Wombats Through Time and Space

2018 Conference

The University of Adelaide

17 – 19 September 2018

Conference Program and Abstract List
The cover photo is of a southern hairy-nosed wombat checking out a motion-activated camera which had been placed outside its burrow in the Gawler Ranges region of South Australia. Southern hairy-nosed wombats are the faunal emblem of South Australia (photo: Mike Swinbourne)
WELCOME

Welcome to Adelaide, to the University of Adelaide, and to the 2018 ‘Wombats Through Time and Space” conference.

The conference will run for 3 days and will feature a range of speakers from the scientific, government, non-government organisations, zoos, landholder and wildlife carer communities. The idea for the conference was born out of a reading the seminal 1998 book ‘Wombats” (edited by Rod Wells and Peter Pridmore) and realising that, whilst the book is still very much ‘the Bible’ for wombat researchers, much has changed over the past 20 years. As a result, we thought it was time we got together with as many people as possible who have an interest in wombats (and let’s face it, who doesn’t?) to learn what they have been up to, what has changed and what has stayed the same. Whilst most conference attendees will be very familiar with wombats, we hope that you will not only learn more about these fascinating creatures, but also potentially see things from a different perspective and perhaps even have some of your current views challenged.

Together with the conference itself, we have arranged a number of social activities where you can get together with other participants in a relaxed atmosphere, where you can share ideas and stories, network, or just have a drink and a chat.

We would like to express our sincere thanks to everyone who helped to organise the conference and social activities. Conferences don’t just happen – they can be a lot more work than it appears from the outside – and without the hard work of the conference organising committee and other supporters, this event would not have happened.

We would like to especially thank our conference sponsors, The Wombat Foundation, Mrs Mary Holt, and CSIRO Publishing for their generous support. Their support has not only been critical to the success of this conference, but their on-going work and support of wombat conservation is a wonderful example to others. We would therefore ask that you take the time during – or after – the conference, to familiarise yourselves with their work, and if possible, to offer whatever support you can. We would also like to thank the University of Adelaide, the Environment Institute, Wombats SA, and the carers who are bringing their wombats along to the conference for their in-kind support and generous donation of their time.

We are also very grateful to Uncle Rod for welcoming us to the country of the Kaurna people, the original inhabitants and traditional owners of the land upon which we meet.

Mike Swinbourne
on behalf of the Conference Organising Committee
ACKNOWLEDGEMENTS

Conference Organising Committee

Bill Breed
Peter Clements
Matt Gaughwin
Fiona McQueen
Bertram Ostendorf
Michael Swinbourne
David Taggart
Rod Wells

Volunteers

Ingrid Ahmer
Brianna Corbin
Skye Brook Jenner
Li Ma
Aidan McGeagh
Georgia Moloney
Stephanie Oliphant
Jessica Scriven
Holly Taylor
Max Tibby
SPONSORS

We would like to express our sincere thanks and gratitude to our sponsors for their generous support for the ‘Wombats Through Time and Space’ conference 2018.

Australia is home to one of the world’s most endangered mammals: the Northern Hairy-nosed Wombat. At one time, there were just 35 left on the planet. The Wombat Foundation is the only organisation dedicated exclusively to conserving this critically endangered species.

There are now 250 Northern Hairy-nosed Wombats. The Wombat Foundation continues to work tirelessly to achieve its vision: Northern Hairy-nosed Wombats living sustainably across their historic range. Take a look at the Wombat Foundation website to see the great work that they do: https://www.wombatfoundation.com.au/

Mrs Mary Holt is the patron of Wombats SA, and together with her late husband, Dr John Holt, has held a life-long passion for wildlife, especially wombats. She has been a generous donor to Wombats SA and many other wildlife causes, including in her home in the Blue Mountains region of NSW. A donation from Mrs Holt was instrumental in helping Wombats SA expand Moorunde Wildlife Sanctuary in 2006.

CSIRO Publishing is an Australian-based science and technology publisher. It publishes books, journals and magazines across a range of scientific disciplines, including agriculture, chemistry, plant and animal sciences, natural history and environmental management. Publications like ‘Australian Mammalogy’, ‘Wildlife Research’, and the ‘Australian Journal of Zoology’ provide an important vehicle for the dissemination of research on many of our interesting wildlife species, including wombats.
CONFERENCE VENUE

The conference will be held at the University of Adelaide, North Terrace Campus, which is located on the edge of the Adelaide CBD. It is only a short walk from the city and associated facilities. Conference presentations will be conducted in the Chapman Lecture Theatre, which is located on the 1st floor of the Engineering North building (F13 on map). Conference Registration, poster presentations and lunch / tea breaks will be in the ground floor atrium of the Ingkarni Wardli building (F12 on map). We would ask that all participants come to the registration desk at the Ingkarni Wardli building on arrival, and we will direct you to the other venues.

The conference will be held during the university mid-semester break, so there will be few students in and around the university precinct. However, some university facilities (cafes etc.) will still be operating.

There are a number of options for transport to and from the conference. The University of Adelaide is located a short walk from the Adelaide Railway Station, and buses and trams stop either right outside the university or close by. For full details of public transport to / from the university, including to / from Adelaide Airport, please refer to the Adelaide Metro website: https://www.adelaidemetro.com.au/. Interstate and overseas visitors should be aware that public transport is available to / from the airport, which is about a 15-minute ($25 – 30) taxi ride. Three-hour ticketed car parking ($4/hour) is available on Victoria Drive immediately behind the university grounds (100 m from the conference venue). All day parking is available in the Wilson Car Park on North Terrace directly across the road from the university for $4/hour (maximum $29/day) – early bird rate (enter between 6 AM – 9:30 AM, exit between 3 PM – 12 AM) for $16/day.
UNIVERSITY OF ADELADE MAP

Staff Club  Ingkarni Wardli Atrium  Chapman Lecture Theatre
INFORMATION FOR PRESENTERS

Oral Presentations

Presenters are allotted a 15-minute period, which should consist of a 12 minute oral presentation followed by 3 minutes for questions. If you speak for less than 12 minutes, you might get asked more questions! Keynote speakers are allocated a ‘double slot’ of 30 minutes.

The session chair will signal when you have been speaking for 10 minutes, then again at 11:30.

Presentations will be uploaded onto the university system at the front of the lecture theatre by one of the conference officials. Please bring your presentation on a flash drive or portable hard drive (not SD card or similar) for upload during the lunch-break on the day prior to your presentation. If you have a large number of files that need to be transferred (e.g. video files), please assist the official with their upload and test them afterwards to ensure they are working. If you are presenting on Monday, please have your presentation available for upload during the registration period on Monday morning.

Presentations should use PowerPoint (any recent edition) and should preferably be in widescreen mode (16:9); although standard size (4:3) is also acceptable.

Please use the name “day_presentation start time_your surname” for your presentation to simplify the upload process.

We will provide a remote ‘clicker’ and laser pointer for use by all presenters. Presenters will also be equipped with a remote microphone for broadcast and recording. If you do not wish to be recorded, please advise the session chair prior to your presentation.

Posters

Space will be allocated for posters in the Ingkarni Wardli atrium (where we will have morning/afternoon tea and lunch). Because of the relatively modest number of posters entered, we will not be having a dedicated poster session. Rather, posters will be on display throughout the conference.

Velcro dots will be provided to put up the posters on the display boards provided.
SOCIAL PROGRAM

Quiz Night

*Monday 6:45 PM: Cathedral Hotel, cnr King William Rd / Kermode St, North Adelaide*

On Monday night, Wombats SA (formerly known as the Natural History Society of South Australia) will be hosting a Quiz / Trivia night at the Cathedral Hotel, North Adelaide. The Cathedral Hotel is just across the river opposite St Peter’s Cathedral, only 1 km from the conference venue, and is one of Adelaide’s most famous ‘watering holes’. The quiz venue is on the 1st floor of the hotel.

Cost for the night is only $10 and we would prefer if you pre-booked so we have an idea of numbers, although payments at the door are also acceptable: (https://www.eventbrite.com.au/e/quiz-night-hosted-by-wombats-sa-tickets-48867819965).

Meet at the hotel at 6:45 PM (or earlier if you are thirsty) for a 7 PM start. There will be lucky door prizes and giveaways, as well as prizes for the quiz. Come along and join a table or organise your own team of up to 10. You can also have dinner at the hotel from their excellent menu.

Conference Dinner

*Tuesday 6:45 PM: University of Adelaide Staff Club, Level 4 Union Building*

The conference dinner will be held at the University of Adelaide Staff Club, located on Level 4 of Union House, which is virtually next door to the conference lecture theatre. The dinner will feature a three-course menu, a premium drinks package, and light entertainment by Stacey Tonkin.
### Monday 17 September 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>09:00 - 10:15</td>
<td>Registration / Presentation Upload – Ingkarni Wardli Atrium / Chapman Theatre</td>
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<tr>
<td>10:15 - 10:45</td>
<td><strong>Morning Tea</strong></td>
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<td>10:45 - 10:50</td>
<td>Welcome to Country</td>
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<tr>
<td>10:50 - 11:00</td>
<td>Administration</td>
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<tr>
<td>11:00 - 11:30</td>
<td>Opening Address</td>
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<tr>
<td>11:30 – 12:00</td>
<td>Keynote Presentation: Southern hairy-nosed wombats: superbly adapted and tough as boot leather: but will that be enough?</td>
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<tr>
<td>12:00 - 13:15</td>
<td><strong>Lunch</strong></td>
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<tr>
<td>13:15 – 13:30</td>
<td>Spatial distribution of mange in south-eastern Australia</td>
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<td>13:30 – 13:45</td>
<td>Mange and other threats to wombats</td>
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<td>13:45 – 14:00</td>
<td>The southern hairy-nosed wombat: an ecosystem engineer in the mid-north of South Australia</td>
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<tr>
<td>14:00 – 14:15</td>
<td>No place like home or home and away? The use of warrens by southern hairy-nosed wombats in 1975-77 and 2000-2002</td>
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<tr>
<td>14:15 – 14:30</td>
<td>A long-term population study of the southern hairy nosed wombat at Moorunde Wildlife Reserve, South Australia</td>
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<tr>
<td>14:30 - 15:00</td>
<td><strong>Afternoon Tea</strong></td>
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<tr>
<td>15:00 - 15:15</td>
<td>Humerus histology in modern and fossil wombats reveals rapid ontogenetic bone adaptation to burrowing</td>
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<td>15:15 - 15:30</td>
<td>Wombats through time and space: using Late Pleistocene Tasmanian bare-nosed wombat populations to inform management strategies into the future</td>
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<tr>
<td>15:30 – 15:45</td>
<td>Islands as refuges: southern hairy-nosed wombats on Wedge Island</td>
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<tr>
<td>15:45 – 16:00</td>
<td>Community involvement and management of conservation parks for wombats</td>
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<tr>
<td>18:45</td>
<td>WombatsSA Quiz Night - Cathedral Hotel, North Adelaide</td>
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<td>Time</td>
<td>Session</td>
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<tr>
<td>09:00 - 09:30</td>
<td>Keynote Presentation: Story of the Northern hairy-nosed wombats</td>
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<td>09:30 - 09:45</td>
<td>Wombats in captivity - we can do better</td>
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<td>09:45 - 10:00</td>
<td>Captive breeding of bare-nosed and southern hairy-nosed wombats by zoos outside Australia</td>
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<tr>
<td>10:00 - 10:15</td>
<td>A guide to the care of bare-nosed wombats</td>
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<tr>
<td>10:15 - 10:45</td>
<td><strong>Morning Tea</strong></td>
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<tr>
<td>10:45 - 11:00</td>
<td>Wombat head injuries, treatment, recovery and the modified Glasgow Coma Scale</td>
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<tr>
<td>11:00 - 11:15</td>
<td>The release of wombats after care</td>
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<td>11:15 - 11:30</td>
<td>“Right-oh Ron”: The as yet untold story of southern hairy-nosed wombat research in the South Australian Murraylands</td>
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<td>11:30 – 11:45</td>
<td>Assessing wombat abundance in the Murraylands</td>
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<tr>
<td>11:45 – 12:00</td>
<td>Blackwood High School science project: developing a mobile burrow camera</td>
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<td><strong>12:00 - 13:15</strong></td>
<td><strong>Lunch with the wombats</strong></td>
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<td>13:15 – 13:45</td>
<td>Keynote Presentation: Demography and reproduction in the northern hairy-nosed wombat</td>
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<td>13:45 – 14:00</td>
<td>The development of breeding technology in captive wombats</td>
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<td>14:00 - 14:15</td>
<td>Urine as a tool to identify and monitor oestrous in captive female southern hairy-nosed wombats</td>
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<td>14:15 – 14:30</td>
<td>In search for a non-invasive pregnancy test for marsupials: The southern hairy-nosed wombat as a model species</td>
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<tr>
<td><strong>14:30 - 15:00</strong></td>
<td><strong>Afternoon Tea</strong></td>
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<tr>
<td>15:00 - 15:15</td>
<td>The wombat ovary. How similar is its structural organization to that of other marsupial species?</td>
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<td>15:15 - 15:30</td>
<td>The sex ratio of young and adult hairy-nosed wombats</td>
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<td>15:30 - 16:00</td>
<td>De novo genome and Transcriptome assemblies of the bare-nosed wombat</td>
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<tr>
<td><strong>18:45</strong></td>
<td><strong>Conference Dinner - Adelaide University Staff Club</strong></td>
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### Wednesday 19 September 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Speaker</th>
<th>Institution</th>
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<tbody>
<tr>
<td>09:00 - 09:30</td>
<td>Keynote Presentation: Sarcoptic mange and wombats</td>
<td>Scott Carver</td>
<td>University of Tasmania</td>
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<tr>
<td>09:30 - 09:45</td>
<td>Status of wombats and mange in Tasmania</td>
<td>Michael Driessen</td>
<td>Tasmanian Department of Primary Industries, Parks, Water and Environment</td>
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<tr>
<td>09:45 - 10:00</td>
<td>An investigation of sarcoptic mange</td>
<td>Julie Old</td>
<td>Western Sydney University</td>
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<td>10:00 - 10:15</td>
<td>Southern hairy nosed wombats of the Murraylands: a survey of health and disease 2011 - 2016</td>
<td>Lucy Woolford</td>
<td>University of Adelaide</td>
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<td>10:15 - 10:45</td>
<td>Morning Tea</td>
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<tr>
<td>10:45 - 11:00</td>
<td>The social behaviour of young southern hairy-nosed wombats</td>
<td>Matt Gaughwin</td>
<td>University of Adelaide</td>
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<tr>
<td>11:00 - 11:15</td>
<td>A revegetation experiment for wombats on Moorunde Wildlife Reserve</td>
<td>Peter Clements</td>
<td>Wombats SA</td>
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<tr>
<td>11:15 - 11:30</td>
<td>Molecular phylogeography of living and extinct populations of northern and southern hairy-nosed wombats</td>
<td>Jeremy Austin</td>
<td>University of Adelaide</td>
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<tr>
<td>11:30 - 11:45</td>
<td>Square salads: exploring the diet of the southern hairy-nosed wombat via metabarcoding</td>
<td>Colin Sobek</td>
<td>Northern Arizona University</td>
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<td>11:45 - 12:00</td>
<td>Dietary overlap between southern hairy-nosed wombats and sheep in the Murraylands of South Australia</td>
<td>Adam Croxford</td>
<td>Australian Centre for Plant Functional Genomics</td>
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<tr>
<td>12:00 – 13:15</td>
<td>Lunch</td>
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<td>13:15 - 13:45</td>
<td>Keynote Presentation: Landholder’s perspective</td>
<td>David Lindner</td>
<td>Wonga Station</td>
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<tr>
<td>13:45 – 15:00</td>
<td>Using remote sensing to assist with the management of southern hairy-nosed wombats</td>
<td>Michael Swinbourne</td>
<td>University of Adelaide</td>
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<tr>
<td>14:00 - 14:15</td>
<td>Evaluating non-lethal human-wombat conflict mitigation strategies</td>
<td>Casey O’Brien</td>
<td>University of Adelaide</td>
</tr>
<tr>
<td>14:15 - 14:30</td>
<td>Mapping and modelling support for future management and conservation</td>
<td>Bertram Ostendorf</td>
<td>University of Adelaide</td>
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<tr>
<td>14:30 - 15:00</td>
<td>Afternoon Tea</td>
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<tr>
<td>15:00 - 15:50</td>
<td>Where to from here? Future priorities for wombat management, conservation and research</td>
<td>Panel Discussion</td>
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<tr>
<td>15:50 - 16:00</td>
<td>Conference close</td>
<td>Bertram Ostendorf</td>
<td>University of Adelaide</td>
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</tbody>
</table>
Hairy-nosed wombats through time and space - molecular phylogeography of living and extinct populations of northern and southern hairy-nosed wombats

Jeremy Austin

Biological Sciences University of Adelaide

Corresponding Author: jeremy.austin@adelaide.edu.au

Hairy-nosed wombat populations have undergone major declines since European arrival in Australia. Over the last 20 years, a number of phylogenetic and population genetic studies have provided insights into the evolutionary history of hairy-nosed wombats in southern and eastern Australia. We have recently completed analysis of mitochondrial DNA genomes obtained from extant southern hairy-nosed wombat populations, and extant and extinct northern hairy-nosed wombat populations. I will present these results and discuss future research directions that can improve our understanding of the evolutionary history, and recent declines, of hairy-nosed wombats in Australia.
The wombat ovary: how similar is its structural organization to that of other marsupial species?

Bill Breed¹, Eleanor Pierce²

¹ School of Biological Sciences, University of Adelaide
² Medical School, University of Adelaide

Corresponding Author: bill.breed@adelaide.edu.au

The adult mammalian ovary contains follicles at various developmental stages in which eggs (= oocytes) occur together with degenerating (= atretic) follicles, and corpora lutea that arise from ovulated follicles and secrete progesterone to prepare the uterus for early embryo attachment if fertilisation occurs. In between these structures there is stromal interstitial tissue in which numerous blood vessels are present. In most marsupials, the interstitial tissue between the follicles and corpora lutea is fibrous, but we have recently found that in wombats there is abundant glandular interstitial tissue throughout much of the ovary. The appearance of this interstitial tissue is similar to that previously documented for the rabbit where it has been shown to secrete 20α-hydroxyprogesterone, which may positively feed back to the pituitary gland to facilitate gonadotrophin secretion to bring about ovulation.

In this present study we compare the structural organization of the wombat ovarian interstitial tissue with that of other marsupial species. We find degenerating oocytes are present surrounded by this tissue. We thus hypothesise that this luteinized interstitial tissue arises from the theca interna of follicles once they start to degenerate to form atretic follicles. The endocrine consequences of this is not known at this stage.
Wombats in children’s literature

Jenni Carter

School of Education, University of South Australia

Corresponding Author: jenni.carter@unisa.edu.au

Stories about animals are a feature of children’s literature, with Australian animals having a prominent role in Australian picture books and novels from early colonial times. In these stories animals are presented in various ways including being exoticised, having human qualities and relationships, and encountering events that are concerned with the nature of relationships between humans and animals.

In this presentation I will consider the contemporary children’s picture book, ‘The Diary of a Wombat’ by the Australian author Jackie French. While this book provides a starting point and fosters curiosity for children to inquire about wombats and how they live, it further challenges thinking about how animals and humans live together in the world and some of the ethical issues that arise.
Sarcoptic mange and wombats

Scott Carver

Department of Biological Sciences, University of Tasmania

Corresponding Author: scott.carver@utas.edu.au

The most important disease of wombats (bare-nosed and southern hairy nosed) in Australia is sarcoptic mange. This disease is caused by Sarcoptes scabiei, a globally dispersed parasitic mite with a broad host range, spanning >100 species across 10 mammalian orders, including humans. In Australia this mite was evidently introduced (directly or indirectly) by European settlers and is known to infest a number of species. Reports of mange driven declines of wombat populations date back to the 1930s, and there remains much to be learned about this disease and how to manage it. I will summarise the research from my group focussed on the ecology and epidemiology of sarcoptic mange disease of wombats. I will present our broad efforts to understand this disease; from within host immune responses to infestation, to population level impacts, invasion history, and conservation management.
A revegetation experiment for wombats on Moorunde Wildlife Reserve

Peter R. Clements¹, Glen Taylor¹

¹ Wombats SA

Corresponding Author: peter.clements@adelaide.edu.au

A community grant scheme was used to fund a revegetation project on Moorunde in 2013. The wombats had been reduced to eating weeds as there were very few native grasses evident on the reserve, due to grazing pressure primarily from kangaroos, rabbits and wombats. A three-hectare area with no burrows was chosen, fenced off and the ground prepared before Austrostipa nitida seeds were spread by hand. No germination occurred in the first 12 months but the year following had good rains at the right time and a good cover of spear grass and wallaby grass appeared. Much of the grass, which germinated in profusion over the entire plot including the control plot, was endogenous Austrostipa eremophila. This was followed a few weeks later by the sown A. nitida. Identified grasses will be listed. Wombat gates were installed once the grasses were established. However, the spear grasses were initially ignored in favour of Moraea setifolia (thread iris), the corms of which the wombats dig up over many hectares. They did eventually eat the spear grass.
Community involvement and management of conservation parks for wombats

Tricia Curtis

Friends of Brookfield Conservation Park

Corresponding Author: triciac99@hotmail.com

Community engagement: if supported and managed well, the community can achieve almost anything. Unfortunately today it is a term frequently over-used by many and at times delivered with minimal substance. What does it truly mean to engage the community? How do we harness the enthusiasm of those who care, who want to contribute or who are just plain curious.

Brookfield Conservation Park, home to the southern hairy-nosed wombat is also home to where a unique and innovative approach to state park management began. Community engagement was at the core of this new management style, harnessing people’s desire to be involved in nature, be it by means of park maintenance or scientific research. Numerous lessons have been learnt along the way; doors have been opened, closed and opened again. There have been triumphs and disappointments. Most importantly, it’s the community who have led the way all along and continue to do so.

What has inspired us to head down this path, to persevere and who will continue to lead the way, to champion this tried and tested model that has immense potential in securing the future of our parks.
A Guide to the Care of Bare-Nosed Wombats

Linda Dennis

Fourth Crossing Wildlife

Corresponding Author: linda@fourthcrossingwildlife.com

My first hand-raised wombat - Tici - was a labour of love. It is said that you do either love or hate caring for wombats… it was love at first bite for me! I say “labour” because at the time there was very little wombat rehabilitation knowledge that was freely shared within the wildlife community. I was pretty much winging it and using my macropod knowledge, adapted for wombats. A few years later, my first pinkie wombat - Keti, started fitting. It was like stumbling around in the dark, trying to get answers as to what was happening with this tiny wombat.

So I started researching in earnest - reading everything I could on wombats and quizzing many long-term wombat carers and in 2005 I wrote my own wombat care guide - A Guide to the Care of Bare-Nosed Wombats - that is available to all wombat carers all around the world - for free! Thirteen years after its debut the guide has had three major updates and includes a section written by veterinarians Dr Anne Fowler and Dr Kim Rolls and a homeopathic section written by Anne-Marie Dineen.

The guide has been hugely beneficial for many wombat carers and it has been touted by some as the Wombat Bible!

"I am caring for wombats through WIRES and I have found that your manual is the best source of information I can possibly have if I need to check something at any time. Thanks."

Michelle Ryan-Gales

Sections in the guide include: - rescue, short term care, raising orphaned joeys, the unwell joey - the carer’s perspective, caring for larger wombats, release, and more. My talk at the Wombat Conference will explore the care guide and I will also share some of my wombat work with delegates.
Status of wombats and mange in Tasmania

Michael M Driessen¹, Rosemary Gales¹, Elise Dewar¹

¹ Tasmanian Government, Department of Primary Industries, Parks, Water and Environment

Corresponding Author: Michael.Driessen@dpipwe.tas.gov.au

Sarcoptic mange is believed to have been affecting wombats in Australia since the arrival of Europeans. Little is known about the prevalence of mange in wombat populations or the potential for severe outbreaks to cause population declines. One such decline was recently documented by the University of Tasmania (UTAS) for common wombats in northern Tasmania. In response, the Tasmanian Department of Primary Industries, Parks Water and Environment:
1) undertook a review of wombat population trends and assessed mange prevalence;
2) provided funding for community groups to treat mange in wild wombats, and;
3) supported investigation of a new treatment option by UTAS.

Systematic spotlight monitoring of wombats for the past 30 years confirmed a localised decline in numbers in northern Tasmania; however, regionally and across all survey areas, wombat numbers have been stable or increasing. Additional spotlight surveys demonstrated that the prevalence of visible mange varied between 0 and 6%, with a state-wide average of around 1%. Mange management continues to be a challenge, the factors that lead to severe outbreaks and population decline is not known and there is currently no effective population-level treatment of mange for wombats. We discuss issues and knowledge gaps for wombat management in Tasmania.
Wombats in captivity - we can do better

Yvette Fenning

Rockhampton Zoo

Corresponding Author: yvette.fenning@rrc.qld.gov.au

Wombats are a challenging species to house well in a captive environment. Modern animal welfare standards demand a deep understanding of the five domains of animal welfare. Within the zoo industry we must demonstrate our commitment to these five domains of animal welfare and prove that we are providing an environment that allows for a positive welfare experience for each individual animal.

Modern welfare standards go well beyond simply providing enough food, water and shelter and preventing injury and disease. Animals must be able to exhibit species specific behaviours. The very nature of the wombat – a large burrowing, grazing herbivore – makes providing an environment conducive to their lifestyle habits a challenge indeed. As a zoo industry we need to show that we are the yardstick of quality animal care and at the moment we are failing in this duty to wombats. While many zoos are genuinely making a good attempt to provide adequately for their wombat species, I believe we are still a long way from achieving positive welfare standards for all captive wombats.

This talk will discuss what the zoo industry is doing well and offer suggestions for things we can do better.
“Right-oh Ron”: The as yet untold story of southern hairy-nosed wombat research in the South Australian Murraylands

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In 1993 an unlikely relationship commenced between research staff from Monash University and a local rabbit hunter from outback South Australia. Who would have known that this would form the start of a long and prosperous partnership of research into various aspects of southern hairy-nosed wombat biology. In the early days the initial challenge was getting enough sleep during field trips, but as methods of capture and processing animals were refined, research investigated various aspects of wombat biology ranging from refining capture techniques, ranging behaviour, burrow use and activity patterns, diet, timing of breeding, growth and development of young, collection and analysis of sperm, super-ovulation, effects of inbreeding on fertility, population genetics, nutrition and anti-oxidant levels, as well as the impacts of an outbreak of mange on populations. With each trip, improvements were made to the wombat facility (the Kooloola woolshed) and the specialised wombat capture vehicle.

This presentation details some of the long-term trends from Kooloola and also some of the more light-hearted moments from a long-standing research partnership and a lifetime dedicated to southern hairy-nosed wombat research.
Wombat head injuries, treatment, recovery and the modified Glasgow Coma Scale.

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Wombat head injuries resulting from motor vehicle collisions are an unfortunate and frequent occurrence that confront wildlife carers and veterinarians. With good care many survive although the journey to recovery may be long and difficult with several critical decision points along the way.

In 1983 a modified version of the more commonly used Glasgow Coma Scale (MGCS) for humans (Teasdale and Jennet 1974) was developed to assess neurological deficit in dogs with head trauma (Shores 1983), to better tailor therapeutic treatment and to assess what the prognosis might be.

The MGCS enables an assessment in relation to brainstem reflexes, motor activity and level of consciousness. The prognostic value of this approach for head trauma in dogs was tested by Simon \textit{et al} (2001) who found an almost linear relationship between the MGCS and probability of survival following head trauma. Gender, weight, age and fractures did not predict survival.

In this paper, the possibility of using the MGCS for wombat head trauma is examined. Case examples are presented, and conclusions drawn as to whether the MGCS could be a useful tool for veterinarians and carers for predicting survival and whether wildlife and wombat-specific characteristics need to be built into the measure.

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The extent to which wombats used particular warrens or clusters of warrens on most nights (i.e. were residents) on the Brookfield Conservation Park was evaluated by direct observations of wombats in 1975 - 1977, and from genetic data obtained by hair-trapping in 2000 - 2001. These data were compared with data from a study of wombats that were radio-tracked on a pastoral property from June 2000 to February 2002.

In 1975 - 1977, ten individually marked wombats (six males and four females) resided in three clusters of warrens. Four of the wombats used burrows almost always in one cluster and the other six wombats resided in the other two clusters. One female wombat resided in all three clusters at different times.

In 2000 - 2001, 7 of 11 wombats resided in the larger of two warrens that were studied and four in the nearby smaller warren. But 29% of detections of females were in warrens other than their home warren compared to 6% for males.

On the pastoral property five different radio-tracked females shared five clusters of warrens with five different males. Apart from one female, each male/female ‘pair’ of one cluster of warrens was not detected in the cluster of another ‘pair’.

Wombats reside in particular warrens or clusters of warrens. Some females change residence. Changing residence may enable female wombats to choose the first social group of their young.
The sex-ratio of pouch-young and adult hairy-nosed wombats (*Lasiorhinus latifrons* and *Lasiorhinus krefftii*)

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We investigated the sex-ratio of populations of *Lasiorhinus latifrons* and *Lasiorhinus krefftii*. Data on the sex of pouch-young of *L. latifrons* were obtained from 283 wombats that were examined on a pastoral property in the Murraylands of South Australia from 1994 - 2014. Of the 283 pouch young that were examined, 160 (56.5%) were female and 123 (43.5%) were male (exact binomial test P = 0.03).

Data on the sex-ratio of adult *L. latifrons* were obtained from published studies and theses. The mean percentage of females in the 11 studies examined was 55.8 with a 95% confidence interval of 51.5 to 60.2. The mean percentage of females in the 7 samples from large contiguous populations was 59.1% whereas it was 50.1% in the 4 isolated populations (t = -3.00, 9 degrees of freedom, P = 0.01).

Data from adult *L. krefftii* showed that the sex-ratio changed from no bias in 1985-1989 to a statistically significant male bias by 2000 and then to about equal numbers of males and females from 2013. Between 2000 and 2013 the rate of increase in females detected was much greater than the rate of increase of males; females increased from 29 to 72 whereas males increased from 52 to 73. (Chi-squared = 6.9, 1 degree of freedom P = 0.008).

A female bias may enable populations to increase more quickly. But, a male-bias especially in small or declining populations of wombats may increase their vulnerability to extinction.
The socialisation of a young southern hairy-nosed wombat

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The behaviour of a young wombat was observed on the Brookfield Conservation Park for nine months from when it was first seen above ground with its mother in July 1975. It resided with its mother in a small warren of three burrows that was situated between two larger warrens. For two months it did not travel away from the warren with its mother. After two months it accompanied its mother when she moved away from the warren to feed and visit other warrens. The percentage of the time that it was seen alone and its mother was not nearby increased from 27% in July to 89% by October. By November 1975 its mother had moved to reside in one of the nearby warrens. The young wombat stayed in its natal warren but was also seen at the other warrens.

The young wombat encountered most of the adult wombats of the nearby warrens. Most of its social encounters and interactions were with the two largest adult male wombats of the warren its mother had moved to. The behaviour toward one of the adult males was almost parent-child like in contrast to the other adult male which more often caused it to be alarmed and flee.

The observations suggest that the young wombat was socialised to a particular group of wombats and recognised individuals, perhaps some as kin.
Mange and other threats to wombats

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Wombat populations are on the decline due to a number of factors. One of the biggest factors is mange, but there is also roadkill, dog attack, loss of habitat and legal / illegal culling. We look at these issues, provide an overview of them, what's being done at the moment and ideas and possible solutions to address them in the future. The main focus will be mange; however, we will also touch on the other threats to create a bigger picture.

We will cover some of our infield treatment experiences and methods, along with observations we have seen, with cameras and first hand.
Demography and reproduction in the northern hairy-nosed wombat

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The northern hairy-nosed wombat is one of the world’s rarest mammals. When the last population was protected in 1971 on Epping Forest National Park in central Queensland, it contained only 20-30 wombats. For the next three decades, the population grew slowly but became male-biased. In 2001, dingoes killed nine wombats, prompting the construction of a predator fence around all wombat habitat on the park. This management action, coupled with the provision of artificial water sources, has led to a major recovery in numbers and sex ratio, and the establishment of a second population of northern hairy-nosed wombats. In the 2016 census, there were 245 northern hairy-nosed wombats on Epping Forest NP and the population continues to grow.

Little is known of the reproductive biology of the northern hairy-nosed wombat. Since 2010, remote camera trapping has greatly increased our knowledge of birth patterns, maternal behaviour, and juvenile development. At least 80 different pouch young have been recorded on camera and several have been followed through to independence. Three-quarters of these young were born in the wet season, confirming a strong relationship between breeding and rainfall. Remote cameras have provided evidence for and against female breeding dispersal, including at least one very prolific female who has produced four young at the same burrow over seven years.
The development of breeding technology in captive wombats

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Successful reliable breeding of wombats in captivity remains a major challenge, primarily associated with an inability to adequately profile their reproductive physiology and behaviour for the purposes of the timing of natural service or artificial insemination. This paper provides a brief historical overview of our wombat reproductive studies over the last 13 years, the majority of which have been directed towards the establishment of improved captive breeding success in the common and SHN wombats as working models for an insurance colony of NHN wombats. We highlight the unique challenges of developing breeding technology in these species compared to the closely related koala and some of the novel innovative approaches we have attempted to overcome these limitations. We also report for the first time, preliminary attempts at an artificial insemination program in the SHN wombat using frozen-thawed cauda epididymal spermatozoa and future research plans for oestrous synchronisation procedures and a second round of artificial insemination attempts using electro-ejaculated semen.
In search for a non-invasive pregnancy test for marsupials: the southern hairy-nosed wombat as a model species.

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Detecting pregnancy in some mammalian species is as easy as confirming the presence of a pregnancy specific hormone such as chorionic gonadotropin (CG) or identifying changes in hormone levels indicative of pregnancy. For marsupials, pregnancy detection is not straightforward due to the similarities between the pattern of hormone secretion and length of the pregnant and non-pregnant luteal phase.

We evaluated two potential biomarkers of pregnancy (successfully used in felids and giant pandas) towards the development of a pregnancy test for the Southern hairy-nosed wombat. First we tested urinary hormone levels of 13,14-dihydro-15-keto-prostaglandin F2α (PGFM) of a pregnant and non-pregnant female but pregnancy related changes were not detected. Next we tested the changes of the activity levels of the acute phase protein ceruloplasmin in the urine of a pregnant and two non-pregnant females. The pattern of urinary ceruloplasmin levels in the pregnant wombat varied considerably from that of the two non-pregnant wombats.

These preliminary results suggest that urinary ceruloplasmin may be a suitable pregnancy marker for wombats. When mating is observed but no young is produced, knowing if failure occurred at mating, during pregnancy or at birth will assist us in identifying causes of reproductive failure, allowing us to improve reproductive success and captive management.
Releasing hand-raised wombats

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Jen Mattingley has been a wildlife carer in Gippsland, Victoria for over 30 years and has spent much of this time raising and releasing bare-nosed wombats. She realizes the importance of preparing a wombat joey so it will be able to survive on its own in the wild. There are a lot of considerations and signs to be looking for when the time comes to release your wombat and she hopes some of her knowledge and experience will help others with this often difficult task.
Story of the northern hairy-nosed wombats

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In 2009, a handful of critically endangered northern hairy-nosed wombats were flown from the last remaining population in central Queensland to populate a new home, hundreds of kilometres away. The establishment of a second population of northern hairy-nosed wombats was a big step forward for a species that had been restricted to fewer than 200 individuals in one small population in central Queensland.

How did we get to this point and what are the elements of ongoing success?

The Wombat Foundation is the only organisation dedicated exclusively to conservation of the northern hairy-nosed wombat: Queensland’s most endangered mammal. We will share top-line preliminary findings from the first comprehensive research gap analysis of northern hairy-nosed wombat reproductive biology, social behaviour, function ecology, and major conservation threats.

Join us as we share the story of the northern hairy nosed wombats and how we can work together to secure their future by continuing to rebuild populations so the species can live sustainably across their historic range.
Humerus histology in modern and fossil wombats reveals rapid ontogenetic bone adaptation to burrowing

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The behaviour of the common wombat requires unique biological adaptations to accommodate efficient digging within a hypoxic burrow environment. Spending prolonged periods of time underground, coupled with a low basal metabolic rate, should be reflected in the structure and growth dynamics of their bone tissue. Consequently, understanding wombat skeletal biology will be key when reconstructing their ecology and behaviour in palaeontological contexts.

Here, we provide the first record of wombat humerus histology in both modern and fossil specimens. We compared bone vascularity and cell network throughout humerus midshaft cross-sections in a modern adult Vombatus ursinus (Mt Fairy, NSW) and a Pleistocene fossil Vombatus sp. (Bakers Swamp, NSW) specimen. We hypothesised:
(1) temporal differences in bone growth dynamics; and
(2) presence of bone growth markers specific to burrowing behaviours.

Our results showed lower values of bone vascularity and wider distances between neighbouring cell cavities in the fossil specimen. Bone histology was densely organised in regions associated with earlier ontogenetic stages in both samples. These data suggest:
(1) a possible increase in bone metabolism rate over time; and
(2) rapid ontogenetic bone adaptation to the burrowing specific biomechanical and environmental contexts may have been present since the Pleistocene.
The southern hairy-nosed wombat (*Lasiorhinus latifrons*), an ecosystem engineer in the mid-north of South Australia

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Ecosystem engineers modify the environment, changing resource availability for use by other species. The southern hairy-nosed wombat (*Lasiorhinus latifrons*) inhabits the semi-arid to arid regions of southern Australia. Its excavation of burrows ameliorates surface conditions, enabling its survival under the extreme temperatures and aridity that characterise these environments. While other digging species have often been identified as functional species, the wombat is perceived as being destructive, resulting in its persecution and leaving its role in the context of functionality largely overlooked.

This study of the southern hairy-nosed wombat and its impact on the environment is current and ongoing. Hence, this presentation discusses the outcomes of only three of the analyses being undertaken: camera trapping, which was used to determine vertebrate visitation to burrows; pitfall trapping, which was used to measure invertebrate occupancy and abundance; and, soil sampling and seed germination, which was used to measure the seedbank potential of excavated areas associated with wombat activity. Results to date suggest that *L. latifrons* is an important functional species. Its roles need to be recognised if the appropriate conservation and collaborative management of a species that is declining across its range largely due to human activities and persecution is to be successful.
Evaluating non-lethal human-wombat conflict mitigation strategies

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Wombats are a much-loved iconic Australian animal, but they are also considered an agricultural pest throughout much of their range. The damage caused by wombats burrowing and grazing behaviour often results in substantial financial losses, decreased production, and a loss of time in reparations. Despite this, farmers show strong support for their conservation and the development of non-lethal damage management strategies (Sparrow 2011). As yet, effective, socially acceptable, and economically viable non-lethal conflict mitigation strategies are not available for wombats. Although wombats have responded to relocation with high survival, it is time consuming, costly, and neighbouring animals recolonised the vacated burrows of translocated individuals within 1 - 2 weeks, failing to resolve conflicts.

This study assessed the effectiveness of dingo urine and faeces, blood and bone (Brunnings PTY LTD) and compact discs (CD’s) in deterring wombats from their burrows. CD’s decreased the number of visits to burrows, but wombats habituated to them within a few days. All other treatments did not significantly affect wombat behaviour. Despite being ineffective in resolving conflicts, this research provides vital information to wildlife managers to aid in the future management of wombats and guide future research directions to develop co-existence strategies.
An investigation of sarcoptic mange

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The southern hairy-nosed (Lasiorhinus latifrons) and bare-nosed wombat (Vombatus ursinus) both suffer from sarcoptic mange. Mange infestations are severely debilitating, and result in death of the wombat through secondary infections. Although wombats can, at times, be treated using ‘treatment flaps’ or invasive techniques, these methods have limitations and are not always effective.

WomSAT is a citizen science-based website, with associated iPhone and Android apps. It allows everyone to log wombats (dead or alive, and their level of mange), and wombat burrow sightings online, in real-time. The information gathered is being used to investigate the ecology of wombats and sarcoptic mange. Long-term data on mange distribution and prevalence will be used to aid the development of a nation-wide strategy to manage mange.

WomSAT has also been collecting data on road killed wombats. Information gathered to date will be discussed and possible locations for implementing road kill mitigation strategies suggested. In addition, other scientific investigations related to sarcoptic mange will be presented, including those related to the immune system and nutrition of wombats.
Mapping and modelling support for future management and conservation

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Although SHN wombats are an iconic species and are protected under state and federal legislation, the species is coming under increasing pressure from a variety of threats. These include: land clearance and degradation, habitat fragmentation, changed drought frequency and duration, disease, inbreeding and increased competition with humans, feral animals and domestic livestock. Understanding present and future distributions of wombats is important for semi-arid environments in general. The role of soil engineers and burrowing species is being increasingly recognised as having broad benefits for fauna and flora biodiversity and ecosystem health due to the influence this group has on soil health, vegetation composition and landscape heterogeneity.

In this presentation we will summarise progress and challenges toward a predictive understanding of population fluctuations in space and time. Preliminary evidence of changing wombat distribution with time suggests that suitable habitat for SHN wombats may be severely reduced under future environmental change. This underpins the need for long-term and broad-scale strategies for conservation with implications beyond the species itself.

From a modelling perspective, both detail and spatial extent of distribution exceeds that of any other wildlife species, providing a unique wildlife dataset compared to any other species worldwide. The conspicuous nature of its burrowing activity within the landscape makes it an ideal species upon which to develop and test new models for wildlife management with footprints of individual warrens readily identified using broad-scale satellite imagery.
Captive-breeding of bare-nosed and southern hairy-nosed wombats by zoos outside Australia

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Dr. Andy Podolsky originally trained as a historian. But about four years ago he developed a hypothesis, based on data from ‘Species 360’ (formerly the International Species Information System), that he could visit all of the 38 zoos and wildlife parks in the world that care for wombats. While his nearly three years of field research confirmed that there are no northern hairy-nosed wombats in captivity, Andy turned up no less than 97 bare-nosed and southern hairy-nosed wombat exhibitors around the world: and he has visited them all!

Of some 20 zoos with wombats outside Australia, there are a handful in North America, Europe, and Asia that have successful bare-nosed and southern hairy-nosed captive-breeding programs. Working independently, these few zoos range from a major, well-known institution in the U.S. to a tiny municipal zoo outside Osaka. A committed wombatophile, Andy will share his observations from his recent travels… and will welcome suggestions of locations with wombats he might have missed!
Assessing wombat abundances in the Murraylands

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Assessing and monitoring of wildlife are central to management. This study compares a broad range of direct and indirect methods including on-ground spotlighting, camera traps, scat counts, Google Earth imagery, and air photos to assess spatial and temporal pattern of wombat activity with the aim to assess wombat numbers. Specifically, this study aimed to determine if a relationship exists between spatially observable warren dimensions, active burrows, and the number of wombats occupying a warren and thus to provide quick and accurate methods to enable wildlife managers to determine future wombat populations. Studies were conducted in Murraylands.

This study found warrens to contain an average of 0.4 wombats per active burrow. This figure is comparable to previous population studies of the southern hairy-nosed wombat conducted in the Murraylands. Scat counts were used to provide a quantitative estimate of the number of wombats using a warren but results were too variable to provide accurate estimates. We also found a substantial temporal and spatial bias in wombat observations during spotlighting. The time of the year, vegetation height and density as well as the density of warrens influenced observed numbers during spotlighting surveys. However, wombat densities derived from spotlighting corresponded with spatial patterns observable from air photos, providing the means to quantify bias by using spatially-derived parameters. A strong positive relationship between the number of active burrows in a warren and its size was also found.

Whilst single spotlighting surveys could not be used to accurately estimate population numbers, combination with camera trap data to assess temporal biases and detailed remote sensing data to assess spatial biases increases the informative value of spotlighting data. This study highlights the benefits of using a range of methods across spatial scales towards accurately estimating southern hairy-nosed wombat populations over large areas.
Wombats through time and space: using late Pleistocene Tasmanian bare-nosed wombat populations to inform management strategies into the future

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The field of applied zooarchaeology – the study of archaeological faunal assemblages to provide deep-time information on changes to biological and cultural conditions relevant to conservation science – has seen a notable increase over the last decade, largely based in North America. Through the application of applied zooarchaeology we are able to investigate a range of research questions, including the historic distribution of species, the origin of different populations through aDNA, disease history and how particular species respond to environmental change.

This paper presents the first application of this approach to the Tasmanian bare-nosed wombat, discussing research utilising several archaeological assemblages excavated in southwest Tasmania dated to between 30,000 – 12,500 years BP. This time period is characterised by significant changes in local and regional ecology and climate, transitioning from a cold, arid climate dominated by grasses, to warm, moist temperate rainforest. Through utilising stable isotopic analysis of wombat dental enamel (δ13C and δ18O), this study has identified changes in diet, behaviour and local adaptation within this population over 20,000 years. The results have implications for conservation biologists investigating the potential outcomes of our warming climate on this cold-adapted species.
Square salads: exploring the diet of the southern hairy-nosed wombat 
(Lasiorhinus latifrons) via metabarcoding

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Southern hairy-nosed (SHN) wombats (Lasiorhinus latifrons) are large semi-fossorial marsupials that inhabit the semiarid areas of South Australia. Despite their size and prominence on the landscape, little is published about diet and foraging preferences. Further, it is unclear whether wombat diet overlaps with sympatric western grey (WG) kangaroos (Macropus fuliginosus), and whether competition for food resources is an added stressor in Murrayland populations where kangaroos are abundant, such as at Brookfield Conservation Park. In this preliminary study, we identified diet items and dietary overlap of SHN wombats and WG kangaroos. We accomplished this by opportunistically sampling 20 fecal pellets from both SHN wombats and WG Kangaroos across Brookfield Conservation Park in April 2017. We performed plant ITS2 metabarcoding via Illumina next generation sequencing of the fecal DNA. From this we identified 20 plant genera for kangaroos and 10 genera for wombats. Eight genera were shared between both marsupials. This initial test highlights the capabilities of non-invasive genetic sampling in concert with DNA metabarcoding to elucidate diet.
Urine as a tool to identify and monitor oestrous in captive female southern hairy-nosed wombats (*Lasiorhinus latifrons*)

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Breeding wombats in captivity has been challenging due to our current inability to accurately identify and monitor oestrous in the female. As faecal hormone analysis has provided useful yet limited information on the female southern hairy-nosed (SHN) wombat’s reproductive physiology and endocrinology, nine captive female SHN wombats were conditioned for daily urine sample collection during two consecutive wombat breeding seasons (2013; 2014).

Urine samples were analysed for progesterone metabolites and physiochemical characteristics including volume, concentration and the number of epithelial cells. When progesterone levels were ≤ baseline, urine volume was low (P = 0.007) while urine concentration (P = 0.001) and number of epithelial cells present in the urine were high (P = 0.001). Additionally, an increase in the duration and frequency of pacing (P = 0.05) and aggressive behaviours such as rump biting (P = 0.04) were also observed prior to an increase in urinary progesterone metabolites.

While there was individual variation between the females within this study, the results suggest that urine has the potential to be a useful non-invasive tool for monitor the reproduction of captive female SHN wombats which could be easily applied to captive breeding programs.
Using remote sensing and spatial science to assist with the management of southern hairy-nosed wombats

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Southern hairy-nosed wombats inhabit open grasslands in the arid and semi-arid regions of south-central South Australia and the south-eastern corner of Western Australia, where they construct extensive warren systems that can be seen from aircraft and satellites. This visibility from above makes them an ideal candidate for population monitoring using satellite imagery and other remote sensing tools.

Using freely available, very-high resolution satellite imagery, combined with data from ground surveys and remote sensing, we have mapped the species-wide distribution and estimated the overall abundance of southern hairy-nosed wombats. By combining this information with spatial data such as soil and climate maps, we have also been able to determine the factors that affect their distribution and abundance at different spatial scales.

The evidence shows that the wombat population has been increasing over the past 30 years, and now numbers ~ 1 million individuals. The information from satellite imagery also confirms that illegal control methods are being used in a number of locations. The key drivers of wombat distribution and abundance appear to be aridity and plant water holding, rainfall reliability, soil clay content, understory vegetation, and land-use. An understanding of these factors will allow us to make better informed management decisions.
Southern hairy-nosed wombats: tough as boot leather – or are they!

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Studies on the biology and ecology of southern hairy-nosed wombats in the Murraylands of South Australia across more than four decades paint a picture of an iconic Australian marsupial superbly adapted to the semi-arid environment in which it occurs. In this environment, annual rainfall averages only 270mm annually and drought is common, yet wombats thrive. Together this information would suggest that this species is as tough as boot leather!

This paper examines this idea and some of the biological, physiological and ecological characteristics of this species that have made it so successful. It also discusses recent research and gaps in our knowledge which suggest that the future outlook for this species may not be as bright as it might initially appear.
A long-term population study of the southern hairy nosed wombat (*Lasiorhinus latifrons*) at Moorunde Wildlife Reserve, South Australia

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In 1994 a paper entitled as above was presented at the conference sponsored by the Zoological Society of SA and published in “Wombats”. It described a method of estimating the population using an activity recorder at a selected wombat warren to establish a ratio between the number of active entrances and the population of the warren. The result was refined by applying it in two study areas during inspections several times a year, then extending them to the inspections of the whole reserve at intervals of several years. This paper is a brief summary of the results of inspections of the two study areas over 43 years up to 2016.
Islands as refuges: southern hairy-nosed wombats on Wedge Island

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We examine a multi-species translocation of marsupials onto Wedge Island off the Southern Australian coast. Fewer than a dozen individuals of three species; southern hairy-nosed wombat (*Lasiorhinus latifrons*), black-footed rock wallaby (*Petrogale lateralis pearsonii*), and brush-tailed bettong (*Bettongia penicillata*) were released. We assess the development of these populations over four decades and provide evidence for species interactions.

All three species have shown substantial population increase. Wombat activity across the island has increased exponentially with >700 burrows detected. Examining animal tracks, we found that rock wallaby activity was observed in 45% of active wombat burrows and bettong activity observed in 10% of inactive burrows. Wallabies prefer active, bettongs inactive burrows, respectively. Camera traps were used to monitor wombat burrow on Wedge Island across a 7-month period between late summer and early spring 2015. During this period 331,639 photos were collected of which 105,749 were analysed with 3,608 records of burrow use. Burrow use records from visitors exceed wombat records. A total of five non-burrowing species were recorded in multiple burrow use events.

Burrowing animals are ecosystem engineers. This study demonstrates benefits wombat burrows for non-burrowing species. Historically, the focus of most translocations has been the conservation of single species with little data on long-term translocation success and population dynamics post release. This study suggests that islands have significant potential for long term threatened species conservation and that translocation of a suite of interacting species may help improve habitat suitability for wildlife and thus increase the overall conservation benefits realised.
Revisiting wombat hair: molecularly tracking a burrowing marsupial through time

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Over 15 years have passed since non-invasive genetic methods were used to identify 110 southern hairy-nosed wombats (Lasiorhinus latifrons) and their space use and relatedness in 1 km² at Brookfield Conservation Park, South Australia. Because the species is long-lived (> 30 years) and genetic methods can identify all wombats in an area, it is possible to determine whether population size or space use has changed and if any individuals are still alive. To this end, we collected hair from the same warrens in April 2017. To do so we suspended sticky tape across 350 burrows, collected hair for five nights, and performed DNA extractions on 460 hit tapes, resulting in 810 genetic samples. We subjected the DNA to six recently-developed microsatellites and a Y-linked sex marker, and have thus far genotyped two nights, detecting 89 wombats (36 males, 53 females). Number of tapes hit and wombats detected are on par with the most active sampling period of the previous study. We expect additional individuals over the remaining nights. In future we will screen older microsatellites to identify any wombats remaining from the early 2000s. This is one of the few studies of Australian wildlife to monitor fine-scale population processes across decades.
Wombats, the past, present and future

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Twenty years have elapsed since publication of ‘Wombats’, the proceedings of the first wombat conference. In this introduction I review the unresolved questions in wombat conservation and management that were raised. I will briefly review progress in the intervening years. I draw on photo point records to highlight vegetation and land use changes in the Murraylands and the implications for the long term survival of this population of the southern hairy-nosed wombat.
Southern hairy nosed wombats of the Murraylands: a survey of health and disease 2011 - 2016

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The Southern hairy nosed wombats (Lasiorhinus latifrons) in the South Australian Murraylands face a number of threats including persecution, habitat loss and degradation and disease, with a 70% decline in the Murray Lands population reported between 2002 and 2008. In response to sightings of sick wombats in degraded regions of the Murraylands, we performed physical and blood examinations on 149 wombats and post mortem examinations on 18 wombats between 2011 and 2016 from both degraded and conserved locations throughout the Murraylands. Most wombats from conserved or good habitat were found to be in good physical health, although there were some regional and age-associated variation in post mortem, haematological and biochemical findings. Conversely, wombats from degraded habitat were often found in poor body condition, in some cases emaciated, with bacterial and parasitic dermatitis, and in a few juvenile individuals, liver disease due to grazing of toxic weeds; haematological and biochemical findings in these wombats also suggested nutritional stress.

Findings from this study provide an overview of current endemic and emerging health issues in Murraylands wombats and show significant deleterious impact due loss of preferred grazing habitat and overgrowth of invasive weed species in some regions.
De novo genome and transcriptome assemblies of the bare-nosed wombat

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As part of the Oz Mammals Genomics Consortium, we have been working on de novo genome and transcriptome sequencing of the bare-nosed wombat (*Vombatus ursinus*). Our datasets include deep Illumina HiSeq 4000 paired-end sequencing data (100x coverage), 10X Genomics microfluidics-based linked reads (56x), low-coverage Pacbio single-molecule real time (SMRT) sequencing data (5x) and RNA-seq data generated from six different tissues using Illumina HiSeq 4000 paired-end technology from a single animal. Additional genomes are currently being sequenced to study differences among wombat species. The draft genome assembly has a N50 scaffold size of 29.4 Mbp with an estimated assembly size of 3.6 Gbp. Four transcriptome assemblies generated using a total of 862 million reads pooled from five of the six tissues with four different assemblers. A consensus set of 135,741 unigenes was constructed using a published pipeline of CD-Hit-EST and annotated with Tritonate to present as the final representative transcriptome assembly. We used the Benchmarking Universal Single-Copy Orthologs (BUSCO) library of mammalian orthologous genes for quality assessment and recovered 95% of 4101 single-copy mammalian orthologs in the transcriptome assembly. This presentation will report the updated state of the genome and transcriptome assemblies and discuss assembly approaches applied using multiple platforms.