 25 putative new species, predominantly from *Acacia* and *Dodonaea*, but significantly, new species from *Daviesia*, *Grevillea*, *Hakea* and *Senna*, host plant genera for which no species are yet formally described.

Other notable discoveries include new species of psyllids on *Dodonaea* that provided important material for a newly completed ABRS Honours Scholarship to Ms Alana Delaine under the supervision of Dr Gary Taylor at the University of Adelaide. In this project, the species of *Acizzia* from *Dodonaea* were

sequenced to provide the first molecular phylogeny for the group and to test their monophyly on this host plant. New species identified in this project will be formally described.

Dragonflies and damselflies (Odonata)

Although several dragonflies were seen flying high above base camp, none could be captured for identification. The near-complete absence of Odonata during the Bush Blitz was attributed to the arid conditions experienced in the region at that time of year. Dragonflies are essentially aquatic insects, spending their egg and larval stages in freshwater, and no bodies of freshwater were observed. In the absence of standing water, we expect that any adult dragonflies that may have emerged from ephemeral waters nearby would have left the area to seek out suitable habitat elsewhere.

Centipedes, spiders, scorpions and pseudoscorpions

The Great Victoria Desert is a region that is poorly known for arachnids and myriapods, with rather low species diversity and relatively sparse records. The aridity of the ecosystem, the lack of geological complexity and the low vegetation diversity renders the deserts of central Australia as species-poor compared to more complex ecosystems elsewhere in the country.

Previous knowledge of the arachnid fauna of the Great Victoria Desert shows very few records (ALA), which is the result of either lack of collections or perhaps more accurately lack of collecting during suitable seasons. It is likely that trips during or straight after periods of intense rain would generate more comprehensive collections, including adult males that would make the identification process more complete.

Historical records, derived from the ALA, suggested that the Great Victoria Desert harbours some very widespread and common desert-dwelling species such as the Christmas Spider (*Austracantha minax*), the Australian Golden Orb-weaving Spider (*Nephila edulis*), the wolf spider *Hoggicosa bicolor*, and the centipede *Scolopendra morsitans*. These conspicuous species are easily collected and are present in several museum collections. All were recorded during the survey.

Less well known are the trapdoor spiders and smaller arachnids such as pseudoscorpions. The Bush Blitz provided a good opportunity to target the rarer groups to ascertain the composition of the desert fauna.

Few species were detected during the Bush Blitz, mostly due to the dry climate and paucity of soils. While several wide-ranging taxa were detected, other more restricted species were present, including several putatively new species of spiders and scorpions. No millipedes (Class: Diplopoda) were collected, probably due to the dry conditions experienced before and during the survey or a lack of suitable habitats. Some genera e.g. Polyxenida are remarkably resilient and have been recorded from extremely arid regions throughout Australia.

Flora

The Bush Blitz provided an opportunity to greatly increase the knowledge on the flora of the area. Institutional priorities for collection included *Acacia* spp., and the families Malvaceae, Solanaceae, Myoporaceae, Zygophyllaceae, Poaceae, Asteraceae, Chenopodiaceae (particularly samphires), Goodeniaceae, plus weeds, macrofungi, lichens, bryophytes and aquatic plants. The aim was to collect a complete list of species for each site, but logistics sometimes placed constraints on the time available to be spent at each site.

Prior to the Bush Blitz, vascular plant data for the study area was compiled from the ALA. In addition, a plant list for the North-west botanical region, which contained the study area, was extracted from the

Census of South Australian Plants, Algae and Fungi (State Herbarium of South Australia 2017). It provided taxon lists for use during field work, and as a reference for comparing the outcomes from the Bush Blitz survey.

Vascular plants

During the Bush Blitz, 539 vascular plant specimens were collected, with nearly all these having duplicate samples for the Western Australian Herbarium plus leaf tissue samples in silica gel for future DNA and other tissue analysis.

These collections represent 319 unique taxa (excluding hybrids and intergrades). A total of 48 vascular plant taxa were collected from the Bush Blitz study area for the first time, and two of those were new records for South Australia. This large number of new records from the study area confirms the choice of this area for a Bush Blitz expedition, based on the premise of it being significantly under-sampled.

A checklist for the area was compiled and extensively validated after combining survey records and ALA specimen-based records. This resulted in a list of 529 accepted vascular plant taxa for the study area (see Appendix A), with 436 of these present in Mamungari Conservation Park.

Population samples for *Lawrencia glomerata* were made at two sites, on request of State Herbarium Hon. Research Associate Bill Barker. Fruit samples of *Solanum* species were collected for Hon. Research Associate Laurie Haegi. Seed collections were made of *Eremophila undulata* and *Swainsona kingii* for the South Australian Seed Conservation Centre.

Fungi, lichens and bryophytes (Cryptogams)

Previous literature revealed records from cryptogam collections made in the region during an Adelaide Botanic Gardens expedition in July 1972, by the Ecological Survey Unit in 1979 and by The Nature Conservation Society of South Australia, in conjunction with staff of the Adelaide and Waite Institute herbaria, in 1980. A partial manual search of collections and collection records at the State Herbarium of South Australia was also undertaken.

It was not possible to provide a definitive list of cryptogam taxa collected from the region prior to the Bush Blitz. Cryptogams are typically under-collected, and the collections that had been made in these areas will not be representative. In addition, ever fewer collections will have been made by persons with some technical knowledge to guide them and this will have limited the recognition of additional taxa. Cryptogams are also challenging to collect and preservation is more difficult. Unfortunately, even those few existing collections are not easy to list or assess, since many of Australia's cryptogamic herbarium collections are not yet databased. Most cryptogams will also not have had their identifications critically authenticated.

The Bush Blitz collections include 25 bryophytes, 18 fungi and 78 lichens. These represent 48 unique taxa, comprising 9 bryophytes, 12 fungi and 18 lichens. A number of apparently new records were found, with some certainly new at least for the study area. Four taxa are potentially new to the State and a further 19 are probably new to the NW region or the study area.

The checklist for cryptogams for the study area now comprises 73 taxa (20 bryophytes, 19 fungi and 34 lichens), but due to limitations of available historical data mentioned above, this is not a definitive list for those groups.

Most of the taxa able to be identified with certainty would be expected to occur in the study area, even though they may not have been recorded previously—poor collecting of these groups has simply

resulted in poor knowledge of their distributions. Some are possibly uncommon or rare but the lack of expert collecting skills nationally, and identification, remains a problem in evaluating their status.

It is quite likely that a number of specimens represent new records for the State Botanical Region, simply due to the very low overall number of cryptogamic specimens in herbaria from the North-west botanical region of SA, not least due to the various difficulties of access within that area. Another issue is the seasonality of some groups, especially fungi and some bryophytes. Depending upon weather conditions, some of these groups would not be observed during any particular survey of a region. At least one of the mosses collected was too immature to be fully determined. The bryophytes are probably the best known of the groups based on previous records, in part due to some previous collections being made by informed collectors.

Whilst the records of fungi may be treated as authentic, the names applied to the apparent new records of lichens are, in some cases, quite tentative and need to be authenticated by relevant experts in the groups concerned. The identifier of these current specimens is not a specialist lichenologist and some of the taxa collected are from taxonomically difficult and poorly known groups. More time, resources and expertise would be required for further authentication. Many lichen species require considerable chemical testing and examination of spores for positive confirmation.

Glossary

Cryptogam: a plant that reproduces by spores, without flowers or seeds. Includes bryophytes (hornworts, liverworts, mosses), lichens, fungi, slime moulds and algae. The term as used here does not include ferns and fern allies as is sometimes part of the definition used by some authors.

Exotic species: a species occurring outside its normal range.

Morphospecies: a group of individuals considered to belong to the same species on the grounds of morphology (physical features) alone.

Pest species: a species that has the potential to have a negative environmental, social or economic impact.

Predator-inquiline: a species that feeds on a host and the host's food store.

Putative new species: an unnamed species that, as far as can be ascertained, was collected for the first time during the Bush Blitz.

Range extension: increase in the known distribution or area of occurrence of a species.

Species range: the geographical area within which a particular species can be found.

Taxon (plural taxa): a member of any particular taxonomic group (e.g. a species, genus, family).

Taxonomy: the categorisation and naming of species. The science of identifying and naming species, as well as grouping them based on their relatedness.

Threatened: fauna or flora that are listed under Section 178 of the EPBC Act (or equivalent State legislation) in any one of the following categories—extinct, extinct in the wild, critically endangered, endangered, vulnerable, conservation dependent.

Type locality: the location where the primary type specimen(s) (holotype or syntype series) was found.

Type specimen(s) (holotype, syntypes): the specimen (or set of specimens) on which the description and name of a new species is based.

Undescribed taxon: a taxon (usually a species) that has not yet been formally described and named.

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Contributors

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Research agencies involved in this Bush Blitz were Alinytjara Wilurara NRM, Department of Environment, Water and Natural Resources (South Australia), Flinders University, South Australian Museum, State Herbarium of South Australia, La Trobe University, The University of Adelaide, University of New South Wales, Western Australian Herbarium and Western Australian Museum.

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Great Victoria Desert

South Australia

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