

Project Closure SP 2007-002

Identifying the cause(s) of the recent declines of woylies in south-west Western Australia

Animal Science

Project Core Team

Supervising Scientist

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Data Custodian

Site Custodian

Project status as of Feb. 4, 2019, 5:01 p.m.

Terminated and closed

Document endorsements and approvals as of Feb. 4, 2019, 5:01 p.m.

Project Team

granted

Program Leader

granted

Directorate

granted

Identifying the cause(s) of the recent declines of woylies in south-west Western Australia

Key publications and documents

0.0.1 PEER-REVIEWED SCIENTIFIC PUBLICATIONS

Averis, S., R. C. A. Thompson, A. J. Lymbery, A. F. Wayne, K. D. Morris, and A. Smith. 2009. The diversity, distribution and host-parasite associations of trypanosomes in Western Australian Wildlife. *Parasitology* **136**:1269-1279.

Bennett, M. D., A. Reiss, H. Stevens, E. Heylen, M. Van Ranst, A. F. Wayne, M. Slaven, J. N. Mills, K. S. Warren, A. J. O'Hara, and P. K. Nicholls. 2010. The first complete papillomavirus genome characterized from a marsupial host: a novel isolate from *Bettongia penicillata*. *Journal of Virology* **84**:5448-5453.

Botero, A., Thompson, C.K., Peacock, C.S., Clode, P.L., Nicholls, P.K., Wayne, A.F., Lymbery, A.J., Thompson, R.C.A., 2013. Trypanosomes genetic diversity, polyparasitism and the population decline of the critically endangered Australian marsupial, the brush tailed bettong or woylie (*Bettongia penicillata*). *International Journal for Parasitology: Parasites and Wildlife* **2**, 77-89.

Glen, A., A. F. Wayne, M. Maxwell, and J. Cruz. 2010. Comparative diets of the chuditch, a threatened marsupial carnivore, in the northern and southern jarrah forests, Western Australia. *Journal of Zoology (London)* **282**:276-283.

Groom, C. 2010. Justification for continued conservation efforts following the delisting of a threatened species: A case study of the woylie, *Bettongia penicillata ogilbyi* (Marsupialia: Potoroidae). *Wildlife Research*. **37**: 183-193.

Kaewmongkol, G., Kaewmongkol, S., Burmej, H., Bennett, M. D., Fleming, P., Adams, P. J., Wayne, A. F., Ryan, U., Irwin, P. and Fenwick, S. G. 2011. Diversity of *Bartonella* species detected in arthropod vectors from animals in Australia. *Comparative Immunology, Microbiology & Infectious Diseases* **34**(5), 411-417.

Northover, A.S., Godfrey, S.S., Lymbery, A.J., Morris, K.D., Wayne, A.F., Thompson, R.C.A., 2015. Evaluating the effects of Ivermectin treatment on communities of gastrointestinal parasites in translocated woylies (*Bettongia penicillata*). *EcoHealth*. DOI: 10.1007/s10393-015-1088-2

Pacioni, C. and Spencer, P. 2010. Capturing genetic information using non-target species markers in a species that has undergone a population crash. *Australian Mammalogy* **32**: 33-38.

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Pacioni, C., Robertson, I., Maxwell, M., Van Weenan, J. and Wayne, A. F. 2013. Hematologic characteristics of the woylie (*Bettongia penicillata ogilbyi*). *Journal of Wildlife Diseases*. **49**(4): 816-830.

Pacioni, C., Johansen, C. A., Mahony, T. J., O'Dea, M., Robertson, I., Wayne, A. F. and Ellis, T. 2014. A virological investigation into declining woylie populations *Australian Journal of Zoology*. **61**: 446-453.

Pacioni, C., Eden, P., Reiss, A., Ellis, T., Knowles, G., Wayne, A.F., 2015. Disease hazard identification and assessment associated with wildlife population declines. *Ecological Management & Restoration* **16**, 142-152.

Pacioni, C., Hunt, H., Allentoft, M., Vaughan, T., Wayne, A., Baynes, A., Haouchar, D., Dortch, J., Bunce, M., 2015. Genetic diversity loss in a biodiversity hotspot: ancient DNA quantifies genetic decline and former connectivity in a critically endangered marsupial. *Molecular Ecology* **24**, 5813-5828.

Pan, S., Thompson, R.C.A., Grigg, M.E., Sundar, N., Smith, A., Lymbery, A.J., 2012. Western Australian marsupials are multiply co-infected with genetically diverse strains of *Toxoplasma gondii*. *International Journal for Parasitology* **7**(9).

Parameswaran, N., O'Handley, R. M., Grigg, M. E., Wayne, A. F. and Thompson, R. C. A. 2009. Vertical transmission of *Toxoplasma gondii* in Australian Marsupials. *Parasitology* **136**:939-44.

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Rong, J., Bunce, M., Wayne, A., Pacioni, C., Ryan, U. and Irwin, P. J. 2012. High prevalence of *Theileria penicillata* in woylies (*Bettongia penicillata*). *Experimental Parasitology* **131**(2), 157-161.

Smith, A., P. Clark, S. Averis, A. J. Lymbery, A. F. Wayne, K. D. Morris, and R. C. A. Thompson. 2008. Trypanosomes in a declining species of threatened Australian marsupial, the brush-tailed bettong *Bettongia penicillata* (Marsupialia: Potoroidae). *Parasitology* **135**:1-7.

Thompson, C.K., Botero, A., Wayne, A.F., Godfrey, S.S., Lymbery, A.J., Thompson, R.C.A., 2013. Morphological polymorphism of *Trypanosoma copemani* and description of the genetically diverse *T. vegrandis* sp. nov. from the critically endangered Australian potoroid, the brush-tailed bettong (*Bettongia penicillata* (Gray, 1837)). *Parasites & Vectors* **6**: 121-133.

Thompson, C. K., Wayne, A. F., Godfrey, S. S. and Thompson, R. C. A. 2014. Temporal and spatial dynamics of trypanosomes infecting the brush-tailed bettong (*Bettongia penicillata*): a cautionary note of disease-induced population decline. *Parasites and Vectors* **7**:169.

Thompson, C.K., Wayne, A.F., Godfrey, S.S., Thompson, R.C.A., 2015. Survival, age estimation and sexual maturity of pouch young of the brush-tailed bettong (*Bettongia penicillata*) in captivity. *Australian Mammalogy* **37**, 29-38.

Thompson, RCA, A. Smith, A. J. Lymbery, S. Averis, K. D. Morris A. F. Wayne 2010. *Giardia* in Western Australian wildlife. *Veterinary Parasitology* **170**: 207-211.

Wayne, A.F., Maxwell, M.A., Ward, C., Vellios, C., Ward, B., Liddel, G.L., Wilson, I., Wayne, J.C., Williams, M.R., 2013a. The importance of getting the numbers right: quantifying the rapid and substantial decline of an abundant marsupial, *Bettongia penicillata*. *Wildlife Research* **40**, 169-183.

Wayne, A.F., Maxwell, M., Ward, C.G., Vellios, C.V., Wilson, I., Wayne, J.C., Williams, M.R., 2015. Sudden and rapid decline of the abundant marsupial, *Bettongia penicillata* in Australia. *Oryx* **49**(1), 175-185.

Yeatman, G.J., Wayne, A.F., 2015. Home range and habitat use of a critically endangered marsupial (*Bettongia penicillata ogilbyi*) inside and outside a predator proof sanctuary. *Australian Mammalogy* **37**, 157-163.

Zosky, K., K. Bryant, M. Calver, and A. F. Wayne. 2010. Do preservation methods affect the identification of dietary components from faecal samples? A case study using a mycophagous marsupial. *Australian Mammalogy* **32**:173-176.

0.0.2 POPULAR PUBLICATIONS/ARTICLES

Ballast, B., Wayne, A.F., 2012. Perup Sanctuary Information Brochure, pp. 1-4. Dept. Environment and Conservation.

Mitchell, S., and A. F. Wayne. 2008. Down but not out: solving the mystery of the woylie population crash. *Landscape* **25**:10-15.

Richards, J., Gardner, T. and Copley, M. 2009. Bringing back the animals. *Landscape* **24**(3), 54 - 61.

Smith, A., Lymbery, A. and Thompson, A. 2009. Meet the parasites. *Landscape* **24**(4), 24 - 29.

Tolfree, S., Wayne, A.F., 2012. Help Save Woylies (Youtube video)

Tolfree, S., Wayne, A.F., 2012. Woylie Handling Video Manual (DVD). Adrian Wayne, DEC, Australia.

Wayne, A. F. 2009. 'Woylie declines: what are the causes? Science Division Information Sheet 7/2009.' Department of Environment and Conservation, Perth, Western Australia.

Wayne, A. F. 2010. Woylie Conservation Research (Fact Sheet). South Coast Natural Resource Management, Albany, Western Australia.

Wayne, A. and Moore, J. 2011. The jewel in the crown: Perup and the Upper Warren. *Landscape* **26**(3), 10-17.

Wayne, A.F., 2014. Perup Sanctuary: insuring woylies against extinction. *Landscape* **29**(3), 12-17.

Wayne, A. F. 2014. Perup Sanctuary: Insuring woylies against extinction. *Wildlife Rescue Magazine* **10**, 47-57.

0.0.3 HONOURS AND POSTGRADUATE STUDENT THESES

Abdad, M.Y. (2011). An epidemiological and serological study of *Rickettsia* in Western Australia. PhD Thesis, Murdoch University.

Bateman, A., 2014. The short-term response of the woylie *Bettongia penicillata ogilbyi* to habitat expansion via underpasses in a fenced reserve at Whiteman Park. Honours thesis. University of Western Australia, Perth.

Botero Gomez, L.A., 2014. Genotypic and phenotypic diversity of trypanosomes infecting Australian marsupials and their association with the population decline of the brush-tailed bettong or woylie (*Bettongia penicillata*). In, School of Veterinary and Life Sciences. PhD thesis. Murdoch University, Western Australia.

Cherriman, (2007). Simon C. Territory size and diet throughout the year of the Wedge-tailed Eagle *Aquila audax* in the Perth region, Western Australia. Honours thesis. Curtin University. [not directly involved in WCRP – Upper Warren but is with Karakamia and Dryandra]

Eikelboom, T. H. (2010). A field comparison of survey methods for estimating the population density of woylies (*Bettongia penicillata*) at Karakamia Wildlife Sanctuary. Honours thesis. University of Western Australia.

- Hide, A. (2006). Survival and dispersal of the threatened woylie *Bettongia penicillata* after translocation. Honours thesis, University of Western Australia.
- Hunt, H. (2010). Molecular evidence of a genetic bottleneck using temporal genetic data in an endangered marsupial, (*Bettongia penicillata ogilbyi*). School of Biological Sciences and Biotechnology. Honours thesis. Murdoch University, Murdoch, Western Australia.
- Kaewmongkol, G.(2012). Detection and characterization of *Bartonella* species in Western Australia. PhD Thesis, Murdoch University, Murdoch, Western Australia.
- Madon, E. (2006). Mating systems and reproductive anatomy in marsupials: explaining the evolution of the anterior vaginal expansion of *Bettongia penicillata*. Page 66. School of Animal Biology. Honours thesis. University of Western Australia, Perth.
- O'Brien, R. Christopher, B.A., M.F.S. (2008) Forensic Animal Necrophagy in the South-west of Western Australia: Species, feeding patterns, and taphonomic effects. Doctor of Philosophy thesis, University of Western Australia.
- Pacioni, C. (2010). The population and epidemiological dynamics associated with recent decline of woylies (*Bettongia penicillata*) in Australia. PhD thesis, Murdoch University.
- Parameswaran, N. (2008). *Toxoplasma gondii* in Australian marsupials. PhD Thesis, Murdoch University.
- Rogers, P. (2009). Predator profiling as a tool for the conservation of the woylie (*Bettongia penicillata*). Honours thesis, University of Western Australia.
- Rong Ho, J. (2009) Biological and Molecular Studies of *Theileria penicillata* infecting Woylies (*Bettongia penicillata ogilbyi*) Honours thesis, Murdoch University.
- Yeatman, G. (2010). Demographic changes of a woylie (*Bettongia penicillata*) population: a response to increasing density and climate drying? Honours thesis, University of Western Australia.
- Zosky, K. (2011). Food resources and the decline of woylies *Bettongia penicillata ogilbyi* in southwestern Australia. PhD thesis, Murdoch University, Western Australia.

0.0.4 STUDENT REPORTS

- Basille, S. (2010). The epidemiology of piroplasm infection in the woylie (*Bettongia penicillata ogilbyi*). Undergraduate Project (Independent Study Contract). Murdoch University, Western Australia.
- Bennett, K. (2012). 'An evaluation of two methods for assessing population densities of introduced predators in southwest Western Australia. Undergraduate independent study report.' Biology SIT Study Abroad Program, Cairns, Australia.
- Harradine, E., White, L., Madsen, A., McMahon, S., Borkowski, K., Pinto, E. (2012). Perup – Nature's Guesthouse: Strategic destination management plan (2012-2016). Tourism Management course unit (TOU303) group project, Murdoch University.
- Horton, C. (2013). 'An Analysis of the Woylie (*Bettongia penicillata ogilbyi*) Population Following Translocation from Perup Sanctuary to Yendicup in the Upper Warren Region of Western Australia.' CIEE Student project report.
- Jaimes, S. (2010) Where's the Woylie? Possible factors affecting post-decline Woylie (*Bettongia penicillata ogilbyi*) abundance in the Upper Warren Region of South West Australia. Undergraduate independent study report. Pacific Lutheran University, Biology SIT Study Abroad Program, Cairns, Australia.
- Jenkins, Gina. (2013). Sampling in 2013 of *Bettongia penicillata* (Woylie) and *Trichosurus vulpecula* (Brush-tail Possum) populations at Warrup and Keninup Sites in southwestern, Western Australia.
- Jenkins, Gina. (2013). Changes in female *Bettongia penicillata* (Woylie) populations from 2010 to 2013 within the Perup Sanctuary, Warrup and Keninup sites in southwestern, Western Australia
- McCalmont, J. (2010). Evaluation of conservation measures for a specific endangered species, *Bettongia penicillata*. 3rd year BSc (Hons) project. Institute of Biological, Environmental and Rural Science, University of Wales, Aberystwyth.
- McGuirk, E. (2013). 'Assessing the success of translocation and effectiveness of surveillance tactics in the conservation of Woylie (*Bettongia penicillata*) species in Yendicup of Upper Warren, Western Australia.' CIEE Student project report.
- Rowells, Jessica. (2013). Comparing *Bettongia penicillata ogilbyi* Population between Warrup and Keninup
- Rowells, Jessica. (2013). Comparing male to female *Bettongia penicillata ogilbyi* populations inside and outside of the Perup sanctuary over time.
- Shah, Pooja. (2013). Woylie population distribution in Warrup and Keninup

Shah, Pooja. (2013). Recurrence of woylies in Perup Sanctuary compared to Warrup and Keninup; where do they survive better.

Wallace, Samantha. (2013). Woylie monitoring: Population numbers in Warrup and Keninup of the Upper Warren.

Wallace, Samantha. (2013). Woylie Monitoring: Health of Woylies from 2010-2013 at the Perup Sanctuary, Warrup and Keninup.

0.0.5 REPORTS

2006

Wayne, A.F. (2006). Science Project Plan, Department of Environment and Conservation, Woylie conservation research project: An investigation into the declines of woylies (*Bettongia penicillata*) in south-western Australia.

Bougher, N. L. (2006). Identity and taxonomy of truffle fungi from an initial survey at Karakamia Wildlife Sanctuary. Department of Environment and Conservation.

Wayne, A. F. (2006). Interim assessment of the evidence for a recent decline in woylie abundance in south-western Australia. Pages 1-28. CALM, Perth, Western Australia.

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2008

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DEC (2008). A. Wayne (Ed.). Diagnosis of recent woylie (*Bettongia penicillata ogilbyi*) declines in southwestern Australia. Progress report of the Woylie Conservation Research Project. Perth, Western Australia, Western Australian Government Department of Environment and Conservation: 1-314.

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Mawson, P., Atkins, K. and Goldberg, J. (2008). '*Bettongia penicillata ogilbyi* –woylie: Species Information Sheet.' Department of the Environment and Water Resources.

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Orell, P. (2009). 'Current Status of the woylie: based on an update of the species information sheet submitted to the Department of Environment and Water Resources in 2008.' Department of Environment and Conservation, Perth, Western Australia.

Threatened Species Scientific Committee (TSSC) (2009). Commonwealth Listing Advice on *Bettongia penicillata ogilbyi* (Woylie). [Online]. Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/66844-listing-advice.pdf>.

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Hunt, H. (2010). A temporal assessment investigating the effects of population declines on genetic diversity, in the critically endangered woylie (*Bettongia penicillata ogilvyi*): A Summary to the Woylie Recovery Team. Murdoch University, Perth, Western Australia

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2011

Hamilton, N. and Rolfe, J. (2011). Assessment of introduced predator presence within the Perup Sanctuary, Western Australia. Unpublished report. Department of Environment and Conservation, Woodvale, Western Australia.

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2012

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Yeatman, G.J., Wayne, A.F., Mills, H., 2013. Terrestrial vertebrate assemblage and species level patterns between major habitat types inside and outside a fenced exclosure in south-western Australia, p. 22. University of Western Australia, Perth.

2014

Pacioni, C. (2014). 'Modelling woylie (*Bettongia penicillata*) population genetics to inform management strategies.' WWF-Australia, Perth, Western Australia.

Pacioni, C., 2014. Population modelling for the development of genetic management guidelines in translocation programs. Perth, Western Australia, p. 27.

2015

Skerratt, L.F., 2015. Outbreak Investigation for the Critically Endangered Woylie (*Bettongia penicillata*). Final Report to WWF-Australia on agreement contract number 0230-007. In. James Cook University, Townsville.

0.0.6 CONFERENCE PROCEEDINGS

2006

Wayne, A. F. (2006). The Post-Recovery Collapse of the Woylie: Diagnosing their recent declines in south-western Australia. Australian Mammal Society Scientific Meeting and Macropod Symposium. Australian Mammal Society, Melbourne, Victoria.

2007

Abdad, Y., P. Adams, L. Pallant, A. Li, A. F. Wayne, and S. Fenwick. (2007). Potential bacterial pathogens in Woylies from SW WA (ABSTRACT). Page 50. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

Burmej, H, Smith, A, Lymbery, A, Wayne, A, Morris, K, Fenwick, S, Thompson, RCA. (2007). The biodiversity and host-specificity of fleas in the woylie (*Bettongia penicillata*). ASP & ARC/NHMRC Research Network for Parasitology Annual Conference, Canberra, ACT, 8-11 July, 2007.

Burmej, H., A. Smith, A. J. Lymbery, A. F. Wayne, K. D. Morris, S. Fenwick, and A. Thompson. (2007). The biodiversity, ecology and importance of ectoparasites in the woylie (*Bettongia penicillata*) and sympatric species (ABSTRACT). Page 51. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

Clark, P., A. Thompson, A. F. Wayne, and S. Averis. (2007). Trypanosomes in relation to the diagnosis of woylie declines: prevalence and molecular characterisation (ABSTRACT). Page 47. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

Eden, P., K. Payne, R. Vaughan, S. Vitali, and A. F. Wayne. (2007). Clinical aspects of disease investigations in population declines of woylies (*Bettongia penicillata ogilbyi*) (ABSTRACT). Page 44. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

Knowles, G., P. Eden, and A. F. Wayne. (2007). Results of woylies (*Bettongia penicillata ogilbyi*) submitted for necropsy to Murdoch University, September 2005 to May 2007 (ABSTRACT). Page 45. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

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Parameswaran, N., O'Handley, R., Thompson, RCA. (2007). Development of an ELISA for the detection of *Toxoplasma gondii* antibodies in macropod marsupials. ASP & ARC/NHMRC Research Network for Parasitology Annual Conference, Canberra, ACT, 8-11 July, 2007.

Parameswaran, N., R. O'Handley, A. F. Wayne, A. Smith, P. Eden, A. J. Lymbery, K. D. Morris, and A. Thompson. (2007). *Toxoplasma* in woylies (ABSTRACT). Page 49. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

Smith, A., A. J. Lymbery, A. Elliot, U. Parkar, A. F. Wayne, and A. Thompson. (2007). Prevalence and diversity of woylie endoparasites: from individuals to populations and sympatric species (ABSTRACT). Page 48. Wildlife Disease Association (Australasian Section), Dryandra Woodland.

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Wayne, A. F., C. Ward, M. Maxwell, C. V. Vellios, I. Wilson, J. Wayne, M. Swinburn, B. Ward, K. Morris, A. Thompson, G. Knowles, P. Eden, A. Dugand, J. Williams, and T. Gardiner. (2007). Diagnosing the recent woylie (*Bettongia penicillata*) collapse in south-western Australia. Ecological Society of Australia Annual Conference. Ecological Society of Australia, Perth, Western Australia.

Wayne, A. F., C. Ward, M. Maxwell, C. V. Vellios, I. Wilson, J. Wayne, M. Swinburn, B. Ward, K. Morris, A. Thompson, G. Knowles, P. Eden, A. Dugand, J. Williams, and T. Gardiner. (2007). Diagnosing the recent woylie declines in south-western Australia (ABSTRACT). Page 43. Wildlife Disease Association (Australasian Section), Dryandra Woodland, Western Australia.

2008

Averis, S. (2008). Characterisation of Trypanosomes from Australian Marsupials. (ABSTRACT). In 'Proceedings of the European Multicolloquium of Parasitology'. Paris, France.

Burmej, H. I. (2008). Describing ectoparasite biodiversity in threatened Western Australian mammals: new methods and challenges. (Abstract). In 'Proceedings of the Australasian Wildlife Management Society, 21st Annual Conference'. Fremantle, Western Australia.

Pacioni, C., Spencer, P. and Wayne, A. F. (2008). Understanding woylie decline: a molecular perspective. (Abstract). In 'Proceedings of the Australasian Wildlife Management Society, 21st Annual Conference'. Fremantle, Western Australia.

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Parameswaran, N., Pan, S., Lymbery, A., Smith, A., Wayne, A. F., Morris, K., Grigg, A. H. and Thompson, R. C. A. (2008). *Toxoplasma* in Australian wildlife – food for thought? (Abstract). In 'Proceedings of the Australasian Wildlife Management Society, 21st Annual Conference'. Fremantle, Western Australia.

Parkar, U., Traub, R., Vitali, S., Wayne, A. F., Morris, K. and Thompson, R. C. A. (2008). Characterisation of *Blastocystis* isolates from zoo animals and native wildlife. (Abstract). In 'Proceedings of the Australasian Wildlife Management Society, 21st Annual Conference'. Fremantle, Western Australia.

Reiss, A., Eden, P., Wayne, A. F., Nicholls, P. and Thompson, R. C. A. (2008). Veterinary investigation of population declines of the woylie (*Bettongia penicillata*) in south-west Western Australia (Abstract). In 'Proceedings of the Australasian Wildlife Management Society, 21st Annual Conference'. Fremantle, Western Australia.

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0.0.7 POSTERS

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0.0.8 PRIZES

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Knowledge Transfer

Hard copy records held at Manjimup

Electronic data stored on: Fauna File (Manjimup)

Backup copy stored at: Fauna File (Kensington)

Study sites are on the Science Plot Register (Manjimup), which provides the information to the GIS Section.

Dataset links

Hardcopy location

Wildlife Science Library and Manjimup

Backup location

None