EXECUTIVE SUMMARY TO THE DRAFT PROGRESS REPORT OF THE WOYLIE CONSERVATION RESEARCH PROJECT

Diagnosis of recent woylie (*Bettongia penicillata ogilbyi*) declines in southwestern Australia

A report to the Department of Environment and Conservation Corporate Executive

Photo courtesy of Sabrina Trocini

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australian wildlife conservancy

Government of Western Australia — Department of Environment and Conservation

Principal Project Funding Sources

'Saving our Species' Biodiversity Conservation Initiative

Department of Environment and Conservation

South West Catchments Council

Recent woylie declines – situation summary

The woylie (*Bettongia penicillata ogilbyi*) had a distribution across much of Australia prior to settlement by Europeans. By the 1960's the woylie was reduced to three isolated remnant populations in southwestern Australia (Upper Warren [principally Perup], Tutanning and Dryandra) (Figure 1). Fox control and woylie reintroductions began in the 1970's. Since 1996, these activities have been expanded and strategically managed as part of the '*Western Shield*' conservation program (Orell, 2004). Cumulatively, these efforts resulted in a dramatic recovery that culminated in the woylie being the first Australian mammal to have its conservation status downgraded as a result of it being delisted from Commonwealth and State conservation lists (Endangered / Threatened) in 1996 (Start *et al.*, 1998).

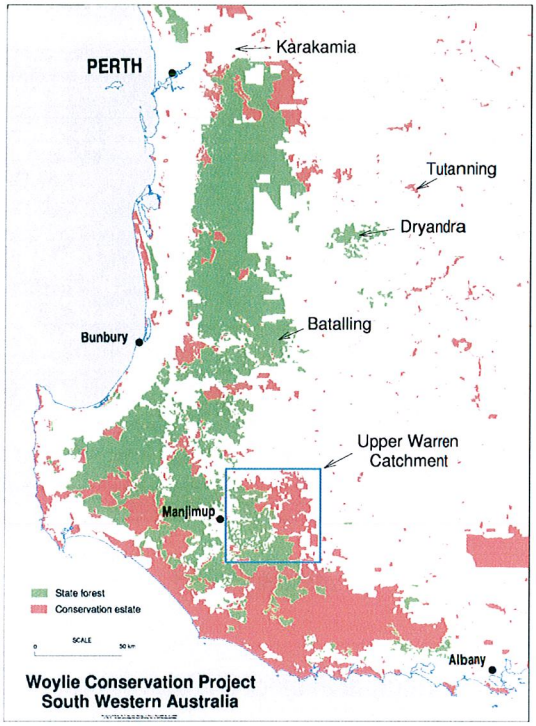


Figure 1. The location of important woylie populations.

Since 2001, however, woylie populations throughout southwestern Australia have undergone rapid and substantial declines. For example, capture rates from long-term monitoring and research has indicated that the woylie population at Dryandra declined by 93% between 2000 and 2006. The Upper Warren population(s) have so far undergone a median decline of 95% between 2002 and 2007 (Figure 2). The woylie population at Batalling (a 1982 reintroduction site east of Collie) has declined by 97% between 2002 and 2007. Evidence from multiple sources including live trapping, sandpad surveys, woylie nest and digging densities and spotlight surveys all concur and demonstrate that these declines are real (Wayne, 2006). A concurrent woylie decline has also been observed in South Australia (Venus Bay Peninsula); while South Australian island populations appear to have remained relatively stable (Jason VanWeenan, pers. comm.).

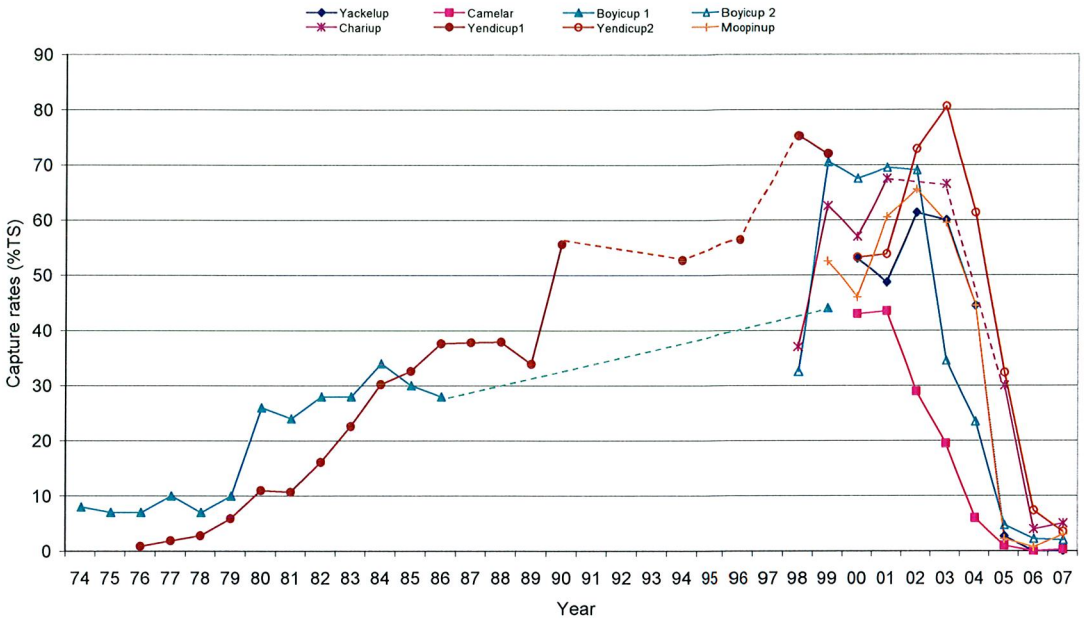


Figure 2. Capture rates of woylies over time on each of the Upper Warren Fauna Monitoring transects in southern and central areas of Perup Nature Reserve.

Note: Transect names with the suffix 1 and 2 distinguish relatively similar transects within the same area with slightly different methodologies surveyed by different groups (e.g. slightly different transect locations, trapping frequency, etc).

The dashed lines are indicative trends during the intervening periods between trapping events in non-successive years

In general, the largest and most substantial woylie populations have undergone substantial declines while the very small and/or low density, often isolated populations appear to be less affected. Overall, an estimated 70-80% decline in woylie numbers has occurred in Australia over five years. These declines are still continuing and there is little evidence of signs of a recovery (Freegard, 2007). Introduced predators (fox and cat) and habitat loss were among the principal factors thought responsible for historical declines (Burbidge and McKenzie, 1989; Start *et al.,* 1995). There also is some anecdotal evidence that disease may have caused the decline of many mammal species (including the woylie) in Western Australia in the late 1800s to early 1900s (Abbott, 2006). The purpose of the Woylie Conservation Research Project (WCRP) is to identify the cause(s) of these current declines.

Project background and design

There was a report of a suspected woylie decline at a trapping site in the Upper Warren on 26 October 2005. An initial situation assessment of woylie populations throughout the southwest was followed by an early-response workshop (February 2006), the establishment of the Woylie Conservation Steering Group and the development and commencement of the Woylie Conservation Research Project (WCRP) (July 2006) (Figure 3). Using a decline diagnosis framework broadly based on the 'declining-population paradigm' (Caughley, 1994), the WCRP focussed primarily at the declines in the Upper Warren and consists of three major components;

1. Upper Warren Fauna Monitoring that built on, enhanced and co-ordinated previously independent existing activities,
2. Meta-analysis of existing datasets that were aggregated into a single database, and
3. A Population Comparison Study (PCS) designed to discriminate factors and attributes associated with contemporary declines. The PCS has five main lines of enquiry;

Woylie components -

a) woylie density and demographics,
b) woylie survival and mortality,

Key putative agents of decline -

c) predators,
d) resources, and
e) disease.

Most of the fieldwork associated with the initial phase of the WCRP was conducted July 2006 to August 2007. Analysing and reporting on the findings will be the focus through to June 2008. This current progress report will help to inform how best to respond to the recent woylie declines beyond the existing commitments (i.e. assist in the development of phase two).

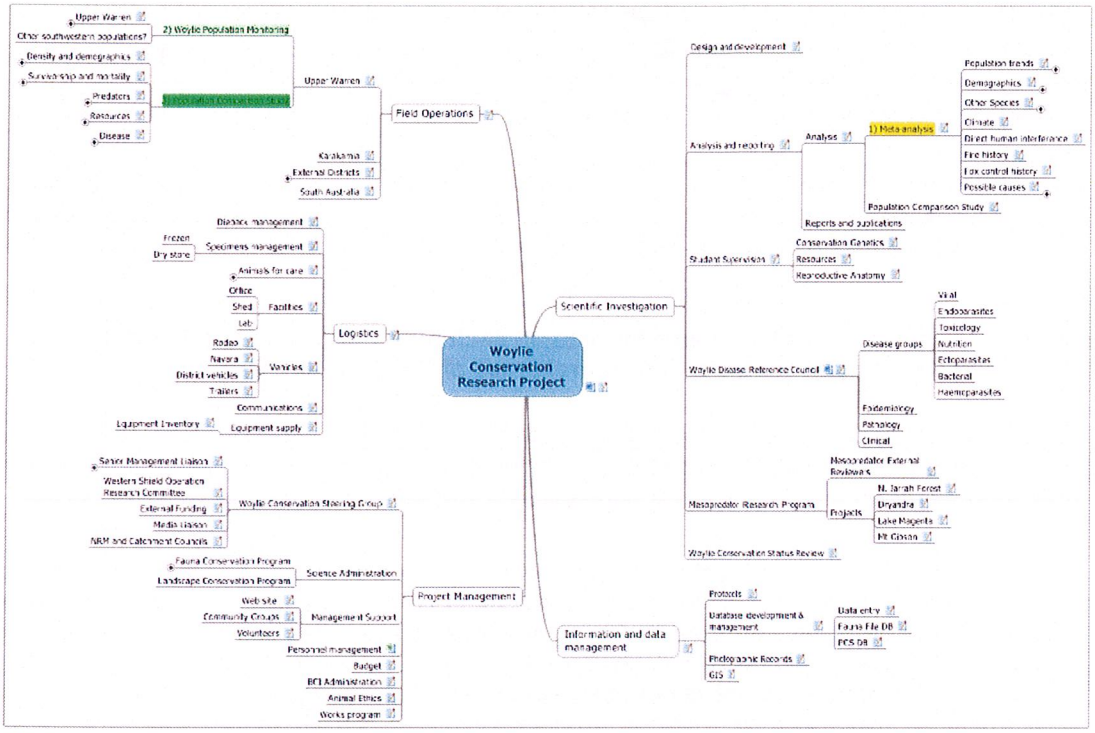


Figure 3. Summary of the Woylie Conservation Research Project management structure and components.

Preliminary inferences (i.e. early hints) of possible causes of recent woylie declines

Although it remains premature to unequivocally identify the cause(s) of the woylie declines, the preliminary results can provide some early hints regarding what the ongoing work is likely to suggest as the likely agents of decline. Factors that are not probably the primary agents of decline include habitat loss / modification, fire, direct human interference from trapping and resources including food. Climate (and extreme weather events) may be associated with woylie declines at Venus Bay Peninsula (VBP), South Australia and cannot be ruled out as a factor in Western Australia. Given the lack of fox activity or density monitoring data associated with most of the observed woylie declines it is not possible to determine whether foxes may be a major agent of decline. This is, however, considered unlikely for the Upper Warren region given that during the WCRP, foxes only accounted for 15% of the implicated primary predators/scavengers associated with observed mortalities and none of the mortalities at the Balban PCS site (which underwent a >80% decline in 12 months) were attributed to foxes.

Increased adult mortality is part of the mechanism driving the rapid and substantial woylie declines. Whether reduced recruitment into the adult (breeding) population is involved in the declines can not yet be established, however, the preliminary evidence suggests breeding rates (prevalence of pouch-young) are not associated with the declines. Emigration of animals elsewhere is not supported by the evidence.

The leading speculative hypothesis (untested) for the cause(s) of the declines is presented (Figure 4). In summary, multiple interactive factors are expected responsible, with disease considered the most likely primary and ultimate agent of decline. The symptoms and unequivocal confirmation of the disease remain elusive at this stage, although some key suspects have been identified including *Toxoplasma*, *Trypanosoma sp. nov.*, possible synergistic effects between the two parasites and the involvement of stressors that may trigger the disease. Other infective agents may also be involved. As a consequence of these disease(s), opportunistic and exploitative predation/scavenging, predominantly by cats, is likely to be the most proximately-related factor associated with the deaths of the woylies. Whether the predation/scavenging occurs on moribund or dead animals that would die regardless, or whether in the absence of predation in general, the woylies would otherwise recover and survive remains unknown.

Shortlist of noteworthy and interesting findings and developments from the WCRP

The Population Comparison Study (PCS) has identified key distinctive differences between woylie populations at Karakamia (which has not declined), and Upper Warren (where substantial declines have occurred) that may relate to the cause(s) of declines. These include;

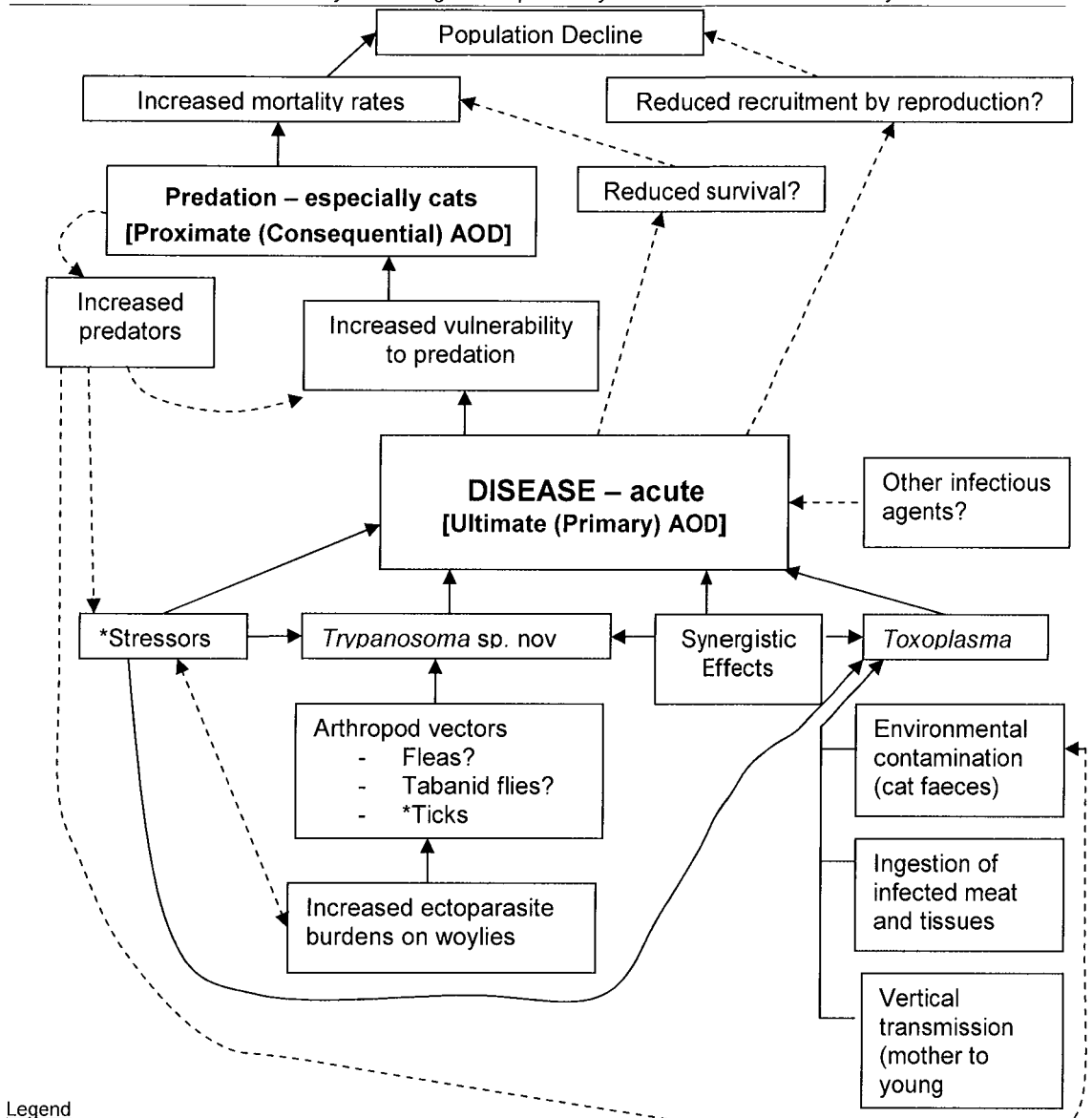
- *Toxoplasma* has not been detected in woylies at Karakamia, but has been detected at Upper Warren.
- *Trypanosoma* is common in the Upper Warren woylie populations (43% prevalence). It has recently been detected at Karakamia, albeit at very low infection levels and prevalence rates relative to the Upper Warren woylie populations.
- Karakamia is effectively free from introduced predators. Cats and foxes are present at Upper Warren.
- Biometric and morphometric data indicates that the high density woylie population at Karakamia, although stable, is very likely resource-limited, in contrast to comparative data from Upper Warren populations, which do not appear resource limited.

Several new species and discoveries have been made as part of the WCRP. These include;

- New species of ectoparasite, endoparasites, haemaparasites, and hypogeal fungi
- New host-parasite associations previously not described
- Evidence of vertical transmission in woylies of *Toxoplasma* from mother to pouch-young.

The collaborations involved in this project are the greatest achievement of the WCRP. These are critical to the success of the project and subsequent conservation outcomes for the woylie. The collaborative capital established as part of this project also has consequences for wildlife research and conservation more broadly. Collaboration developments include;

- Establishment of the Woylie Conservation Steering Group (WCSG) to oversee, co-ordinate and support research and management endeavours to identify the causes of the recent woylie declines and improve the conservation outcomes for the species.
- Project integration with the DEC *Western Shield* Mesopredator Research Program.
- Establishment of the Woylie Disease Reference Council (WDRC) comprised of expertise from Murdoch University and Perth Zoo.
- The principal role of the WCRP and WDRC in the successful support and funding for an ARC linkage project involving DEC and Murdoch University investigating the diseases within threatened mammal fauna throughout Western Australia.



Legend
AOD = Agent of Decline
——▶ = 1st order factor / Higher confidence based on available evidence
- - - - - -▶ = 2nd order factor / Likely relationships but less evidence available

Not primary factors of decline:

Habitat loss/modification	Direct human interference (live trapping)
Fire	Food resources

Population change – mechanical algorithm for Upper Warren Woylie Population:

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Recruitment (immigration + reproduction) – Loss (Emigration + Mortality) ⇒ Population decline

*Possible stressors include:

Predation	Ectoparasites
Competition	Nutrition
Climate factors / Extreme weather	Disease reservoirs in sympatric species
Concurrent infections	High density woylie populations

Figure 4. The leading (untested) hypothesis of the causes of woylie declines in the Upper Warren region based on preliminary and untested inferences.

- The direct involvement of seven university student projects, including three full-time Murdoch University PhD projects with a principal focus on woylies (Resources by Kerry Rodda, Conservation genetics and epidemiology by Carlo Pacioni, Ectoparasites by Halina Burmej) and an Honours project (Reproductive anatomy by Ewa Madon, UWA). Three other Murdoch PhD projects in which the woylie declines constitute a significant component include *Toxoplasma* by Nevi Parameswaran, Endoparasites by Unaiza Parkar and Ectoparasites and bacteriology by Yazid Abdad.
- Critical and important collaborative relationships with Australian Wildlife Conservancy and South Australian Government Department of Environment and Heritage.
- Close collaborations within DEC; within the Science Division and between the Science Division and Donnelly District, Warren Region, Nature Conservation Division, Species and Communities Unit, Wellington District, Wheatbelt Region, etc

Operational achievements include;

- A central relational database for fauna in the Upper Warren, including 25,479 woylie records since 1974 to December 2007 created by the aggregation of multiple, previously isolated datasets.
- Field operations handbook providing details on the methodology and protocols for the WCRP, which are also relevant and/or used as part of other DEC activities (monitoring and research).
- Standardisation and synchronization of separate, independent fauna monitoring activities in the Upper Warren region.
- Wildlife forensics course and workshop for DEC and WCRP collaborators.

Interim research and management recommendations

While the Woylie Conservation Research Project (WCRP) is ongoing, some interim and preliminary recommendations for the development of the next phase of research, fauna monitoring, conservation management and project management can be outlined.

The principal research framework includes four themes of development;

1. Phase 1 completion and synthesis
2. Key putative agents of decline
   a) Disease - *Toxoplasma*, *Trypanosoma*, supporting (diagnostic) evidence (field, clinical, pathology, epidemiology), other infectious agents (including priority risks), and dependent follow-up (e.g. synergistic effects)
   b) Predator control experiment (Active Adaptive Management)
   c) Resources
   d) Stressors
3. Species recovery
   a) Conservation genetics
   b) Small population paradigm – limiting factors and risks
   c) Population viability analysis
4. Research management (statistical analyses support, reviews, symposium and workshop, data and information management)

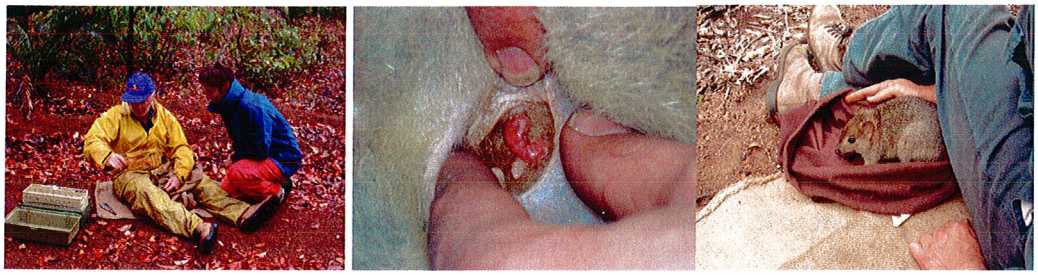
Fauna monitoring recommendations include;

- Suggested programs for Upper Warren and elsewhere
- Improved monitoring protocols (surveillance versus ecological monitoring; target species, predators, other covariates; and trigger points, reporting and response protocols)

Interim and preliminary conservation management recommendations include;

- Conservation status reviews
- Recovery planning
- Improved efficiency to the current fox-control program

- Data and information management improvements
- Project management considerations include adopting the appropriate framework for an ongoing program (as distinct from the rapid response approach of phase 1), consider the sustainability of the project (personnel to meet workload, resources, etc), support and funding, communication, data and information management, media and public engagement and the value of external and internal reviews.



a) b) c)

d) e) f)

g) h) i)

Selected images a) Trapping for Upper Warren Fauna Monitoring and Population Comparison Study; b) checking breeding status as part of the demographics study; c) adult woylie ready for release; d) forensics of woylie body as part of survival and mortality study; e-f) hypogeal fungi (truffles) and spores as part of resources study; g) field health check and disease sampling; h) predator activity surveys using sandpads; i) fox foot print from sandpad surveys.

1.7. References

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